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Abstract–Meteoritical Bulletin 107 contains 2714 meteorites including 16 falls (Aba Panu, Ablaketka, Andila, Gueltat Zemmour, Hamburg, Karimati, Mahbas Arraid, Mangui, Mazichuan, Mukundpura, Ozerki, Parauapebas, Renchen, San Pedro de Urabá, Sokoto, Tintigny), with 2226 ordinary chondrites, 168 HED achondrites, 132 carbonaceous chondrites (including 41 CM, 34 CV, 26 CO, 21 CK, 4 CR, 5 ungrouped), 43 ureilites, 30 iron meteorites (including 2 ungrouped), 29 lunar meteorites, 22 Martian meteorites, 16 primitive achondrites (including 3 brachinites), 12 Rumuruti chondrites, 9 enstatite chondrites, 7 ungrouped achondrites, 6 pallasites, 5 mesosiderites, 3 enstatite achondrites, 3 ungrouped chondrites, and 2 angrites. 1569 meteorites are from Antarctica, 835 from Africa, 206 from South America, 62 from Asia, 21 from North America, 11 from unknown locations, 8 from Europe (including one from Russia), and 1 from Oceania.

TRENDS AND SPECIFICITIES

Meteoritical Bulletin 107 (MB107) contains the 2714 meteorites reported to and accepted by the Nomenclature Committee of the Meteoritical Society in 2018. This number is the second highest ever after a peak in MB102 with 3141 meteorites. The number of NWA meteorites reaches a new peak with 799 meteorites (Fig. 1). Antarctic and NWA meteorites make up 58% and 29% of the total number of meteorites in MB107, respectively. As for the last few years, Chile, with 200 meteorites, is now the main meteorite provider outside of NWA and Antarctica.

The 2714 meteorites in MB107 total over 2.3 t of material, including 6 meteorites over 50 kg. Of particular significance for 2017 is the large number of lunar meteorites: 29 meteorites totaling over 68 kg, with 10 stones over 1 kg and 2 stones over 10 kg (Fig. 2). All these lunar meteorites are from NW Africa (Algeria, Mali, Mauritania, Morocco, Western Sahara) and coordinates are known for two of them (Aridal 017 and Errachidia). Many of these stones are likely paired.

A similar surge in Martian meteorites is observed with 22 meteorites totaling over 15 kg, including 3 meteorites over 2 kg (Fig. 2). Again, most of these meteorites are from NW Africa (19 of 22). Seventeen are shergottites, one is a nakhlite, and the remaining four (totaling 30 g and including Rabt Sbayta 010 for which coordinates are available) are polymict breccias paired with NWA 7034.

The total numbers of lunar and Martian meteorites published until and including MB107 are 383 and 239, respectively, and growing at an increasing rate (Fig. 3).

NOTABLE METEORITES

Four non-ordinary chondrite falls are reported: Mazichuan (diogenite), Mukundpura (CM2), Sokoto (iron, IIIAB), and Tintigny (polymict eucrite). Another notable fall is Aba Panu, a 160 kg L3 from Nigeria. Other notable meteorites include NWA 12322 (35 kg CV3), NWA 11610 (28 kg CO3), NWA 12320 (4 kg angrite).

NOVELTIES IN THE METEORITE BULLETIN DATABASE

Strewn field data can now be plotted into Google Earth from the Meteorite Database. Example for Sutter's Mill meteorite is shown in Fig. 4. Data are available in

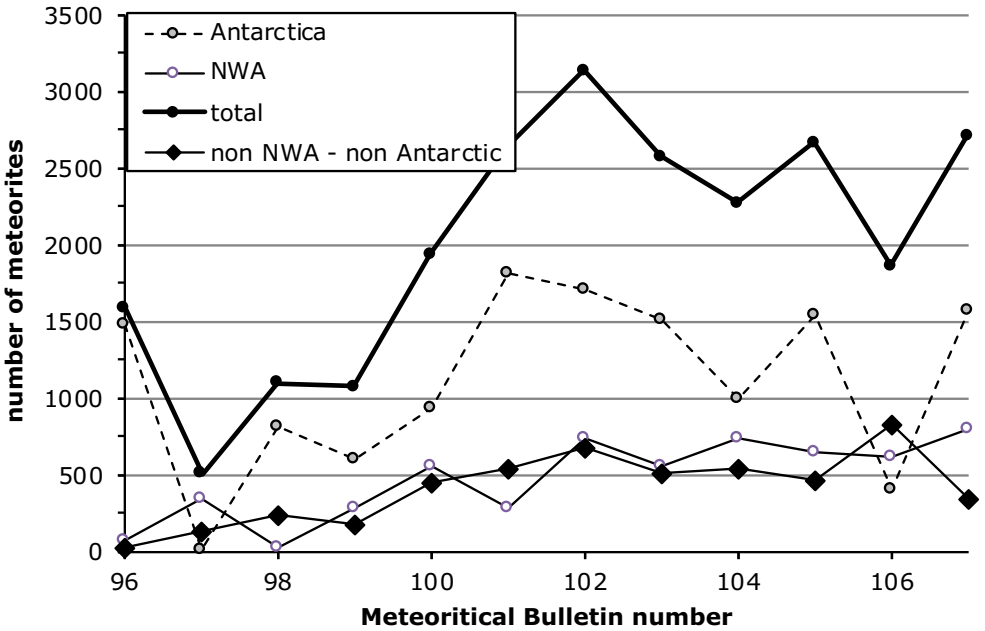

Fig. 1. Number of meteorites from Antarctica, NWA, and other areas reported in the last 12 Meteoritical Bulletins.

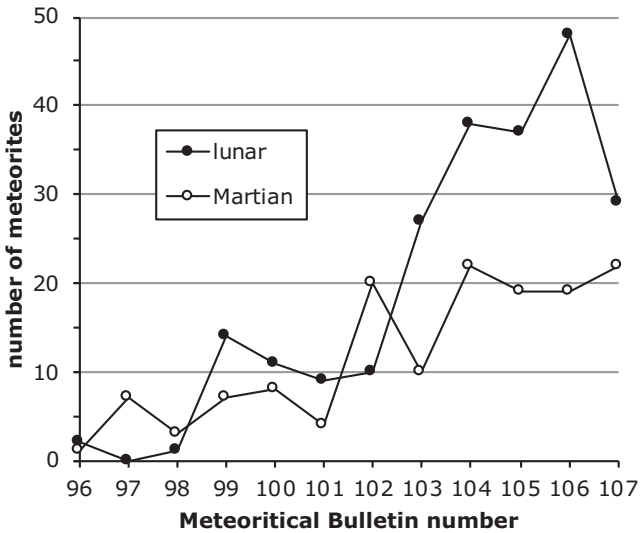

Fig. 2. Number of lunar and Martian meteorites reported in the last 12 Meteoritical Bulletins.

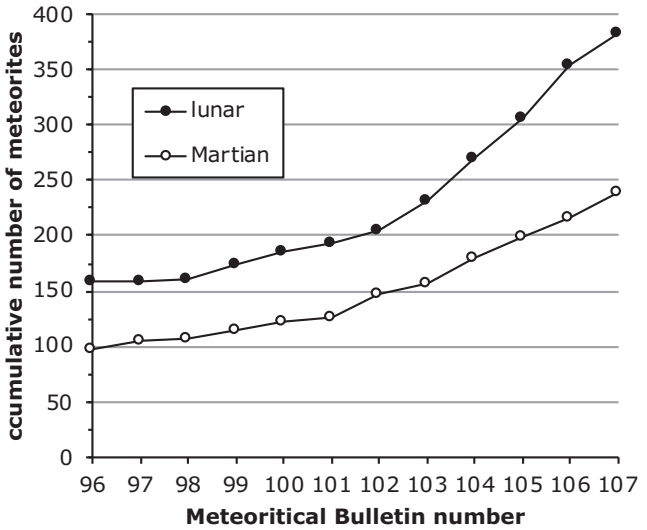

Fig. 3. Cumulative number of lunar and Martian meteorites with time.

the Meteorite Bulletin Database by following the strewn field link. We encourage submission of location coordinates for past and future strewn fields.

ALPHABETICAL TEXT ENTRIES FOR NON-ANTARCTIC METEORITES

See online version of this article.

NEW DENSE COLLECTION AREAS

In 2018, 24 new dense collection areas (DCA) were created, including 13 in China. See online version of this article for a list of DCA approved in 2018. A full list of all approved DCAs can be found at https://www.lpi.usra.edu/meteor/DenseAreas.php.

LISTING OF INSTITUTES AND COLLECTIONS

Eight new type specimen repositories were approved (see online version of this article for a complete list).

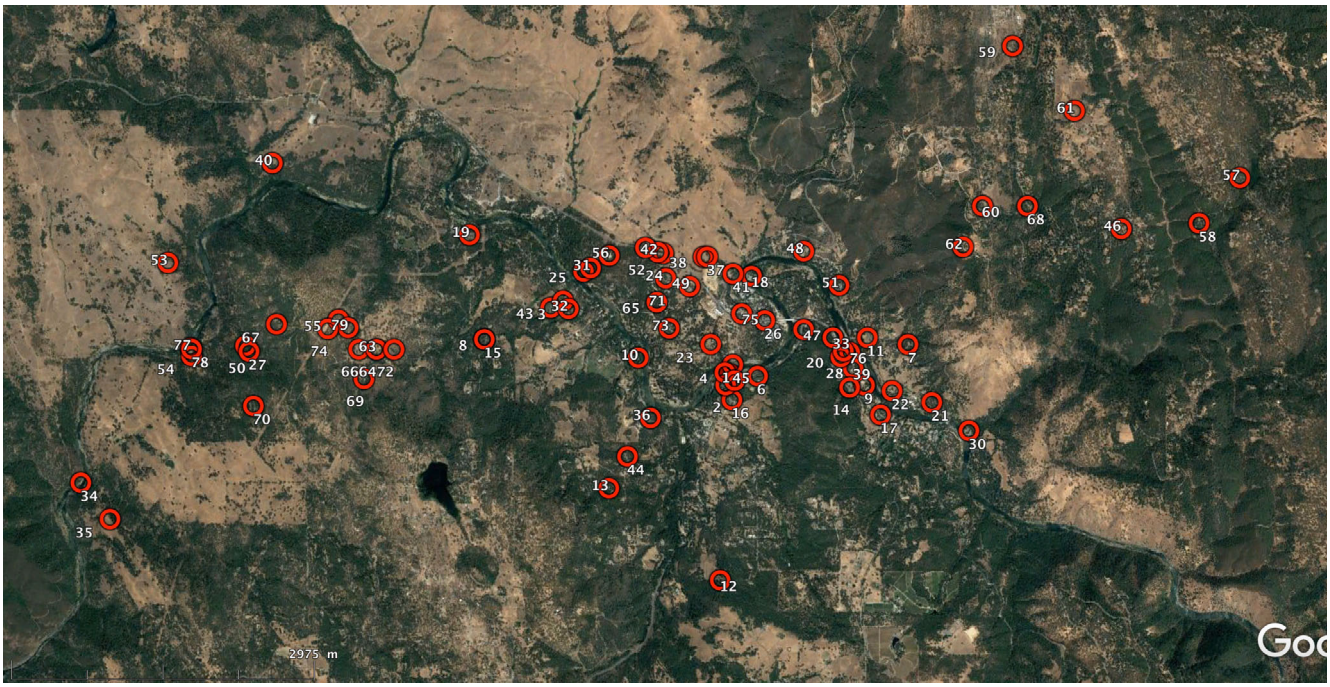

Fig. 4. Sutter's Mill strewn field as extracted from the Meteoritical Bulletin Database. Each stone is numbered with full details (mass and coordinates) available in the database. (Color figure can be viewed at wileyonlinelibrary.com.)

In accordance with §7.1 of the *Guidelines for Meteorite Nomenclature*, type specimens of all new meteorites "must be deposited in institutions that have well-curated meteorite collections and long-standing commitments to such curation." The minimum mass of a type specimen should be 20% of the total mass or 20 g, whichever is the lesser amount. For larger meteorites, the Nomenclature Committee now strongly recommends the following: for 0.4–10 kg at least 5% of total mass, and for meteorites >10 kg at least 500 g. However, these larger type specimens requirements are mandatory for meteorites declared to be in Special Pairing Groups (§4.2c).

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article.

Online Supplement S1: Table of data including Antarctic meteorites.

Online Supplement S2: Table of corrections.

RECLASSIFICATIONS

Sixteen meteorites have been reclassified in MB107. Eleven of these are Martian meteorites, likely paired with NWA 7034, that are now classified as "Martian (polymict breccia)." See online version of this article for a complete list of reclassifications.

REFERENCES

See online version of this article.

Data S1: A complete copy of entire Meteoritical Society Bulletin can be found in the supplementary information of this article as well as on the Meteoritical Bulletin Archive page at http://meteoriticalsociety.org/?page_id = 57. Information about the approved meteorites can be obtained from the Meteoritical Bulletin Database (MBD) available online at https://www.lpi.usra.edu/meteor/.

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1. Alphabetical text entries for non-Antarctic meteorites

Aba Panu 8°16’55.83"N, 3°34’1.72"E
Oyo, Nigeria
Confirmed fall: 19 April 2018
Classification: Ordinary chondrite (L3)

History: On the afternoon of 19 April 2018, a large fireball detonated over the Nigerian state of Oyo. This fireball was recorded by NASAs Center for Near Earth Object Studies (CNEOS) as event 2018-04-19 14:02:27. The meteoroid entered at 20.9 km/s and detonated at an altitude of 30 km at 7.5’N, 3.6’E releasing a calculated total impact energy of 0.23 kt. Many stones fell between the villages of Ipapo (8°7’50.84"N, 3°30’34.58"E) and Tede to the north (8°33’21.49"N, 3°26’46.31"E). Stone were collected at multiple locations. The meteorite is named for the village of Aba Panu near the center of the strewn-field: multiple kg-sized stones were found in and around this village. Current total known weight is near 160 kg.

Physical characteristics: The stones are hard, range from 30 g to near 40 kg, rounded with broad poorly developed regmaglypts, and largely lacking fusion crust. Fusion crust is occasionally preserved within the shallow regmaglypts. Most stones are greyish green and show areas of rounded to angular light-colored clasts. Largest clast (5 × 2 cm) is angular, fine-grained, and achondritic. Observations from multiple slices show that clasts constitute roughly <10 areal%.

Petrography: Visually the cut surfaces are dominated by a gray matrix, studded with well-developed chondrules and chondrule fragments. Some chondrules to 4 mm but the majority are 0.1 to 1 mm across. Observations on an 8 × 7 cm slab shows the following clasts: L6 (3 × 1 cm); L5 (1.5 × 1 cm); and sub-rounded 1-cm dark clast with sparse 200 micron chondrules. Shock veins are rare. Metal and sulfide occurs as: fined grained spheres in the matrix; armoring chondrules; and, occasional lumps to 5 mm. Petrographic observations show a range of chondrule types dominated by PO, POP, RP, PP, and BO. Particularly evident in thin section are BO and PO chondrules with reddish purple (in plain polarized light) glass that is isotropic under crossed polars. The silicates are extensively shocked with olivine showing mosaicism and PDFs. SEM observations show that much of the metal/sulfide in the matrix occurs as fine-droplets, veins, and melt pods. Large Fe-Ni grains are polycrystalline with each crystal showing a kamacite core, dark-

etched martensitic inner rim, and outer Ni-rich rim. Troilite is dominantly single crystal, and occasionally polycrystalline. Sparse chromite grains.
Geochemistry: (L. Garvie, *ASU*) Olivine $Fa_{24.3\pm5.7}$, n=18, range $Fa_{7.5\text{-}32.8.}$ Mean Cr_2O_3 = 0.08, sigma-Cr_2O_3 = 0.07, range 0.02 to 0.3. FeO/MnO=55.8±12.6. Low Ca, pyroxene $Fs_{17.0\pm11.6}Wo_{2.0\pm1.9}$ range $Fs_{2.4\text{-}49.2}Wo_{0.3\text{-}6.0}$, n=17. High Ca pyroxene $Fs_{8.7}Wo_{49.2}$, n=1. Reddish purple, isotropic glass within BO and PO chondrules $Or_{1.4\pm0.8}Ab_{87.6\pm4.8}$, n=6, TiO_2 to 1 wt%. Oxygen isotopes (K. Ziegler, *UNM*): analyses of three subsamples by laser fluorination gave, respectively, $\delta^{17}O$ = 3.724, 3.625, 3.684; $\delta^{18}O$ = 5.160, 4.980, 5.089; $\Delta^{17}O$ = 1.000, 0.996, 0.997 per mil.
Classification: Geochemistry and oxygen isotopic data consistent with L chondrite. Estimated petrologic type 3.6 based on Fa and Fs spread, and Cr_2O_3 content in olivine. L3, S4, W0.
Specimens: Michael Farmer and Moritz Karl - 50 kg, Eric *Twelker* 7.74 kg, and *ASU* 242 g. Based on photographic evidence, it is estimated that the Nigerian government collected on the order of 100 kg of stones, though this mass is uncertain. Given the size of the fall and area of the fall, the total mass is conservatively given as 160 kg.

Ablaketka 49°51.27’N, 82°48.89’E
East Kazakhstan, Kazakhstan
Fall: 16 Feb 2018
Classification: Ordinary chondrite (H5)
History: The fall occurred on the 16 Feb 2018 at 14:43:37 UTS. Residents of Ablaketka, a suburb of Ust-Kamenogorsk, Kazakhstan, watched a bright bolide moving approximately north and accompanied by an explosion. The bolide was recorded by video camera mounted on a locomotive moving NE from Charsk. The first sample was discovered by Mr. Alexander Baranov on February 18, near the Irtysh river, on a field covered by snow ~10-20 cm deep. The fall left two scratchy traces: the first was ~0.5 m in length, excavating snow and some soil; the second scratch, 8 m away, was terminated by a channel in the snow where the stone was found. On Feb. 22, two other pieces were recovered by anonymous finders. Later, about 10 pieces were collected by anonymous persons from Feb to Apr 2018, in a strewn field of 1 × 5 km, on an azimuth of 20°, with central coordinates of 49°51.27’N, 82°48.89’E.
Physical characteristics: The stone discovered first is 763 g and covered by black fusion crust, with only a few small broken parts, displaying light-gray interior. Two smaller individuals are 63.5 and 266.6 g. Later, several individual samples with dark-grey- to black interior were recovered. The masses of individuals are in a range 0.1-1.2 kg. A total collected mass of the meteorite shower is approximately 5.5 kg.
Petrography: The meteorite has brecciated, chondritic texture. Macroscopically, a light-gray chondritic host contains cm-sized clasts of dark-gray chondritic lithology (~20 vol%). The clasts have sharp contacts with the host. The host is composed of chondrules and chondrule fragments, mineral clasts and fine-grained, recrystallized,

silicate matrix. The main phases are olivine, pyroxene, FeNi metal; minor phases are devitrified glass, feldspar, troilite; spinel is accessory. Olivine has weak undulatory extinction and planar fractures. Impact melt veinlets and melt pockets are present in the host chondite. The dark lithology has the same texture and composition of the silicates, but is intensive darkened. It has high abundance of tiny inclusions and narrow veinlets of troilite, occurring in the fractures and along the grain boundaries. Several objects in the dark lithology are fine-grained, silicate breccias with troilite matrix. The olivine demonstrates strong undulatory extinction and planar fractures decorated by opaque inclusions.
Geochemistry: Mineral compositions and geochemistry: (N. N. Kononkova, EMP, *Vernad*): Olivine $Fa_{19.1\pm 0.4}$ (N=24), Pyroxene $Fs_{17.1\pm0.6}Wo_{1.4\pm0.2}$ (N=23).
Classification: (C. A. Lorenz, *Vernad*) ordinary chondrite (H5, monomict breccia) Shock stage is S3; weathering grade is W0.
Specimens: Two thin sections and two samples of 108.7 and 57.2 g are on deposit in *Vernad*; anonymous collectors hold the main mass.

Alaer 003 ~40°20’N, ~81°15’E
Xinjiang, China
Find: 2007
Classification: Ordinary chondrite (LL~6)
History: (Ziyao Wang) Purchased by Wang Ziyao from Fan Xingang in Aksu, Xinjiang in 2010. This meteorite was discovered in the Taklimakan region, close to Alaer in 2007.
Physical characteristics: (Wang Ziyao) Dark brown stone of 85.4 g
Petrography: (R. Bartoschewitz, *Bart*) Brown stainted recrystallized matrix with nearly complete recrystallized chondrules (0.9-1.8 mm, av. 1.1 mm) and few metal specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.44
Classification: Ordinary chondrite (LL~6, W3)
Specimens: 18.1 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 22 g with *Bart*.

Alatage Mountain 043 (AM 043) 41°03’22"N, 92°06’00"E
Xinjiang, China
Find: 2013
Classification: Iron meteorite (IVB)
History: The meteorite was found in 2013 by a stone hunter in the eastern of Lop Nur, Xinjiang Province.
Physical characteristics: The total mass of the four meteorites is 9.8 kg. The largest one is 7.68 kg. The largest meteorite has an irregular shield shape, the back side with regmalypts and the front side with melting streamlines.

Petrography: Polished section of the sample observed under the SEM shows extremely fine (~5um) taenite and kamacite forming an ataxite pattern. No inclusions can be observed in the section
Geochemistry: (ELAN DRC-e Q-ICP-MS) Ni=16.7, Co=0.73 (in wt%), Ga=0.22, Ge=2.27, As=1.35, W=3.36, Ir= 36.80, Au=0.06 (in ppm)
Classification: Iron Meteorite (ataxite), IVB
Specimens: Main mass with Xinping Wen. One polished section and a 100 g slice was deposited in *IGCAS*

Alatage Mountain 044 (AM 044) 41°04’44.73"N, 92°01’24.76"E
Xinjiang, China
Find: 22 Jan 2015
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) The meteorite was discovered by Xu Jianjiang (Hami/Xinjiang) in the Gobi Desert about 120 km NE of Lop Nur, colose to the Dawadi pass, near Ruoqiang county, Korla city, Bayingol Mongolian Autonomous Prefecture, Xinjiang province on Jan. 22, 2015. Wang Ziyao purchased part of it.
Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Reddish-brown, heavily fractured, irregular rock of 709 g without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) Brown-stained, recrystallized matrix, with well developed chondrules (0.3-0.6 mm) and irregular metallic specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.89
Classification: Ordinary chondrite (H~5, W3)
Specimens: 23.3 g on deposit at *Kiel*, Xu Jianjiang (Hami/Xinjiang) and Wang Ziyao hold the main mass, and 79.2 g with *Bart*.

Andila 12.79°N, 21.20° E
Ouaddai, Chad
Confirmed fall: 2014 Aug 21
Classification: Ordinary chondrite (L6)
History: According to written report from the prefect of Abdi (Mr. Levy Dappina), on August 21, 2014, around 10 am, a series of strong detonations were heard over a distance of 70 km. Later the prefect got a phone call from the village of Andila (12 km W of Abdi) signaling that rocks fell from the sky. A police patrol went to the place and collected, the same day, a series of stones, said to have made a 10 cm hole in the soil and which produced smoke on impact. It is not clear if several individuals were collected or if the stones mentioned were fragments from a single individual. Based on the 171 g piece received by J.C. Doumnang from N’Djamena University, and a discussion with Mr. Dappina, the whole individual mass is estimated to about half a kg. The prefect later handed the stones (except the one that was brought to J.C. Doumnang for identification in 2018) to the governor of

Ouaddaï, together with a report. J.C. Doumnang later brought the stone to *CEREGE* where it was classified.
Physical characteristics: The 171 g fragment is one-third covered with black fusion crust. Fractures reveal a homogeneous, light gray, chondrule-bearing stone with a few faint rust stains. Some troilite aggregates. The material is quite fragile due to intense fracturing.
Petrography: Recrystallized chondritic texture with average plagioclase size >50 μm, but relatively well-preserved chondrules. Main minerals are olivine, pyroxene, plagioclase, kamacite, troilite. Olivine shows sharp optical extinction. No oxidation products visible in section.
Geochemistry: Olivine $Fa_{25.5\pm0.2}$ (N=3), orthopyroxene $Fs_{21.8\pm0.1}Wo_{1.8\pm0.3}$ (N=3).
Classification: Ordinary chondrite, L6
Specimens: 124 g fragment in N'Djamena University, type specimen (42 g) a polished section and a thin section at *CEREGE*.

Aridal 017 25.634°N, 13.193°W
Rio de Oro, Western Sahara
Purchased: 2016 Sep
Classification: Lunar meteorite (feldspathic breccia)
History: Found in Morocco in sandy soil, several meters from the find site for Northwest Africa 10608 (which was found earlier by desert truffle hunters). The stone was purchased by Dr. David *Gregory* in September 2016 from a Moroccan dealer at the Denver Show.
Physical characteristics: A single grayish stone (590 g) lacking fusion crust but with a glossy external patina. The fresh interior consists of small whitish clasts in a dark-gray matrix.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular mineral clasts of anorthite, olivine, orthopyroxene, pigeonite, ferropigeonite, augite, silica polymorph, TI-chromite and ilmenite (with rare inclusions of baddeleyite) in a fine grained matrix of the same minerals plus minor kamacite, troilite and K-bearing glass.
Geochemistry: Olivine ($Fa_{10.1\text{-}27.0}$, FeO/MnO = 74-106, N = 3), orthopyroxene ($Fs_{20.9}Wo_{4.5}$, FeO/MnO = 51), pigeonite ($Fs_{21.7}Wo_{7.0}$, FeO/MnO = 54), ferropigeonite ($Fs_{63.1}Wo_{18.5}$, FeO/MnO = 72), augite ($Fs_{17.3}Wo_{40.5}$, FeO/MnO = 46), anorthite ($An_{95.2\text{-}95.4}Or_{0.5}$, N = 2).
Classification: Lunar (feldspathic regolith breccia). This stone was found at the same place as Northwest Africa 10608 and probably is paired with it.
Specimens: 10.1 g including one polished endcut at *UWB*; 10.1 g at *ROM*; main mass with *Gregory*.

Aydar 27°49'33.10"N, 10°31'0.40"W
Morocco
Find: 2008

Classification: Primitive achondrite (Acapulcoite)
History: The stones were found by Mohamed Maskour. They were bought in TanTan in 2017 from Mohamed Elguirah.
Physical characteristics: Dark brown irregular stones. The largest stone weighs 267 g. Cut surface reveals a dark interior.
Petrography: Recrystallized texture with triple junctions. Typical silicate grain size 200 μm. Main minerals are olivine, orthopyroxene, Ca-pyroxene. No plagioclase was observed. FeNi metal and troilite are found as small blebs in silicates and as euhedral grains to 500 μm. Chromite to 100 μm. Abundant μm wide veins filled with opaques and associated weathering products.
Geochemistry: Olivine $Fa_{10.9\pm0.0}$, FeO/MnO=18.9 (N=2). Orthopyroxene $Fs_{9.8\pm0.0}Wo_{1.5\pm0.3}$, FeO/MnO=12.6 (N=2). Ca-pyroxene $Fs_{4.2\pm0.0}Wo_{44.0\pm1.7}$, Cr_2O_3 1.07 wt%, FeO/MnO=12.6 (N=2). Kamacite Ni=5.87 wt%, Co = 0.27 wt% (N=2)
Classification: Achondrite (acapulcoite)
Specimens: 20.3 g at *CEREGE*. Main mass with Jean Redelsperger.

Bañobárez 40°51.04'N, 6°36.46'W
Salamanca, Spain
Find: 1981
Classification: Iron meteorite (IIIAB)
History: Eduardo Martín González, retired teacher and founder of the Archeological Museum of Lumbrales (Salamanca), got the sample from a farmer, who found it in 1981. He gave it to Angel Rolland (researcher at IAA-CSIC), who gave it in 2008 to Alberto Castro-Tirado (also researcher at IAA-CSIC), who in turn sent it to Jordi Llorca (*UPC*) for study.
Petrography: (J. Llorca, *UPC*) The meteorite is a medium octahedrite containing kamacite, taenite and few plessite fields. Kamacite bandwidth is 1.0±0.2 mm.
Geochemistry: (J. Llorca, *UPC*) ICP-OES data: Ni=80.8, Co=5.6, P=1.4, S=0.1 (all mg/g); ICP-MS data: Cu=167, Cr=48, Ge=42, Ga=21, Pt=11, Os=5.0, Ru=9.7, Ir=3.6, Au=1.0 (all μg/g)

Beryozovka 52°39.86'N, 76°55.26'E
Pavlodar, Kazakhstan
Find: August 2013
Classification: Ordinary chondrite (H5-6)
History: A single stone was found in August 2013 by Mr. K. M. Tulendiev ~18 km north of the village Berezovka (synonym Zhambyl, Pavlodar region, Kazakhstan) on the steppe during hay making. The stone was in a pit of 2 m in diameter and ~0.7 m in depth. The sample was moved to Berezovka and remained there in a shed. In 2015, Mr. Aron Kadyrov learned about the stone's location from Mr. Tulendiev and searched for it. He find that the shed was demolished, but eventually found the stone among junk. Several pieces of ~100 g were separated from the

main mass. The stone was identified as a meteorite by Dr. V. L. Levin (K. I. Satpaev Institute of Geological Sciences, Almaty, Kazakhstan). In 2016 Mr. Kadyrov presented the sample of the meteorite to *DMUH*.
Physical characteristics: The stone is a pie-shaped oriented meteorite with a flat frontal surface and well-developed regmaglypts on the sides. The color is grayish-brown. Rear side appears faceted. Fusion crust is mostly preserved. Total recovered weight is 35.65 kg.
Petrography: (C. A. Lorenz, *Vernad*) The slices show a fractured and brecciated interior. In section, the meteorite has a recrystallized chondritic texture corresponding to type 5 and comprises mineral grains, chondrule fragments and uncommon complete chondrules, cm-sized completely recrystallized fragments of type 6 chondrite, and rare carbonaceous chondrite fragments up to 1.5 mm in size containing fine-grained phillosylicate matrix and different objects. The type-5 lithology contains shock melt pockets and veinlets. Main phases are olivine, pyroxene, feldspar, Fe,Ni metal, troilite; chromite and phosphate are accessory. The type-6 clasts are up to 1.5 cm in size and have sharp borders with the H5 host. Carbonaceous chondrite clasts, up to 1.5 mm in size, have a fine-grained phyllosilicate-rich matrix enclosing inclusions of serpentine, olivine, pyroxene, sulfides, minor magnetite, and FeNi metal enclosed within the olivine grains. Two olivine chondrules of 25 and 100 μm in diameter were found in the carbonaceous clasts.
Geochemistry: Mineral compositions and geochemistry: (N. N. Kononkova, *Vernad*.) Olivine $Fa_{19.1\pm0.5}$ (N=18); Pyroxene $Fs_{16.7\pm0.3}Wo_{1.4\pm0.2}$ (N=16) . Carbonaceous chondrite clasts matrix (defocused beam, N=17), wt%: Na_2O 0.18±0.15; MgO 15.5±2.6; Al_2O_3 2.44±0.18; SiO_2 31.2±2.2; K_2O 0.46±0.45; CaO 0.58±0.36; TiO_2 0.11±0.3; Cr_2O_3 0.39±0.8; MnO 0.18±0.11; FeO 29.9±3.2; NiO 2.02±0.82.
Classification: H5-6 breccia with CM-chondrite clasts. The meteorite is moderately weathered (W2) and shocked (S3).
Specimens: A sample of 1468 g and two sections are deposited in *Vernad*; *DMUH* holds a sample of 31.7 kg.

Caçapava do Sul 30°41’34.9"S, 53°39’05.1"W
Rio Grande do Sul, Brazil
Find: about 1908
Classification: Iron meteorite (IID)
History: The meteorite was found around 1908 among the remains of an abandoned country seat. The stone drew attention due to its weight and the farmer decided to use it to amuse visitors. Prof. Elver Ubirajara had heard about the mysterious rock since he was a boy. Recently, thinking it to be a meteorite, he spent many years in finding the current owner of the stone, Mr. João A. R. Lopes. When the meteoritic nature was confirmed by the *MNRJ*/UFRJ, it was donated to the local university (UNIPAMPA).

Physical characteristics: A rough pear-shaped mass of 27 kg, with average dimensions of 27 × 21 × 12 cm and weathered surface.
Petrography: (Zucolotto, M.E., *MNRJ, IGEO-UFRJ*) The etched sections display a medium Widmanstätten structure, consisting of kamacite lamellae bordered by taenite and plessite fields. The kamacite lamellae are straight, swollen and have an average bandwidth of 0.65±0.15 mm and microhardness HV 325±30. The kamacite has an indistinct ε-structure. Taenite and plessite cover 30-40% per area, mainly as comb and net plessite fields and some with martensitic varieties. The broad taenite lamellae have a mean microhardness HV 500±30. Schreibersite occurs as small blocks or skeletal crystals, mainly enveloped by swathing kamacite broad lamellae. Troilite is very rare as scattered nodules.
Geochemistry: Bulk composition (INAA - J.T. Wasson, *UCLA*) in wt%: Ni = 9.43, Co = 0.66; and in ppm: Cr=90, Cu=307, Ga=70.8, As=4.3, W=2.8, Ir=21.6 and Au=0.56. Presents the highest Ir among IID irons and one of the lowest Au and As values. (EPMA - A. Tosi, LABSONDA/*IGEO-UFRJ*) kamacite 7.32 ± 0.15 wt.% Ni and 0.65 ± 0.06 % Co content and taenite lamellae 21.5±0.5 wt.% Ni and 0.35±0.05 wt.% Co.
Classification: (J.T. Wasson, *UCLA*) Iron (IID), medium octahedrite
Specimens: 94.8 g *MNRJ, IGEO-UFRJ*, main mass UNIPAMPA.

Calama 005 22°23.56’S, 68°38.61’W
Antofagasta, Chile
Find: 25 March 2017
Classification: Carbonaceous chondrite (CO3)
Physical characteristics: 1 individual sample, 380 g, broken in several pieces, brown-black and covered with brown fusion crust.
Petrography (M. A. Ivanova, *Vernad*): meteorite consists of fine-grained matrix material, chondrules of Type I and II, and refractory inclusions. Average diameter of chondrules is 0.2 mm. Chondrules consist of olivine, pyroxene and plagioclase mesostasis. The minor phases are spinel, melilite, chromite, sulfides, kamacite, taenite, and tetrataenite.
Geochemistry: Mineral compositions and geochemistry (M. A. Ivanova, *Vernad*): Olivine (EMPA) is $Fa_{22.2\pm18.4}$ (N=98) mol%, CaO 0.24±0.16 ; MnO 0.23±0.13 (both wt. %), pyroxene is presented by orthopyroxene ($Fs_{11.6\pm10.8}Wo_{1.8\pm1.4}$ (N=20)), augite ($Fs_{4.5}Wo_{41.9}En_{53.5}$), diopside ($Fs_{1.4}Wo_{50.7}$), and Al-diopside ($Fs_{4.3}Wo_{51.7}$), Al_2O_3 16.3 wt%, TiO_2 2.9 wt%. Mesostasis in chondrules is (wt%): SiO_2 50.4; TiO_2 0.42; Al_2O_3 22.8; Cr_2O_3 0.19; FeO 3.6; MnO 0.14; MgO 2.80; CaO 14.6; Na_2O 2.95; K_2O 0.19.
Classification (M. A. Ivanova, *Vernad*): Based on the texture, average chondrules size, mineralogy, and mineral chemistry the meteorite is a carbonaceous chondrite of CO3 type. The meteorite shows only minor weathering features.
Specimens: 1 piece (70 g) and a thin section are deposited in *Vernad*. The main mass with Mr. Timur Kryachko and Mt. Eugeniy Zakharchuk.

Calama 008 22°27’32.7" S, 68°39’12" W
Antofagasta, Chile
Find: 2017 Oct 19
Classification: Ordinary chondrite (L6)

History: Meteorite (11.23 g) was found 19 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolunin R.N.) near Chiu-Chiu, Calama region.

Physical characteristics: Total mass is 11.23 g. The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. No fusion crust was observed.

Petrography: Classification (V.V. Sharygin, *SIGM* and *UrFU*). Petrographic observation of a polished thin section shows very rare chondrules in a coarse-middle recrystallized matrix. Such chondrules are very poorly delineated and their sizes vary from 500 μm to 3 mm. They have porphyritic texture and mainly consist of olivine, low-Ca-pyroxene and plagioclase, and ± diopside, chromite and blebs of troilite and FeNi-metal. Chromite-plagioclase segregation (300 μm, chondrule ?) was also observed in the matrix. Olivine, low-Ca-pyroxene and plagioclase are main minerals in matrix. Plagioclase grains are larger than 50-100 μm. This indicates petrologic type 6. Undulatory extinction and irregular fractures in olivine, as well as the absence of opaque shock veins and melt pockets, indicate a shock stage of S2. Majority of grains of FeNi metal (kamacite, taenite, rarely tetrataenite, up to 500 μm) and troilite (200-500 μm) are fresh. Weathering products (goethite and other Fe-Ni-hydroxides) occur as in situ partial alteration of FeNi-metals and troilite and fill microfractures in minerals from matrix and chondrules (weathering grade – W2). Clinopyroxene, chromite, chlorapatite and merrillite (200-400 μm) occur locally in the matrix. Single inclusion (5 μm) of molybdenite was found in troilite grain.

Geochemistry: EDS-WDS analyses (V. V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine $Fa_{25.59\pm0.50}$ (N=27), orthopyroxene $Fs_{21.72\pm0.28}Wo_{1.61\pm0.21}$ (N=22), plagioclase $Ab_{83.5}An_{10.8}Or_{5.7}$ (N=23), Cr-bearing clinopyroxene $En_{45.3}Fs_{8.6}Wo_{46.1}$ (N=6), chromite Crt82.3Spl12.4 (N=16), chlorapatite, merrillite and FeNi-metals. Chlorapatite contains F (up to 0.5 wt.%); Cl – 5.30 wt.% (N=3). Merrillite is poor in FeO (0.6-0.7 wt.%). Composition of metals (in wt.%): kamacite (N=9) – Fe 93.71±1.55, Ni – 5.39±1.01, Co – 0.97±0.17; taenite (N=17) – Fe 68.28±4.53, Ni 31.24±4.67, Co 0.50±0.09; tetrataenite (N=3) – Fe 49.22, Ni 50.29, Co 0.33. Fe-Ni-hydroxides sometimes contain 22.6-38.3 wt.% NiO.

Classification: Ordinary chondrite. L6, S2, W2. In chemical composition of olivine and low-Ca pyroxene this meteorite seems to be similar to Calama 006.

Specimens: 8.4 g cut-off – *UrFU*; 1.25 g cut-off and thin section – *SIGM*.

Calama 009 22°24.200’ S, 68°37.632’ W
Antofagasta, Chile
Find: 2017 Oct 13
Classification: Ordinary chondrite (L6)

History: The 13.5 kg meteorite was found 13 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolunin R.N.) near Chiu-Chiu, Calama region.

Physical characteristics: The meteorite has angular shape. Exterior of the stone is desert polished. The interior of the meteorite is light gray in color with red-brown spots due to Fe-hydroxides around metal and troilite. Fusion crust is present.

Petrography: Classification (V. V. Sharygin, *SIGM* and *UrFU*). Petrographic observation of a polished thin section shows very rare chondrules in a coarse recrystallized matrix. Chondrules are very poorly delineated with apparent size to 1 mm. The porphyritic and olivine- or orthopyroxene-barred chondrules are common and mainly consist of olivine, low-Ca-pyroxene and plagioclase, diopside, and ±chromite and blebs of troilite and FeNi-metal. Olivine, low-Ca-pyroxene and plagioclase are main minerals in matrix. Plagioclase grains are larger than 50-100 μm. This indicates a petrological type of 6 for the meteorite. Undulatory extinction, irregular and planar fractures in olivine, as well as the presence of opaque melt pockets and twinning in low-Ca-pyroxene, troilite and ilmenite, indicate a shock stage of S3/4. Majority of grains of FeNi metal (kamacite, taenite, tetrataenite, up to 1.5 mm) and troilite (100-500 μm) are fresh. Weathering products (goethite and other Fe-Ni-hydroxides) occur as in situ partial alteration of FeNi-metals and troilite and fill microfractures in minerals from matrix and chondrules (weathering grade W1/2). Grains of copper (up to 50 μm) are occasionally found in kamacite-taenite-tetrataenite aggregate. Pentlandite (±Ni-rich pyrrhotite, 4.4-6.1 wt.% Ni, up to 10 μm) is rarely observed in troilite. Ni-free pyrrhotite sometimes fills fissures in troilite and seems to be an intermediate phase of troilite alteration to goethite and other Fe-hydroxides. Clinopyroxene, chromite, ilmenite, chlorapatite and merrillite (100-300 μm) occur locally in the matrix. Opaque melt pockets (up to 100 μm) are rarely located near large FeNi-metal grains and contain abundant metal blebs in fine-grained olivine-pyroxene aggregate.

Geochemistry: EDS-WDS analyses (V. V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine $Fa_{25.68\pm0.43}$ (N=40), orthopyroxene $Fs_{21.46\pm0.32}Wo_{1.43\pm0.31}$ (N=32), plagioclase $Ab_{83.9}An_{10.5}Or_{5.6}$ (N=25), Cr-bearing clinopyroxene $En_{45.8}Fs_{8.6}Wo_{45.8}$ (N=2), chromite $Crt_{81.2}Spl_{13.3}$ (N=11), ilmenite $Ilm_{84.9}Gkl_{12.9}$ (N=16), chlorapatite, merrillite, FeNi-metals and copper. Chlorapatite contains F (up to 0.9 wt.%); Cl – 5.33 wt.% (N=11). Merrillite is poor in FeO (0.5-0.7 wt.%, N=11). Composition of metals (in wt.%): kamacite (N=22) – Fe 94.38±1.59, Ni – 4.77±1.52, Co – 0.84±0.24; taenite (N=40) – Fe 66.78±3.53, Ni 32.75±3.49, Co 0.42±0.08; tetrataenite (N=16) – Fe 44.65±1.24, Ni 55.07±1.26, Co 0.22±0.05; copper (N=10) – Cu 93.13±0.69, Fe 4.46±0.66, Ni 2.37±0.18.

Classification: Ordinary chondrite. L6, S3/4, W1/2.

Specimens: 12.512 kg at *UrFU*; 960 g at The Catholic University of the North, Antofagasta, Chile; 19 g and thin section – *SIGM*.

Calama 010 22°24.643’ S, 68°34.622’ W
Antofagasta, Chile
Find: 2017 Oct 15
Classification: Ordinary chondrite (H6)

History: The meteorite was found 15 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolunin R.N.) near Chiu-Chiu, Calama region.

Physical characteristics: The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. No fusion crust was observed.

Petrography: Classification (V. V. Sharygin, *SIGM* and *UrFU*). Petrographic observation of a polished thin section shows very rare chondrules in a coarse recrystallized matrix. Chondrules are very poorly delineated with apparent size to 2 mm. The POP chondrules are common and mainly consist of olivine, low-Ca-pyroxene and plagioclase, diopside, and ±chromite and blebs of troilite and FeNi-metal. Olivine, low-Ca-pyroxene and plagioclase are main minerals in matrix. Plagioclase grains are larger than 50-100 μm. This indicates a petrological type of 6 for the meteorite. Undulatory extinction and irregular fractures in olivine, as well as the presence of opaque shock veins, indicate a shock stage of S3. Majority of grains of FeNi-metal (100-800 μm) are mainly represented by kamacite; taenite and tetrataenite are rare. Sizes of troilite grains are 50-300 μm. Weathering products (goethite, Fe-Ni-Cl-hydroxide and other Fe-Ni-hydroxides, gypsum) occur as in situ partial alteration of FeNi-metals and troilite and fill microfractures in minerals from matrix and chondrules (weathering grade – W2). Nickel (1-3 μm) was found in abundant Fe-Ni-Cl-hydroxide-goethite aggregate around tetrataenite. Pentlandite (up to 10 μm) is rarely observed in troilite. Clinopyroxene, chromite, chlorapatite and merrillite (50-300 μm) occur locally in the matrix. Opaque shock veins are locally abundant and contain troilite (±Fe-Ni-metal) blebs in fine-grained olivine-orthopyroxene±clinopyroxene aggregate.

Geochemistry: EDS-WDS analyses (V. V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine $Fa_{19.33\pm0.35}$ (N=29), orthopyroxene $Fs_{16.96\pm0.28}Wo_{1.46\pm0.20}$ (N=25), plagioclase $Ab_{83.9}An_{10.5}Or_{5.6}$ (N=25), Cr-bearing clinopyroxene $En_{45.9}Fs_{7.6}Wo_{46.5}$ (N=3), chromite $Crt_{80.4}Spl_{14.9}$ (N=15), chlorapatite, merrillite, and FeNi-metals. Chlorapatite contains F (up to 1.1 wt.%); Cl – 4.87 wt.% (N=11). Merrillite is poor in FeO (0.5-0.9 wt.%, N=12). Composition of metals (in wt.%): kamacite (N=23) – Fe 92.85±0.41, Ni – 6.60±0.42, Co – 0.84±0.09; taenite (N=43) – Fe 60.31, Ni 39.38, Co 0.28; tetrataenite (N=1) – Fe 50.55, Ni 49.17, Co 0.14. Fe-Ni-Cl-hydroxide (N=5, in wt.%): FeO - 59.37, NiO – 11.91, CoO – 0.75, Cl – 16.83.

Classification: Ordinary chondrite. H6, S3, W2.

Specimens: 1189.29 g (18 pieces) at *UrFU*; 53.8 g sample and thin section at *SIGM*.

Calama 014 22°26.27’S, 68°51.27’W
Antofagasta, Chile
Find: 11 Feb 2018
Classification: HED achondrite (Eucrite, monomict)

Petrography: Monomict breccia composed of mostly rounded basaltic eucrite clasts in a sparse matrix of related crystalline debris. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, chromite and troilite.

Geochemistry: Host orthopyroxene ($Fs_{58.6\text{-}60.0}Wo_{2.8\text{-}4.1}$, FeO/MnO = 31±0.6, N=24). Clinopyroxene exsolution lamellae ($Fs_{29.5\text{-}30.6}Wo_{40.1\text{-}40.4}$; FeO/MnO = 32±0.8, N=16). Plagioclase ($An_{88.2\text{-}89.0}Or_{0.9\text{-}1.0}$, N=10)

Calama 022 22°18.192’S, 68°33.0557’W
Antofagasta, Chile
Find: 2017 Oct 15
Classification: Ordinary chondrite (L6)

History: The meteorite (1 piece 12 kg and many smaller fragments) was found October 15, 2017 by Timur Kryachko.

Physical characteristics: Total mass is about 32 kg. Many similar meteorite frаments were collected in area about 40 square meters. Largest stone (about 12 kg) ~12% covered by fusion crust. Fragments all have different shapes plus very rare fragments of fusion crust. The interior of the meteorite is light brown, whereas the surface is dark brown. Some cracks (up to 0.3 mm in thickness) are filled by alunite.

Petrography: (Pavel Yu. Plechov, *FMMR*). The main part of the meteorite contains many chondrules without clear borders. Chondrule sizes vary from 400 to 800 μm. Some chondrules (about 5%) have clear barred olivine textures, with plagioclase between the bars. Most of the chondrules consist of Ol+Opx with Cpx+Pl interstitial. Matrix consists of olivine and low-Ca pyroxene grains (70-200 μm) with aggregates of Ca-pyroxene and plagioclase. Plagioclase grains ($An_{10.4\text{-}10.8}$) are about 40-70 μm. These features indicate a petrologic type of 6 for the meteorite. Rare Fe-Ni metal blebs (up to 300 μm) and very rare troilite (up to 30 μm) occur in matrix. Metal consists of kamacite and taenite (with 35-53 wt.% of Ni). Olivine has no undulatory extinction; this plus the absence of opaque shock veins and melt pockets indicates a shock stage of S1. Weathering products (goethite, "hydrogoethite") occur as veins and in situ alteration of FeNi-metals. Troilite, olivine, pyroxene, chromite, metal are fresh and not weathered (weathering grade W1).

Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (Pavel Yu. Plechov, *FMMR*). The primary chondrite paragenesis includes olivine $Fa_{25.35\pm0.56}$ (N=25), orthopyroxene $Fs_{20.7\pm0.7}Wo_{1.47\pm0.29}$ (N=21), plagioclase $Ab_{82.0}An_{10.6}Or_{6.7}$ (N=4), Cr-bearing clinopyroxene $En_{46.6}Fs_{9.1}Wo_{44.1}$ (N=2), chromite $Crt_{75.6}Spl_{9.1}$ (N=2) and Cl-apatite. No merrillite occurred in the meteorite.

Composition of kamacite (in wt.%, N=1): Fe 93.78, Ni 5.25, Co 0.75. Taenite (N=4) contains 33.85 and 0.46 wt.% of Ni and Co, respectively. Troilite is close to ideal FeS.
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. L6, S1, W1.
Specimens: Timur Kryachko, Ilya Kryachko, Mikhail Nepomiluev holds main mass about 32 kg. 60 g (7 small fragments) and thin section, *FMMR*.

Calama 023 22°28.050'S, 68°38.786'W
Antofagasta, Chile
Find: 19 Oct 2017
Classification: Ordinary chondrite (H6)
History: Meteorite (284.04 g) was found 19 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolunin R.N.) near Chiu-Chiu, Calama region.
Physical characteristics: Total mass is 284.04 g. The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. No fusion crust was observed.
Petrography: Classification (Victor V. Sharygin, *SIGM* and *UrFU*). Very rare chondrules in a coarse recrystallized matrix. Chondrules are poorly delineated and their sizes vary from 200 μm to 2 mm. The largest chondrules (1-2 mm) are visible macroscopically and represented by PO, POP and RP textural types. They mainly consist of olivine, low-Ca-pyroxene and plagioclase, diopside, and ±chromite and blebs of troilite and FeNi-metal. Olivine, low-Ca-pyroxene and plagioclase are main minerals in matrix. Clinopyroxene, chromite, ilmenite and merrillite (50-300 μm) occur locally in the matrix, chlorapatite was not observed. Large olivine grains from matrix and POP chondrules may contains partially crystallized (silicate-melt?) inclusions (low-Ca-pyroxene + diopside + plagioclase/glass + troilite). Plagioclase grains in the matrix are larger than 50 μm, indicating a petrologic type of 6 for the meteorite. The absence of opaque shock veins and weak undulatory extinction and irregular fractures in olivine indicate a shock stage of S2. Majority of grains of FeNi metal (kamacite, taenite, tetrataenite, up to 1.5 mm) and troilite (100-500 μm) are fresh. Pentlandite (±Ni-rich pyrrhotite, up to 50 μm) is rare in troilite on the contact with kamacite. In addition, alabandite + Ni-rich pyrrhotite (?) association (3x10 μm) was found in a kamacite-hosted troilite bleb (70 μm). Grains of copper (up to 5 μm) were observed in a kamacite-taenite-tetrataenite-troilite aggregate. Weathering products (goethite, Fe-Ni-Cl-hydroxide and other Fe-Ni-hydroxides, Fe-S-hydroxide) occur as in situ partial alteration of FeNi-metals and troilite and fill microfractures in minerals from matrix and chondrules (weathering grade – W2). The association of trevorite + akaganeite is common as an alteration product of Ni-rich metal grains (taenite or kamacite + taenite + tetrataenite). Rare Fe-Ni-hydroxides veins are crosscut the meteorite sample.
Geochemistry: EDS-WDS analyses (Victor V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine $Fa_{19.44\pm0.18}$ (N=36), orthopyroxene

$Fs_{17.28\pm0.35}Wo_{1.45\pm0.14}$ (N=36), plagioclase $Ab_{82.5}An_{11.8}Or_{5.7}$ (n=10), Cr-bearing clinopyroxene $En_{47.4}Fs_{7.0}Wo_{45.6}$ (N=8, Cr_2O_3 – 0.83 wt.%), chromite $Crt_{81.5}Spl_{13.9}$ (N=16), ilmenite $Ilm_{79.4}Gk_{10.9}$ (N=10), merrillite, and FeNi-metals. Merrillite is poor in FeO (0.4-0.8 wt.%, N=14). Composition of metals and sulfides (in wt.%): kamacite (N=27) – Fe 92.83±0.31, Ni – 6.73±0.13, Co – 0.44±0.05; taenite (N=12) – Fe 75.44, Ni 24.26, Co 0.28; tetrataenite (N=14) – Fe 47.24, Ni 52.59, Co 0.14; pentlandite (N=5) – Fe 45.99, Ni 20.67, Co 0.27, S 33.05; alabandite (N=2) – Mn 53.45; Fe 9.12, Ni 1.09, Co 0.14, S – 36.28.
Classification: Ordinary chondrite. H6, S2, W2.
Specimens: 249.36 g sample – *UrFU*; 27.25 g sample and thin section – *SIGM*.

Calama 024 22°27.549’S, 68°39.227’W
Antofagasta, Chile
Find: 19 Oct 2017
Classification: Ordinary chondrite (H6)
History: Meteorite (252.95 g) was found 19 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolunin R.N.) near Chiu-Chiu, Calama region.
Physical characteristics: Total mass is 252.95 g. The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. Fusion crust is locally preserved (up to 1 mm).
Petrography: Classification (Victor V. Sharygin, *SIGM* and *UrFU*). Petrographic observation of a polished thin section shows chondrules in a coarse recrystallized matrix. Chondrules are poorly delineated and their sizes vary from 200 μm to 2 mm. The largest chondrules (1-2 mm) are visible macroscopically and represented by PO, POP and RP textural types. The PO and POP chondrules mainly consist of olivine, low-Ca-pyroxene and plagioclase, diopside, and ± chromite and metal-sulfide blebs. Some RP chondrules may contains SiO_2 polymorph (10x100 μm) In addition to chondrules, a "refractory forsterite-rich object" (size - 300 μm, RFRO) was found. It consists of high-Mg forsterite and low-Ca pyroxene phenocrysts, and interstitial augitic clinopyroxene and An-rich plagioclase. Olivine, low-Ca-pyroxene and plagioclase are main minerals in the chondrite matrix. Clinopyroxene, chromite, chlorapatite and merrillite (50-300 μm) occur locally in the matrix. Plagioclase grains in the matrix are larger than 50 μm, indicating a petrologic type of 6 for the meteorite. The absence of opaque shock veins and weak undulatory extinction and irregular fractures in olivine indicate a shock stage of S2. Majority of grains of FeNi metal (kamacite, taenite, tetrataenite, up to 1 mm) and troilite (100-500 μm) are fresh. Pyrrhotite (Ni – 0.4 wt.%, up to 10 μm) occurs in outer parts of troilite. Grains of copper (up to 10 μm) were observed in kamacite-taenite-tetrataenite-troilite aggregates. Weathering products (goethite, Fe-Ni-Cl-hydroxides, Fe-chloride-hydrate and gypsum) occur as in situ partial alteration of FeNi-metals and troilite and fill microfractures in minerals from matrix and chondrules (weathering grade – W2). Rare Fe-Ni-hydroxides veins are crosscut the

meteorite sample. Fusion crust consists of dendritic/skeletal magnetite and olivine and Fe-rich glass. Plagioclase near fusion crust is transformed into maskelynite. Fe-rich glass contains rare metal-sulfide blebs (5-10 μm).
Geochemistry: EDS-WDS analyses (Victor V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine $Fa_{19.73\pm0.36}$ (N=48), low-Ca pyroxene $Fs_{17.24\pm0.26}Wo_{1.22\pm0.25}$ (N=26), plagioclase $Ab_{82.8}An_{11.7}Or_{5.5}$ (n=17), Cr-bearing clinopyroxene $En_{47.3}Fs_{7.2}Wo_{45.5}$ (N=8, Cr_2O_3 – 0.87 wt.%), chromite $Crt_{81.7}Spl_{13.6}$ (N=12), merrillite, chlorapatite and FeNi-metals. Chemical variations in RFRO: olivine $Fa_{4.9\text{-}20.3}$ (N=10), low-Ca pyroxene $Fs_{3.1\text{-}3.6}Wo_{0.3\text{-}0.4}$ (N=5), clinopyroxene $En_{59.6\text{-}62.5}Fs_{3.2\text{-}5.9}Wo_{30.9\text{-}35.1}$ (Cr_2O_3 - 1.8-2.5 wt.%, Al_2O_3 – 3.3-5.0 wt.%, N=8), plagioclase $An_{47.3}Ab_{51.9}Or_{0.8}$ (N=1). Merrillite in matrix is poor in FeO (0.6-0.9 wt.%, N=11). Chlorapatite contains F (up to 0.5 wt.%); Cl – 5.32 wt.%, Na_2O – 0.5 wt.% (N=8). Composition of metals (in wt.%): kamacite (N=30) - Fe 93.46±1.78, Ni 6.10±1.78, Co 0.46±0.06; taenite (N=9) – Fe 67.25, Ni 32.55, Co 0.26; tetrataenite (N=6) – Fe 49.21, Ni 51.60, Co 0.15; copper (N=4) – Cu 92.66, Fe 5.05, Ni 2.33. Fe-chloride-hydrate (in wt.%): FeO 62.6, NiO 2.8, CoO 0.5, SO3 0.5, Cl 30.1.
Classification: Ordinary chondrite. H6, S2, W2.
Specimens: 213.8 g sample – *UrFU*; 32.51 g sample and thin section – *SIGM*

Caleta el Cobre 022 ~24°20’S, ~70°15’W
Antofagasta, Chile
Find: 2016 Nov
Classification: Martian meteorite (Nakhlite)
History: A single stone was found casually by a tourist family next to their night camp in the Atacama desert. The stone was presented to Rodrigo Martinez from *MMC*, and identified as a meteorite. A sample was then sent by the finder to *CEREGE* for classification.
Physical characteristics: A single stone entirely covered by shiny fusion crust. Cut surface reveals a dark greenish coarse-grained interior with a few mm-sized orangish crystals. Magnetic susceptibility measured on several pieces is very homogeneous with log χ ($\times 10^{-9}$ m^3/kg) = 3.93±0.01 (N=5, including measurement of the main mass remaining after cutting)
Petrography: Cumulate texture with euhedral elongated augite crystals (typical size 1 mm by 300 μm) with interstitial plagioclase (typical size 250 μm, birefringent) and rare fine grained mesostasis. Olivine crystals (up to 2.5 mm) are crosscut and surrounded by aqueous alteration products ("iddingsite") and contain melt inclusions (to 100 μm). Thin sulfide veins (pyrrhotite) penetrate the olivine crystals. Other notable minerals: finely exsolved Fe-Ti oxides to 1 mm in size, with TiO_2 16.8 wt% , Cr_2O_3 2.23 wt%, $Al_2O_3$1.56 wt%, MgO 0.50 wt%, MnO 0.42 wt% (mean of 4 analyses with electron beam defocused to 10 μm). Modal abundances (from image analyses of a 2 cm^2 polished section): pyroxene 69.0 vol%, plagioclase and mesostatis 27.1 vol%, olivine 2.2 vol%, opaque minerals 1.8 vol%. Magnetic measurements (hysteresis properties of a 360 mg piece) indicate a

titanomagnetite content of at least 4.3 wt%. None of the silicates show petrological sign of shock.
Geochemistry: Augite $Fs_{28.4\pm2.9}Wo_{40.0\pm0.6}$ (N=20), with Fe-rich ~10 umthick rims (cores down to $Fs_{24.5}$, rims up to $Fs_{33.3}$), FeO/MnO=37.4±3.6. Plagioclase $An_{30.4\pm1.0}Ab_{66.9\pm0.8}Or_{2.8\pm0.4}$ (N=7). Olivine $Fa_{70.2\pm3.4}$ (range $Fa_{67.2\text{-}76.4}$), FeO/MnO=47.6±1.6 (N=7). Olivine alteration products (iddingsite) SiO_2 53.2 wt%, FeO 26.1 wt%, MgO 2.5 wt%, Al_2O_3 0.56 wt%, MnO 0.32 wt%, CaO 0.21 wt%, K_2O 0.18 wt%, Na_2O 0.16 wt%, total 83.3 wt% (average of 5 analyses with electron beam defocused at 10 μm). The bulk chondrite-normalized REE pattern (V. Debaille, ULB) is similar to that of nakhlites.
Classification: Martian (nakhlite). Minimal weathering. This nakhlite is unusually rich in plagioclase and in titanomagnetite.
Specimens: 21 g, 3 polished sections, 1 thin polished section at *CEREGE*. Main mass with anonymous finder

Caleta el Cobre 024 ~24°20'S, ~70°15'W
Antofagasta, Chile
Find: 2018 Apr
Classification: Enstatite chondrite (EL6)
History: The stone was found lying at the surface in the Atacama desert in April 2018.
Physical characteristics: A single dark brown stone. Cut face reveals a dark interior with abundant metal.
Petrography: (J. Gattacceca, Bertrand Devouard, *CEREGE*) Highly recrystallized chondritic texture. One relict chondrule observed in the 2 cm^2 studied section. Main minerals are enstatite, plagioclase (typical size 100 μm, to 200 μm), kamacite (typical size 100 μm), sulfides (typical size 100 μm, also present as abundant 5-10 μm mixed sulfides/kamacite grains in the silicates). No olivine. Sulfides include alabandite and troilite.
Geochemistry: Enstatite $Fs_{0.4\pm0.1}Wo_{1.4\pm0.0}$ (N=3). Plagioclase $An_{14.4\pm0.5}Ab_{81.2\pm0.5}Or_{3.8\pm0.0}$ (N=2). Si in kamacite 1.5±0.1 wt% (N=5). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 5.36.
Classification: Enstatite chondrite (EL6). EL classification from the Si content of kamacite and the presence of alabandite. Minimal weathering. This meteorite was found 2 km away from the Caleta el Cobre 025 EH3 meteorite.
Specimens: Type specimen 32 g at *CEREGE*. Main mass with *ARTMET*.

Caleta el Cobre 025 ~24°20'S, ~70°15'W
Antofagasta, Chile
Find: 2018 Apr
Classification: Enstatite chondrite (EH3)
History: The stone was found lying at the surface in the Atacama desert in April 2018.

Physical characteristics: A single dark-brown stone. Cut face reveals a dark interior with abundant metal and small chondrules.
Petrography: (J. Gattacceca, Bertrand Devouard, *CEREGE*) Chondrite with well-defined chondrule (average apparent diameter 270±150 μm, N=33) with clear mesostasis. Main mineral is enstatite. Abundant kamacite and sulfide in the form of rounded composite grains with typical size 100 μm. Sulfides display a wide compositional range and include troilite, alabandite, and niningerite.
Geochemistry: Enstatite $Fs_{2.7\pm2.1}Wo_{0.8\pm0.9}$, Fs PMD=58% (N=7). Si in kamacite 2.8±0.2 wt% (N=5). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 5.24.
Classification: Enstatite chondrite (EH3). EH classification from the Si content of kamacite. Minimal weathering. This meteorite was found 2 km away from the Caleta el Cobre 024 EL6 meteorite.
Specimens: Type specimen 67 g at *CEREGE*. Main mass with *ARTMET*.

Catalina 257 ~25°14'S, ~69°43'W
Antofagasta, Chile
Find: 2010 Apr 14
Classification: Ordinary chondrite (H3-6)
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-defined, packed chondrules. One 3 mm type 6 clast.
Geochemistry: Type 3 host lithology: olivine $Fa_{18.2\pm1.9}$, PMD = 9%, (N=6), low-Ca pyroxene $Fs_{16.9\pm0.5}$ (N=3). Type 6 clast: olivine $Fa_{19.7}$ (N=1), orthopyroxene $Fs_{17.7}Wo_{1.4.}$

Catalina 278 24°55'54.2"S, 69°44'15.9"W
Antofagasta, Chile
Find: 2017 Nov 08
Classification: Ordinary chondrite (LL3.4)
Petrography: (J. Gattacceca, *CEREGE*) Tightly packed chondrules. Clasts with cluster chondrite texture as defined by Metzler (2012). Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy, this meteorite appears to be as metamorphosed as Chainpur (LL3.4). The Raman spectroscopy parameters of interest are FWHM-D (cm-1)=155.8±7.6, ID/IG=1.02±0.04 (see Bonal et al., 2016, figure 7).
Geochemistry: Olivine $Fa_{13.9\pm9.6}$, Fa PMD=65%, range $Fa_{1.1\text{-}29.7}$ (N=16), Cr_2O_3 in ferroan olivine 0.14±0.11 wt% (N=15). Low-Ca pyroxene $Fs_{15.1\pm6.9}Wo_{2.1\pm1.9}$, range $Fs_{1.1\text{-}22.2}$ (N=10).
Classification: LL3.4. Subtype from Raman spectroscopy.
Specimens: 182 g and a polished section at *CEREGE*. Main mass at MMC.

Catalina 300 25°14'S, 69°43'W
Antofagasta, Chile

Find: 2018 March
Classification: Carbonaceous chondrite (CV3)

Physical characteristics: Dark stone. Cut surface reveals chondrules and CAIs set in a dark matrix.

Petrography: Chondrules with average size 1350 μm (n=10) and CAIs set in fine grained matrix (45vol%, from point counting n=207). Abundant sulfides and magnetite, rare metal.

Geochemistry: Olivine $Fa_{4.7\pm6.1}$, PMD=11%, range $Fa_{0.2\text{-}14.9}$ (n=7), Cr_2O_3 in ferroan olivine is 0.58±0.78wt% (n=5). Low-ca pyroxene $Fs_{1.0}Wo_{0.6}$ (n=1)

Classification: Carbonaceous chondrite (CV3, oxidized subgroup)

Specimens: 23 g and a polished section at *CEREGE*. Main mass with Luc *Labenne*

Chasseron 46°51.07'N, 6°32.32E
Vaud, Switzerland
Find: 1959
Classification: Pallasite (Main group)

History: Found by Mr. Reto Merlo, Grüningen, Switzerland, during a school excursion in summer 1959 while he was searching for firewood. The finder remembers having found the sample between the hotel and the summit of Chasseron (distance ~160 m). The finder glued the sample on a piece of wood and kept it until 2017. After reading about meteorites, he sent the sample to the *NMBE* (received May 9, 2017) from where it was transferred to *UNIL*.

Physical characteristics: Metallic sponge shape, only slightly rusted, fragment with embedded yellow-green forsterite (olivine) grains. Locally fresh-looking, shiny fusion crust on metal and olivine. 23.5 × 13 × 11 mm.

Petrography: Typical pallasitic texture. Forsterite (olivine) grains size is 8-2 mm. Droplet-like troilite grains up to 0.6 mm embedded in forsterite (olivine). Schreibersite rounded inclusions in Ni-rich iron up to 1.8 mm. Ni-rich iron weathering is relatively low in an outermost zone just 0.1 mm thick, consistent with weathering grade W1. Bulk density by immersion in isopropanol is 6.17 g/cm3. From density calculation, volume fraction of forsterite is 57% and volume fraction of Ni-rich iron is 43%.

Geochemistry: Forsterite (olivine): microprobed $Fa_{14.9\pm1.1}$ (range $Fa_{13.6\text{-}15.9}$), Fe/Mn (at.) 34± n=5. Two analyses of Ni-rich iron (variety kamacite) yielded: Ni 7.15±0.21 wt. % and Co 1.20±0.20 wt. %. One analysis of schreibersite (XRD checked) yielded the following formula (based on 4 apfu): $(Fe_{1.92}Ni_{0.97}Co_{0.03})_{2.92}P_{1.08}$. Stoichiometric troilite crystals checked by XRD. One analysis of chromite (XRD checked) yielded the following formula (based on 4 oxygen atoms):$(Fe_{0.62}Mg_{0.35}Mn_{0.03})_{1.00}(Cr_{1.65}Al_{0.31}Fe_{0.02}V_{0.02})_{2.00}O_4$. Forsterite (olivine) oxygen isotopes (R. Greenwood, *OU*): $\delta^{17}O$ 1.514±0.051, $\delta^{18}O$ 3.239±0.094, $\Delta^{17}O$ -0.170 (n=2). Cosmogenic radionuclides: (Å. Rosén, GeMSE): Gamma-spectrometry performed in May 2017 showed significant activities of ^{26}Al (10.8+2.5/-1.7 dpm/kg) and ^{40}K (17.6+9.3/-4.9 dpm/kg, probably a contamination). No short-lived cosmogenic isotopes were detected. A significant activity

(17.0+2.1/-1.2 dpm/kg) of ^{137}Cs is present as terrestrial contamination, consistent with a first peak of nuclear bomb-produced ^{137}Cs in the years 1957-1959.
Classification: This is a main-group pallasite based on texture, mineralogy and mineral composition including oxygen isotopes. Low degree of weathering.
Specimens: 4.8446 g and one epoxy resin polished section with isolated olivine grains at *UNIL*; sample number 093320.

Chug Chug 003 22°29.931'S, 69°8.683'W
Antofagasta, Chile
Find: 2018 Apr 5
Classification: Ordinary chondrite (H4)
History: Meteorite (1 piece 8700 g and 5 small fragments) was found April 5, 2018, by Mikhail Nepomiluev during a meteorite search organized by Timur Kryachko.
Physical characteristics: Total mass is 8918 g. Meteorite has roughly rounded and slightly elongated shape. The surface and interior of the meteorite is light, with dark brown fusion crust up to 2 mm. No fresh glass in fusion crust was observed. Outermost slightly fractured zone is up to 5 mm width. Cracks (up to 0.1 mm in thickness) form a network in this zone.
Petrography: (Pavel Yu. Plechov, *FMMR*). Petrographic observation of a polished section shows that main part of the meteorite contains well-formed chondrules in the matrix. Chondrules sizes vary from 200 to 600 μm. They have quenched or porphyritic texture, rarely cryptocrystalline, and consist of Ol, Ol+Opx, Ol+Opx+Cpx+Pl. Matrix consists of olivine grains (50-150 μm) and less low-Ca-pyroxene, which is surrounded by cryptocrystalline matrix with a significant amount of tiny (about 1 μm) round drops of metal (kamacite and taenite), chromite and plagioclase. Plagioclase grains ($An_{18.5-41}$) are less than 5 μm. These features indicate a petrological type of 4. Fresh Fe-Ni metal blebs (up to 300 μm) and troilite (up to 20 μm) occurs in matrix. Metal consists of kamacite surrounded by relatively small grains of taenite and troilite on the boundary with matrix. One elongated area (4 × 7 mm) in the thin section have sharp boundaries with main part of the meteorite. It also consists of chondrules (about 500 μm) and coarse-grained (200-400 μm) Ol-Px matrix. Less metal is in the matrix of the area of a large (2 × 2 mm) metal blob. Olivine has no undulatory extinction, and opaque shock veins and melt pockets are absent, indicating a shock stage of S1. Weathering products (goethite, "hydrogoethite") occur as veins and in situ alteration of FeNi-metals and troilite near meteorite surface. Olivine, pyroxene, chromite, metal and troilite are fresh and not weathered (weathering grade W1). Clinopyroxene, chromite and merrillite (up to 200 μm) occur locally in the matrix.
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (Pavel Yu. Plechov, *FMMR*). The primary chondrite paragenesis includes olivine $Fa_{19.9\pm1.6}$ (N=34), orthopyroxene $Fs_{14.1\pm3.5}Wo_{1.42\pm1.26}$ (N=34), plagioclase $Ab_{62.6}An_{28.8}Or_{6.7}$ (N=3), Cr-bearing clinopyroxene $En_{48.1}Fs_{6.4}Wo_{45.4}$ (N=1), chromite $Crt_{77.8\pm5.93}Spl_{13.2\pm0.78}$ (N=3) and merrillite. No Cl-apatite occurred in the

meteorite. Merrillite contain (in wt.%, N=6) FeO - 0.28-1.71 wt.%, MgO - 3.52-3.83 and Cl - 0.01-0.02. Composition of kamacite (in wt.%, N=2): Fe 93.3-94.0, Ni 6.2-6.7, Co 0.88. Taenite contain 39.8 wt.% of Ni. Troilite is close to ideal FeS. Rare goethite contains 1.9 wt.% NiO and 0.4 wt.% CoO.
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. H4, S1, W1.
Specimens: 8700 g, Mikhail Nepomiluev; 198 g (4 pieces), Timur Kryachko, type specimen at *FMMR*.

Coya Sur 004 (CS 004) 22°26.07’S, 69°39.16’W
Antofagasta, Chile
Find: 13 Oct 2017
Classification: Ordinary chondrite (LL3)
Petrography: Average chondrule diameter 870 μm

Coyote Dry Lake 349 (CyDL 349) 35°3.396’N, 116°46.096’W
California, USA
Find: 2015 Dec 12
Classification: Ordinary chondrite (H6)
History: While hunting for meteorites on a dry-lake, Mark Bittmann, spotted a rusty rock protruding out of the corner of a hummock that was just beginning to be eroded by a small gully. Glancing at the gully he noticed many more fragments protruding out of the surface. Digging deeper into both the small dune and gully, he recovered 20 more equally weathered chondritic fragments. Later, returning with a recovery crew and a metal-detector, another 130 g, sand-encrusted fragment was unearthed.
Physical characteristics: All 22 fragments are very weathered, but have a range of grades and color from yellowish-brown to brownish-black. Some fragments are coated in silt and sand-grains cemented with orange rust. Cut surfaces show fine-grained metal/sulfide set in a uniformly brown matrix, faint chondrules barely detectable.
Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (250-600 μm, N=6). Recrystallized coarse-grained matrix with plagioclase (>60 μm). Numerous interconnected iron-oxide veins.
Geochemistry: Olivine, $Fa_{20.1\pm0.1}$ (N=26); orthopyroxene, $Fs_{19.3\pm0.2}Wo_{2.3\pm0.1}$ (N=25). It is noted that the measured Fs and Wo values are slightly higher than the main amounts present in most H chondrites.
Classification: Ordinary Chondrite (H6)
Specimens: 36 grams at *UCLA*; main mass with *Verish*.

Da Qaidam 001 37°49’2.34"N, 95°23’25.53"E
Qinghai, China
Find: 13 July 2015

Classification: Ordinary chondrite (L~6)

History: (Ziyao Wang) Ma Yonglu (Lenghu/Qinghai) discovered two stones of about 17.5 kg while they were doing road maintenance work 4 km SE of Chaidan Town, Qinghai province, on July 13, 2015. Both stones were purchased by Wang Ziyao.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Two black-brown stones, one of 16.5 kg and a second one of about 1 kg, both without fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) internally brown-stained (in some rim areas, less oxidized) recrystallized matrix with poorly developed chondrules and irregular metal specks up to 1 mm and much smaller irregular sulfide specks.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.55

Classification: Ordinary chondrite (L~6, W3)

Specimens: 22.7 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 168.4 g with *Bart*.

Dahongliuxia 44°10’20", 91°42’30"

Xinjiang, China

Find: 1999

Classification: Iron meteorite (IIIAB)

History: The meteorite was found in 1999 by a local herder in Balikun County, Xinjiang Province.

Physical characteristics: The total mass of the meteorite is 15.6 kg. It is an ovoid shaped iron meteorite covered with a brown to black layer. One side is smooth and the other side shows regmaglypts.

Petrography: Polished section of the sample observed under the SEM reveals bands of kamacite and taenite interleaved with bandwidth of 1.2 mm (medium Widmanstätten pattern). No silicate inclusions and other minerals can be found in the section.

Geochemistry: (ELAN DRC-e Q-ICP-MS) Ni=9.4, Co=0.65 (in wt%). Ga=18.15, Ge=34.53,Ir=9.35, W=1.71, Au=0.53 (in ppm).

Classification: Iron Meteorite (Om), IIIAB

Specimens: Main mass with Peng Wang. One polished section and a 300 g slice was deposited in *IGCAS*

This meteorite was mistakenly released on 24 Feb 2018 as NWA 11650. That name will henceforth be a synonym for **Dar al Gani 1069**.

Dhofar 1762 (Dho 1762) 18.888°N, 54.467°E

Zufar, Oman

Purchased: 2018 Feb

Classification: Carbonaceous chondrite (CO3)

History: Found in Oman in 2010 by an anonymous prospector and subsequently purchased by Martin Goff in February 2018.
Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely packed, well-formed, small chondrules (apparent diameter 220±130 μm, N = 20), mineral grains and very fine grained CAI are set in a finer grained matrix (orange-brown in thin section).
Geochemistry: Olivine ($Fa_{1.7\text{-}60.7}$, Cr_2O_3 in ferroan examples 0.10-0.45 wt.%, mean 0.19±0.13 wt.%, N = 8), orthopyroxene ($Fs_{0.6\text{-}36.6}Wo_{0.9\text{-}2.8}$, N = 3), clinopyroxene ($Fs_{1.3\text{-}1.5}Wo_{38.3\text{-}46.0}$, N = 2).
Classification: Carbonaceous chondrite (CO3).
Specimens: 16.3 g including one polished thin section at *UWB*; remainder with Mr. M. Goff.

Dhofar 2092 (Dho 2092) 18°45.30'N, 54°31.15'E
Zufar, Oman
Find: 15 Feb 2015
Classification: HED achondrite (Eucrite)
Physical characteristics: A 440 g sample supplied by the Sultan Qaboos University, which has a millimeter thick, dark brown fusion crust present on all faces except one cut face. This fusion crust lacks remaglypts instead has a mainly rough surface and angular. There are no contraction cracks present on this sample. This rock has already been cut and there is a clean face already present. Beige colour clasts can be identified on cut face and they are surrounded by a light grey ground mass. The sample is not magnetic.
Petrography (P. Hill, *UWO*) The sample is breccia containing numerous clasts of coarse-grained plagioclase and pyroxene. The clasts are poorly sorted and are sub-rounded with one clast reaching up to 2 cm on the cut face. Pyroxene (low and high Ca) and plagioclase make up most of the clasts and the groundmass; however, and free silica was observed in significant quantities. The free silica mainly located at grain boundaries within the fine-grained groundmass. Distinct exsolution lamellae are present within the grains of pyroxene. Troilite and oxides are present within the sample and through EDS analysis the oxides were determined to be ilmenite. No weathering products were observed within the samples suggest a low degree of terrestrial weathering. The sample does show undulose extinction in some of the grains of plagioclase and irregular fractures were observed, but not in high abundance suggesting that the sample is very weakly shocked.
Geochemistry: Mineral composition and geochemistry (M. Beauchamp, P. Hill, *UWO*) Plagioclase ($An_{88.4\pm0.9}$), Low-Ca Pyroxene ($Fs_{59.8\pm2.5}Wo_{3.0\pm2.4}$), High-Ca Pyroxene ($Fs_{27.36\pm2.1}Wo_{42.5\pm2.3}$) and Free Silica ($SiO_2$ 99.3 ±1.3 wt%)
Classification: Classificaiton: Eucrite S2, W1.
Specimens: 440 g type specimen, including polished thin section, are on deposit at *SQU*.

Dhofar 2093 (Dho 2093) 18°34.398’N, 54°8.889’E
Zufar, Oman
Find: 2014
Classification: HED achondrite (Eucrite)
History: Discovered by an anonymous finder on a desert trip 12 km SE of Dauka in 2014.
Physical characteristics: Four gray fragments, partly covered by black-browinish crust ranging from 301.3 to 30.5 g. Cut face shows light-gray matrix with white, black, and light-brown inclusions.
Petrography: (R. Bartoschewitz, *Bart*) Microscopic examination of a thin section shows holocrystalline hypidiomorphic texture and weak shock effect: undulatory extinction in plagioclase. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 2.88.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Pyroxene (pigeonite) $Fs_{56.8\pm3.3}Wo_{7.2\pm4.4}$, Fe/Mn 29.5 (n=13); Plagioclase $An_{89.4\pm4.9}Ab_{10.2\pm4.5}$ (n=20); SiO_2; chromite CRAL 80, FFM 98 (n=1); ilmenite; kamacite Ni <0.1, Co 0.5 wt.% (n=2).
Classification: Achondrite (basaltic eucrite, monomict breccia)
Specimens: 20.0 g on deposit at *Kiel*, main mass anonymous

Dueodde 54°59’24’’N, 15°04’12"E
Denmark
Find: 2017 July 17
Classification: Ordinary chondrite (H5)
History: While cleaning the roof of the annex of their summerhouse in the area of Dueodde, in the southern part of the island of Bornholm, Denmark, the finder noticed a circular hole of approximately 5 cm in diameter in the roof. Further inspection of the area under the roof revealed the presence of single dark stone with apparent fusion crust. The finder estimates that the meteorite fall must have occurred within the last 2-3 years. Following recovery of the specimen, staff at the *NHMD* were contacted and the stone delivered.
Physical characteristics: Single 75 g spherical stone covered by irregular black fusion crust.
Petrography: The petrography was investigated from a polished thick section using backscattered electron imaging and X-ray scans. The meteorite displays an unbrecciated and recrystallized chondritic texture. Plagioclase grains are present and are typically less than 50 μm in size. The chondrules typically display obscured outlines. Porphyritic olivine and radial pyroxene chondrules are observed, ranging in sizes from 0.2 to 1 mm in diameter.
Geochemistry: The mean composition of olivine is $Fa_{19.4\pm0.4}$ with a compositional range of $Fa_{19.1\text{-}19.8}$ (n=14). The low-Ca pyroxenes have a mean composition of $Fs_{17.2\pm0.5}$ (n=15), defining a compositional range of $Fs_{16.4\text{-}17.2.}$ The mean plagioclase composition is $An_{12.0\pm0.3}Or_{5.4\pm2.0}$ (n= 15; range $An_{11.6\text{-}12.2}$).
Classification: H5
Specimens: Main mass and one thick polished section at *NHMD*.

Dunhuang 001 40°13’12.56"N, 94°23’55.97"E
Gansu, China
Find: 16 Sept 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Liu Binghan (Haixi/Qinghai) in the desert, 25 km WNW of Dunhuang City, Gansu Province, on 16 Sept 2018
Physical characteristics: (Wang Ziyao) Nine dark brown flat eroded stones of totally 1427 g (main mass 1283 g).
Petrography: (R. Bartoschewitz, *Bart*) Brown stainted recrystallized matrix with well recognizable chondrules (0.6-1.6 mm, av. 0.7 mm) and few metal specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.84
Classification: Ordinary chondrite (L~6, W3)
Specimens: 22.3 g on deposit at *Kiel*, Wang Ziyao and Liu Binghan holds the main mass, and 109 g with *Bart*.

El Médano 381 (EM 381) 24°41’34.9"S, 70°07’18.9"W
Antofagasta, Chile
Find: 2017 Nov
Classification: Ordinary chondrite (L5)
Physical characteristics: Dark stone. Cut surface reveals a dark interior with chondrules and abundant and fresh FeNi metal.
Petrography: (J. Gattacceca, *CEREGE*) Recrystallized chondrite with packed chondrules. The meteorite displays pervasive shock darkening, with abundant troilite and metal veinlets and droplets. Metal and sulfides are often associated and form grains to several mm. Plagioclase-chromite assemblages to several hundreds μm are found. Plagioclase average size is <50 μm.
Classification: Ordinary chondrite (L5). Shock darkened.
Specimens: Type specimen at *CEREGE*. Main mass with *ARTMET*.

El Médano 389 (EM 389) ~24°51’S, ~70°32’W
Antofagasta, Chile
Find: 2016 Nov 04
Classification: Carbonaceous chondrite (CO3)
History: The meteorite was found in January 2016 in the Atacama desert by Rodrigo Martinez while he was looking for meteorites
Petrography: (J. Gattacceca, *CEREGE*) Chondrules (predominantly of type I) and small CAIs set in a fine-grained Fe-rich matrix. Average chondrule apparent size 300 μm (N=26). Opaques are metal and troilite.

Geochemistry: Olivine in the range $Fa_{0.5\text{-}69.1}$ (mean $Fa_{16.8\pm18.2}$, PMD=89%, N=25). Cr_2O_3 in ferroan olivine 0.11±0.09 wt.% (N=22). Low-Ca pyroxene $Fs_{5.5}Wo_{1.0}$ and $Fs_{4.8}Wo_{0.9}$ (N=2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.42.
Classification: Carbonaceous chondrite (CO3). Minimal weathering
Specimens: 53 g and a polished section at *CEREGE*. Main mass at *MMC*.

El Médano 390 (EM 390) ~24°51'S, ~70°32'W
Antofagasta, Chile
Find: 2017 May 17
Classification: Carbonaceous chondrite (CO3)
History: The meteorite was found in May 2017 in the Atacama desert by Rodrigo Martinez while he was looking for meteorites
Petrography: (J. Gattacceca, *CEREGE*) Chondrules (predominantly of type I) and small CAIs set in a fine-grained Fe-rich matrix. Average chondrule apparent size about 250 μm. Opaques are metal and troilite.
Geochemistry: Olivine in the range $Fa_{0.5\text{-}34.4}$ mean $Fa_{18.0\pm15.6}$, N=4). Cr_2O_3 in ferroan olivine 0.07±0.01 wt.% (N=3). Low-Ca pyroxene $Fs_{1.01}Wo_{4.0}$ (N=1). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.63.
Classification: Carbonaceous chondrite (CO3). Moderate weathering
Specimens: 20 g and a polished section at *CEREGE*. Main mass at *MMC*.

El Médano 394 (EM 394) 24°51'S, 70°32'W
Antofagasta, Chile
Find: 2018 Apr
Classification: Enstatite chondrite (EL6)
History: The stone was found lying at the surface in the Atacama desert in April 2018.
Physical characteristics: A single dark brown stone. Cut face reveals a dark interior with abundant metal.
Petrography: (J. Gattacceca, Bertrand Devouard, *CEREGE*) Highly recrystallized chondritic texture. No visible chondrule in the 1.5 cm2 observed section. Main minerals are enstatite, plagioclase (typical size 100 μm, to 400 μm), kamacite (typical size 300 μm, to mm), sulfides (typical size 150 μm, to 400 μm). No olivine. Sulfides include alabandite, oldhamite, troilite.
Geochemistry: Enstatite $Fs_{0.3\pm0.0}Wo_{1.6\pm0.0}$ (N=3). Plagioclase $An_{15.2\pm0.2}Ab_{80.6\pm0.7}Or_{4.3\pm0.5}$ (N=2). Si in kamacite 1.4±0.0 wt% (N=5). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 5.51.
Classification: Enstatite chondrite (EL6). EL classification from the Si content of kamacite and the presence of alabandite. Minimal weathering.
Specimens: Type specimen 41 g at *CEREGE*. Main mass with *ARTMET*.

Elephant Moraine 14007 (EET 14007) 76°17.213'S, 156°26.081'E

Antarctica
Find: 2014 Nov 16
Classification: Carbonaceous chondrite (CK5)
Petrography: The section consists of high abundance of recrystallized matrix. Complete absence of FeNi-metal. Cr-bearing magnetite is dominant.
Geochemistry: Olivine is $Fa_{29.5-30.0}$; low-Ca pyroxene is $Fs_{25.1-26.3}Wo_{0.6}$; plagioclase is $An_{42-71.}$

Elephant Moraine 14013 (EET 14013) 76°17.195'S, 156°27.181'E
Antarctica
Find: 2014 Nov 21
Classification: Carbonaceous chondrite (CM2)
Petrography: The section consists of a few small chondrules (~22 vol %, <~100 μm to ~2 mm in diameter), CAIs (~2 vol%), and matrix (~76 vol%) with carbonate, sulfides, and phyllosilicates. Fe-Ni metal is very rare (<0.1 vol%). The chondrules have experience varying ° of aqueous alteration. The matrix occurs as fine-grained rims surrounding chondrules.
Geochemistry: Olivine is $Fa_{0.3-65.7}$; low-Ca pyroxene is $Fs_{1.1-4.5}Wo_{0.7-4.4.}$

Elephant Moraine 14017 (EET 14017) 76°18.424'S, 156°31.991'E
Antarctica
Find: 2014 Nov 21
Classification: Ordinary chondrite (LL3)
Petrography: Sharply defined chondrules (~80 vol %, average size of ~0.9mm) with glassy mesostasis are observed. Metal is less than 1 vol%. Aluminum-rich chondrules are present.
Geochemistry: Olivine is $Fa_{0.4-53.5}$; low-Ca pyroxene is $Fs_{1.1-37.1.5}Wo_{0-6.2.}$

Elephant Moraine 14018 (EET 14018) 76°17.125'S, 156°29.040'E
Antarctica
Find: 2014 Nov 21
Classification: Ordinary chondrite (L3)
Petrography: The section has sharply defined chondrules (average size of ~0.6 mm) with some glassy mesostasis. Metal abundance is ~4 vol%.
Geochemistry: Olivine is $Fa_{0.5-27.1}$; low-Ca pyroxene is $Fs_{4.9-29.4}Wo_{0.2-4.0.}$

Elephant Moraine 14049 (EET 14049) 76°15.926'S, 156°38.370'E
Antarctica
Find: 2014 Dec 12
Classification: HED achondrite (Eucrite)

Petrography: The section consists of pyroxene and calcic plagioclase (>An_{80}) with minor amount of silica and metal. The section is brecciated and contains mineral and lithic fragments.
Geochemistry: Low-Ca pyroxene is $Fs_{19.4\text{-}60.9}$ $Wo_{1.5\text{-}7.9}$; Plagioclase is $An_{80.2\text{-}97.2.}$

Elephant Moraine 14053 (EET 14053) 76°17.138'S, 156°35.726'E
Antarctica
Find: 2014 Dec 12
Classification: Ureilite
Petrography: The section consists of large olivine (up to ~2 mm) and low-Ca pyroxene (up to ~2 mm), and dark interstitial materials including carbon, metal, and sulfides. The high CaO contents (0.24~0.32 wt%) in olivine are observed.
Geochemistry: Olivine is $Fa_{4.2\text{-}15.3}$; low-Ca pyroxene is $Fs_{12.5\text{-}13.2}Wo_{4.1\text{-}4.6.}$

Elephant Moraine 14056 (EET 14056) 76°12.637'S, 156°41.497'E
Antarctica
Find: 2014 Dec 12
Classification: HED achondrite (Eucrite)
Petrography: The section mainly consists of low-Ca pyroxene and plagioclase (>An_{90}). This meteorite is unbrecciated and equigranular with grain sizes of 0.3-2 mm in diameter.
Geochemistry: Low-Ca pyroxene is $Fs_{44.8\text{-}46.8}$ $Wo_{1.1\text{-}3.3}$; Plagioclase is $An_{93.1\text{-}94.8}$

Elephant Moraine 14064 (EET 14064) 76°15.224'S, 156°35.422'E
Antarctica
Find: 2014 Dec 12
Classification: Ordinary chondrite (LL3)
Petrography: The section shows sharply defined chondrules (~70 vol %, average chondrule size of ~0.9mm) with glassy mesostasis. Metal abundance is ~<2 vol%.
Geochemistry: Olivine is $Fa_{0.6\text{-}28.9}$; low-Ca pyroxene is $Fs_{3.6\text{-}23.6}Wo_{0.2\text{-}7.2.}$

Elephant Moraine 14066 (EET 14066) 76°15.492'S, 156°36.556'E
Antarctica
Find: 2014 Dec 12
Classification: HED achondrite (Eucrite)
Petrography: The section mainly consists of pyroxene and plagioclase (>An_{86}) with a minor amount of silica and metal. The section is brecciated with mineral and lithic fragments.
Geochemistry: Low-Ca pyroxene is $Fs_{21.1\text{-}56.5}$ $Wo_{1.3\text{-}7.1}$; Plagioclase is $An_{86.0\text{-}97.2.}$ One olivine was analyzed ($Fa_{26.6}$).

Elephant Moraine 14068 (EET 14068) 76°14.940’S, 156°36.855’E
Antarctica
Find: 2014 Dec 12
Classification: Carbonaceous chondrite (CM2)
Petrography: The section consists of a few small chondrules (~30 vol %, up to 1.5 mm in diameter, the average size of chondrule is ~300 μm), and matrix (~70 vol%). Fe-Ni metal is very rare (<0.1 vol%). The section has abundant hydrated materials, mainly serpentine.
Geochemistry: Olivine is $Fa_{0.5\text{-}35.9}$; low-Ca pyroxene is $Fs_{0.8\text{-}5.5}Wo_{0.6\text{-}2.7}$.

Elephant Moraine 14074 (EET 14074) 76°15.525’S, 156°34.277’E
Antarctica
Find: 2014 Dec 12
Classification: Primitive achondrite (Acapulcoite)
Petrography: The section mainly consists of fine- to medium grained equigranular (~220 μm) orthopyroxene and olivine, abundant FeNi metal (~14 vol%), and minor amount of chromite and apatite.
Geochemistry: Olivine is $Fa_{9.6\text{-}11.0}$; low-Ca pyroxene is $Fs_{10.0\text{-}10.6}Wo_{2.0\text{-}2.3}$.

Elmore County
United States
Find: 1940
Classification: Iron meteorite (IAB-MG)
History: Purportedly found in Alabama, USA. Presented to *UCLA* by L. Garvie in 2014. The find account provided by Fred Bart is the following: "Many years after leaving medicine, I learned that I practiced in near proximity to the Wetumpka Impact Crater. Not knowing that any fragments of the impact meteorite would have long ago rusted, I asked Greg Dubay to ask his patients if any of them had found fragments of the meteorite and if they would allow me to hunt their property. Michael Mulgrew politely pointed out that this was an exercise in futility--a fact I failed to convey to Greg Dubay. One of his patients (Mr. Greathouse) relayed that they had a "space rock" in their house that had been found by his father and/or uncle in the 1940s. This farmer family was working the land for most of their lives. One day, they encountered a rock unlike anything they had seen before and brought it home. Sometime in the next decade or so, it was transported to Auburn University, where it was confirmed to be a meteorite and painted with a sealant. Mr. Greathouse gave the piece to Dr Dubay who, in turn, gave it to me. After I received it, I carefully removed the sealant with pure acetone. While he was alive, I asked Dr. Dubay to inquire if he knew the origin of the find or even the name of the farm from where it came. Regrettably, such specifics were forgotten years ago, if they were ever known. All I know is that is was unearthed in Elmore County, Alabama."

Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 66.4, Co = 4.48 (both mg/g), Ga = 89.6, As = 11, W = 1.25, Ir = 4.1, Au = 1.457 (all µg/g).
Classification: Iron, IAB main group. Chemical composition is similar to Campo del Cielo with which it may be paired.
Specimens: Type specimens at *UCLA* and *ASU* (both >20 g).

Entrèves 45°49.14'N, 06°54.82'E
Valle d'Aosta, Italy
Find: May 1987
Classification: Iron meteorite (IAB-MG)
History: A single 20 × 17 × 18 cm mass was found in 1987 by an anonymous bomb-slivers hunter near a moraine at the border of the Brenva glacier, on the Italian side of Mont Blanc, near Entrèves. The sample was subsequently sold to Claude Scavone, a French mineral collector who sold it to Giorgio Tomelleri, an Italian meteorite collector
Physical characteristics: The main mass, weighing 17.3 kg, displays several small fusion pits and is apparently well preserved from rust. A distinct coarse grained Widmanstaetten pattern is visible on sawn and etched surfaces.
Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*). The 2 × 2 cm cut and etched chip examined contains no silicates. Coarse-grained (~5 mm width) equigranular kamacite grains with 120° grain boundaries can be distinguished, with rare taenite. No Neumann lines are visible. Schreibersite is present as rare laths, up to 150 µm in width and to 1 mm in length, within some kamacite grains and at grain boundaries. Schreibersite is frequently surrounded by iron oxides.
Geochemistry: SEM-EDX spot analyses, all in wt% (V. Moggi Cecchi, G. Pratesi, S. Caporali, Uni-Fi): schreibersite P19.9±0.2Fe44.6±0.6Ni35.6±0.8 (N=6); taenite Fe70.5±0.5Ni29.5±0.2 (N=6); kamacite Fe92.6±0.6Ni7.4±0.2 (N=5). Bulk composition (C. Herd and G. Chen, *UAb*) Ni=69.0, Co=4.5 (both mg/g); Cu=124, Ga=91, As=11.2, W=1.8, Ir=3.9, Pt=9.9, Pd=3.4, Ru=7.4, Re=0.4, Os=5.2, (all µg/g). Obtained by ICP-MS using North Chile as standard.
Classification: IAB-MG, coarse octahedrite. Composition is consistent with IAB Complex, Main Group (MG). The composition of this meteorites is extremely similar to that of Campo del Cielo. However Neumann bands are absent whereas they are abundant in Campo del Cielo.
Specimens: A polished chip weighing 28 g is on deposit at *MSN-FI*. Main mass with Giorgio Tomelleri.

Erg Chech 001 (EC 001) 26.0555°N, 2.0797°W
Algeria
Find: 2016 Dec
Classification: HED achondrite (Diogenite)

History: Three similar looking stones (weighing 998, 138, and 130 g) were found in December 2016 and January 2017 in the Erg Chech Desert, 235 km WSW of the village of Tawrirt in the Adrar region of Algeria. The 138 g stone was subsequently acquired by John Higgins.
Physical characteristics: The 138 g stone lacks fusion crust and the fresh interior is mostly yellowish-green with sparse opaque grains.
Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate of predominantly orthopyroxene (mean grainsize 0.9 mm) plus minor chromite (containing blebs of troilite) and rare taenite (containing minor Cu).
Geochemistry: Orthopyroxene ($Fs_{23.1-23.2}Wo_{1.7-1.8}$, FeO/MnO = 28-33, N = 3).
Classification: Diogenite.
Specimens: 21.6 g including one polished endcut at *UWB*; remainder of the 138 g stone with Mr. J. Higgins; other stones with the anonymous finders.

Errachidia 31°41.28102’N, 4°11.16582’W
Morocco
Find: April 2016
Classification: Lunar meteorite (feldspathic breccia)
History: One piece of 156 g was found April 2016 about 0.5 km west of Aoufous in Morocco.
Petrography: (A.-K. Kraemer and A. Bischoff, *IfP*) Breccia composed of angular anorthite-rich lithic and mineral fragments embedded in a fine-grained clastic matrix. The sample also contains melt spherules and some glassy areas. Observed minerals include anorthite, olivine, low-Ca pyroxene, Ca-rich pyroxene, Al-Ti-chromite, kamacite, taenit, ilmenite and troilite.
Geochemistry: Mineral compositon and geochemistry: Olivine (mean: $Fa_{32.6}$, Fe/Mn = 96; N = 43), low-Ca pyroxene (mean $Fs_{29.5}Wo_{7.9}$, Fe/Mn = 59, N = 40), Ca-rich pyroxene (mean: $Fs_{15.8}Wo_{41.4}$; Fe/Mn = 49; N = 11), anorthite (mean $An_{95.9}Or_{0.1}$, N = 56).

Errachidia 002 31°52’03.4"N, 4°09’55.2"W
Draâ-Tafilalet, Morocco
Find: 2017
Classification: HED achondrite (Eucrite, polymict)
History: (H. Chennaoui Aoudjehane, *FSAC*) Found in a flat area SE of Errachidia called An-Nebch around 8 km NE of a Jramena village. A single piece of 4.02 g was collected on 11 Oct 2017 in the field during a systematic prospecting mission by a team of PhD students (*FSAC*) with H. Chennaoui. This area was selected because of the report of the first sample 17.24 g that was found there by a hunter on January 2017.
Physical characteristics: (H. Chennaoui Aoudjehane) One stone partially covered by a shiny fusion crust. Fresh pieces showing a low weathering grade. Clear grains of a small size (up to 1 mm) are visible through the fusion crust. The fractured face

shows brecciation with dark and clear areas. Up to 1 mm sized grains of fresh unoxidized metal are present in the cut portion.
Petrography: (T. Shisseh, *FSAC*; R. Hewins, S. Pont, *MNHNP*) Breccia with rock fragments up to 0.7 mm and lithic clasts up to 1 mm embedded in a fine grained clastic matrix. Grains of exsolved low-Ca pyroxene with up to 16 μm exsolution lamellae, fractured with a 6 μm displacement and distorted, are present in the lithic clasts and the matrix. Contains shock veins up to 0.2 mm with entrained rounded grains of pyroxene, plagioclase and silica. A faulting surface was also observed extending over 1.5 mm. The main minerals are Ca-poor pyroxene, augite and plagioclase, with minor silica, ilmenite, chromite and pure Fe-metal.
Geochemistry: Mineral compositions and geochemistry: (T. Shisseh, H. Chennaoui Aoudjehane, *FSAC*) Orthopyroxene compositions are $En_{37.9}Fs_{59.5}Wo_{2.6}$, low-Ca pyroxenes $En_{32.7}Fs_{61.8}Wo_{5.6}$ to $En_{31.2}Fs_{59.3}Wo_{18.3}$ (N=7), augite $En_{51.9}Fs_{27.2}Wo_{20.9}$ to $En_{26.9}Fs_{29.8}Wo_{43.4}$ (N=4) Fe/Mn=30 in average. Plagioclase is $An_{95.2\text{-}87.9}$ $Ab_{4.64\text{-}11.7}$ $Or_{0.12\text{-}0.5}$ (N=6).
Classification: (H. Chennaoui Aoudjehane, T. Shisseh, *FSAC*) Polymict eucrite breccia. The meteorite contains anorthite, and pyroxene with Fe/Mn ratios matching eucrite, plus typical eucrite textures.
Specimens: The main mass 17.24 g is held by a private collector. The type specimen consists of 4.4 g and one polished section in *FSAC*.

Gandom Beryan 011 31°52.659’ N, 57°02.920’ E
Kerman, Iran
Find: 4 January 2017
Classification: Ordinary chondrite (LL3)
History: The meteorite was found on 4 January 2017 by the *UrFU* meteorite expedition-2017 in Iran (Pastukhovich A. Yu., Larionov M. Yu., Kruglikov N.A., Zamyatin D.A.) 5 km north-east from the middle part of the road Ravar – Dige-e-Rostam hot springs, Tabas (northern sandy part of the Lut desert).
Physical characteristics: The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. Fusion crust is present.
Petrography: Classification (V. V. Sharygin, *SIGM* and *UrFU*). The meteorite shows a chondritic texture. The amount of chondrules and their fragments is up to 90 vol.%. Their sizes vary from 30-50 μm to 2 mm and they are well delineated. They have barred, porphyritic or cryptocrystalline texture and mainly consist of olivine, low-Ca-pyroxene and glassy matrix, diopside, and ±chromite and blebs of troilite and FeNi-metal. In all chondrules the matrix does not contain fresh glass, now it is fine-devitrified aggregate. Olivine and sometimes low-Ca-pyroxene form skeletal/dendritic crystals and contain silicate-melt inclusions in some chondrules. In addition the crystals of these minerals sometimes show evident zonation. All these indicate the high rate of quenching. The exotic porphyritic chondrules containing olivine, spinel, plagioclase and cryptocrystalline Pl-Cpx matrix (former glass) are very rare. Olivine and low-Ca-pyroxene are main minerals in fine-

grained matrix; plagioclase was not observed. All petrographic features indicate a petrological type of 3 for the meteorite. Undulatory extinction and irregular fractures in olivine reveal a shock stage of S2. Majority of grains of FeNi-metal (100-500 μm) are mainly represented by kamacite, taenite and tetrataenite; but individual grains of kamacite also occur. The Neumann lines were locally observed in kamacite. Rare copper grains (up to 10 μm) were found in tetrataenite-taenite-troilite association. Sizes of troilite grains are 50-200 μm. Weathering products (goethite and other Fe-Ni-hydroxides, calcite, Fe-Ni-carbonate) are not very abundant and occur as in situ partial alteration of FeNi-metals and troilite and fill microfractures in all minerals (weathering grade – W2). Pentlandite+Ni-rich pyrrhotite (up to 10 μm) is rarely observed in troilite. Clinopyroxene, chromite and chlorapatite (50-100 μm) occur locally in the matrix. Merrillite was found only as rounded inclusions (up to 5 μm) in FeNi-metal and troilite. The fine-grained fusion crust (occasionally vesicular) is up to 100 μm and contains zoned olivine, Fe-rich or Fe-poor glass, magnetite and sulfides, rare low-Ca pyroxene. In the chondrules, which were in fusion crust zone, the matrix turned into glass and individual metal-sulfide blebs appeared. The blebs consist of troilite, Ni-rich metal and Ni-rich sulfides.

Geochemistry: EDS-WDS analyses (ViV. ctor V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine, low-Ca-pyroxene, Cr-bearing clinopyroxene, plagioclase, spinel-supergroup minerals, chlorapatite, merrillite, FeNi-metals and copper. The main minerals vary widely in composition. The averaged olivine is $Fa_{23.94\pm7.36}$ (N=141). However its zoned crystals in chondrules show more contrast compositions: core (min) – $Fa_{0.80}$, rim (max) – $Fa_{31.53}$; grains from matrix indicate more homogeneous composition - $Fa_{29.4\pm0.61}$ (N=31), outlining the LL group. The same situation is with low-Ca-pyroxene: average - $Fs_{14.91\pm8.12}Wo_{1.96\pm1.85}$ (N=70); chondrules: core (min) – $Fs_{1.97}$, rim (max) – $Fs_{36.93}$; matrix – $Fs_{19.10\pm6.07}Wo_{1.35\pm0.32}$ (N=8). Plagioclase is rare: anorthite $An_{72.9}Ab_{24.3}Or_{2.8}$ (N=6) occurs in spinel-containing chondrules, whereas albite $Ab_{93.2}An_{3.7}Or_{3.1}$ (n=1) – in matrix of some POP chondrules. Spinel-supergroup minerals are represented by chromite $Crt_{87.1}Spl_{6.5}$ (N=15, common in matrix), spinel $Spl_{98.8}Crt_{0.3}$ (N=6, in some chondrules) and intermediate chromite-spinel $Crt_{49.9}Spl_{47.5}$ (n=5, in some chondrules). Composition of metals (in wt.%): kamacite (N=35) – Fe 93.16±0.59, Ni – 5.88±0.58, Co – 1.00±0.17; taenite (N=22) – Fe 65.55, Ni 34.02, Co 0.48; tetrataenite (N=19) – Fe 48.43, Ni 51.25, Co 0.34; copper (N=5) – Fe 5.42, Ni 3.02, Cu 91.61. Pentlandite (in wt.%, N=5): Fe 46.42, Ni 19.83, Co 0.42, S – 33.49. Former glasses in chondrules also show contrast compositions: with moderate alkalis (Na_2O 5.3-9.7, K_2O 2.2-4.1, SiO_2 60.1-77.4, Al_2O_3 10.6-16.3 wt.%) and nepheline-normative (Na_2O 10.2-15.2, K_2O 0.2-3.5, SiO_2 47.5-60.7, Al_2O_3 18.0-27.4 wt.%).

Classification: Ordinary chondrite. LL3, S2, W2. Estimated subtype 3.4/3.9 based on variations of Fa in olivine and Fs in low-Ca pyroxene.

Specimens: 2056.6 g sample – *UrFU*; 6.53 g cut-off and thin section – *SIGM*.

Ganq 001 37°29’12.31"N, 92°18’37.84"E
Qinghai, China
Find: 03 Nov 2013
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Liu Binghan (Haixi/Qinghai) in the Gobi desert about 150 km SE of Huangtouzhen, Haixi Mongolian and Tibetan Autonomous Prefecture, Qinghai province, on Nov. 3, 2013.
Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) One black-brown almost complete rounded stone of 3907 g with about 90% of weathered and eolic eroded fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) heavy brown stainted recrystallized matrix with poor defined chondrules (0.4 - 3 mm) and irregular metal and sulphide inclusions up to 2 mm
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.62
Classification: Ordinary chondrite (L~6, W3)
Specimens: 20.5 g on deposit at *Kiel*, Liu Binghan (Haixi/Qinghai) and Wang Ziyao hold the main mass, and 108.5 g with *Bart*.

Ganq 002 37°34’54.59"N, 92°14’45.81"E
Qinghai, China
Find: 10 Mar 2014
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Zhang Qun (Haixi/Qinghai) and Liu Binghan (Haixi/Qinghai) in the Gobi desert about 150 km SE of Huangtouzhen, Haixi Mongolian and Tibetan Autonomous Prefecture, Qinghai province, on March 10, 2014.
Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Shield shaped oriented individual of 5340 g. Black, eroded fusion crust presents well-developed flow lines.
Petrography: (R. Bartoschewitz, *Bart*) weak brown-stained, recrystallized matrix with poorly defined chondrules and irregular metal and sulfide inclusions up to 1 mm
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.95
Classification: Ordinary chondrite (L~6, W1)
Specimens: 20.3 g on deposit at *Kiel*, Liu Binghan (Haixi/Qinghai) and Zhang Qun (Haixi/Qinghai) hold the main mass, 150 g with Wang Ziyao, and 129.6 g with *Bart*.

Ganq 003 37°39’35.17"N, 92°15’36.22"E
Qinghai, China
Find: 16 Sept 2015

Classification: Ordinary chondrite (L~5)
History: (Ziyao Wang) Discovered by Chen Wie (Haixi/Qinghai) in the desert close to Mangai county, Haixi, Mongolian and Tibetan Autonomous Prefecture on 16 Sept 2015. Liu Binghan (Haixi/Qinghai) purchased the complete stone in 2018.
Physical characteristics: (Ziyao Wang) Black-brown stone of 2200 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown stainted recrystallized matrix with well-defined chondrules (0.4-2 mm, av. 0.7 mm).
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.82
Classification: Ordinary chondrite (L~5, W3/4)
Specimens: 20.7 g on deposit at *Kiel*, Liu Binghan holds the main mass, 138 g with Wang Ziyao, and 106 g with *Bart*.

Gueltat Zemmour 25°05’32.0’’N, 12°37’23.9’’W
Boujdour, Morocco
Fall: 21 Aug 2018
Classification: Ordinary chondrite (L4)
History: (H. Chennaoui Aoudjehane *FSAC*, UH2C, Ahmed Bouferra, Mohamed Aid, "Moroccan association of meteorites"). On 21 Aug 21 2018 around 14:20, many people from the south of Morocco saw a bright fireball. In Smara, Seddiki Mbarek reported the passing of a fireball similar to a yellow-white shining star, moving from the northeast to southwest, in the direction of Gueltat Zemmour. His son Aboubakr also saw the fireball, saying that his sighting only lasted a few seconds before a building blocked the view. Abderrahmane Latifi and his son Adil, also from Smara, both saw a fireball shining red, then yellow, brighter than the Sun, lasting about 3 s. In the fall area, Mahjoub Boutabâa, a nomad, was inside his tent; he heard a sound similar to the explosion of a mine, followed by a few sonic booms that resonated in the entire Oued Labiyad valley, similar to thunder. Abba Essahed, another nomad, and his wife Basaddouk Aicha were out of their tent when they heard a whistling sound almost identical to ocean waves, then five sonic booms akin to the explosion of a mine, making them feel like the mountains would crumble. They saw a very bright fireball comparable to a burning 4x4 vehicle in terms of size, first red then yellow, more dazzling than the Sun, with a flashing light moving from north to south for a few seconds. There was smoke in the sky directly above them. Aicha was so scared that she went to hide between the water barrels. All testimonies are concordant on the date and the time of August 21 around 14:20. Due to the period of the fall (one day before "Aid El Adha"), hunters could not search immediately. Searching began ten days after the fall and the first pieces were found in mid-September, about three weeks after the fall, a few km to the west of Gueltat Zemmour. A group of hunters: Mohamed Ouicha, Brahim Ouhra, Mbarek Amediaz, Aissa Ouicha and Brahim Ouaadjou found many pieces (5.1, 5.0, 6.3, 7.2, and 15 g) in a valley between Wad Awzireft and Wad Labiyad (N25°05’32.0’’; W12°37’23.9’’) and north of Koudiat Rjilya. Bigger pieces were

found SW of this site (N24°53’29.52"; W12°42’10.5’’ ; around 700 g) (N24°56’37.06"; W12°40’52.12’’; around 200 g). The direction of the fall was NNE-SSW and the strewnfield is about 12 km.
Physical characteristics: A few small pieces totalling around 500 g and 3 bigger ones (5448 g, 1374 g and 426 g) not weathered, totally covered by a black matte fusion crust, showing fine grains, very friable material, and easily discernable chondrules. Large pieces are broken and show a gray-colored interior; they are partially covered by fusion crust.
Petrography: (H. Chennaoui Aoudjehane UH2C, L. Folco UniPi) Numerous well-defined chondrules (POP, PO, GPO, PP, RP and glassy chondrules) up to 3 mm. Plagioclase is very small (2 µm maximum). Mesostasis is microcrystalline. Most metal and sulfides are automorphous grains, um sized, to large grains up to 500 um; they occur inside chondrules as small grains, in the mesostasis as small and large grains, and surrounding some chondrules.
Geochemistry: (V. Moggi Cecchi, *UniFi*, H. Chennaoui Aoudjehane UH2C) Olivine $Fa_{26.0\pm0.7}$ Fe/Mn=51.23 (N=10), low-Ca pyroxene $Fs_{20.7\pm0.8}Wo_{1.1\pm0.5}$ Fe/Mn=28.51 (N=7), plagioclase $An_{8.2\pm2.4}Or_{4.8\pm0.8}$ (N=3), Taenite Ni 50.3±2.7 (N=3) Whole-rock trace-element concentrations by ICP-MS (M. D’Orazio, UniPi): V 59, Cr 2799, Ni 10115, Co 399, La 0.329, Ce 0.879, Pr 0.138, Nd 0.645, Sm 0.211, Eu 0.088, Gd 0.284, Tb 0.054, Dy 0.364, Ho 0.081, Er 0.242, Tm 0.035, Yb 0.236, Lu 0.038 (units = µg/g). Cosmogenic radionuclides: (Å. Rosén, B. Hofmann, NMBE, GeMSE): Gamma-spectroscopy performed in October 2018 on a 21.74 g sample showed the presence of several short-lived cosmogenic radionuclides (^{57}Co, ^{46}Sc, ^{56}Co, ^{58}Co, ^{7}Be ($t_{1/2}$= 53 d; 84.6±10/-7 dpm/kg) and ^{48}V ($t_{1/2}$= 16 d; 17.8±4.6/-5.4 dpm/kg). Recalculated to August 21, 2018 the ^{22}Na/^{26}Al activity ratio is 1.69±0.1. These data confirm that it is a fresh fall. The ^{26}Al activity of 55.5±3.6/-3.1 dpm/kg and absence of detected ^{60}Co (<0.8 dpm/kg) indicates only a few cm of shielding.
Classification: L4
Specimens: A sample of 20.1 g provided by the "Moroccan association of meteorites", small pieces totaling 30 g provided by *Aaronson*, *FSAC*. Aaranson: 1374 + 426 g; Mohamed Aid: 5448 g; Private collector, Casablanca: 21 + 7.2 + 6.3 + 5.1 + 5 g.

Gumu 33°10.17’N, 85°41.86’E
Tibet, China
Find, possible fall: June 25, 2018
Classification: Ordinary chondrite (H6)
History: There was a rumor that a meteorite fall had happened in the Qiangtang region of Tibet. A local farmer first found a 0.5 kg meteorite on June 25, 2018. After that, 14 kg and 24.5 kg were collected in the same location on July 1 and Aug 5, 2018.
Physical characteristics: About 20 pieces were found, with a total weight of ~39 kg. A few of them are covered with black fusion crust, and some show rusty spots.

Petrography: (N. Wang, Y. Xu and Y. Lin, *IGGCAS*) It is an equilibrated oridinary chondrite, with homogeneous compositions of olivine and pyroxene. Most of the feldspars are >50 μm in size. The chondrules are very poorly delineated. Fe-Ni metal and troilite, with minor phosphate make up about 20% of the volume.
Geochemistry: The chemical compositions of olivine and pyroxene are homogeneous across the thin section. Olivine: $Fa_{19.1\pm1.2}$ (n=28), orthopyroxene: $Fs_{16.3\pm0.9}Wo_{1.4\pm0.4}$ (n=34)
Classification: H6 (N. Wang, Y. Xu and Y. Lin, *IGGCAS*)
Specimens: Main mass with P. Chen.

Hamburg 42°26.82'N, 83°50.5'W
Michigan, United States
Confirmed fall: 2018 Jan 16
Classification: Ordinary chondrite (H4)
History: On 16 January 2018 around 20:10 EST, a fireball was observed and reported by hundreds of people from seven states. The fireball was recorded by multiple security cameras and registered as a 2.0 magnitude earthquake. Mike Hankey (*AmMS*) calculated the trajectory within one hour. A strewnfield map was produced by Marc Fries (*JSC*) using weather radar data from radar reflections of falling meteorites. The first fragment was found on 18 January 2018 at 7:50 EST by Robert *Ward* on Strawberry Lake near Hamburg, Michigan. Five other masses, ranging from 17 to 102.6 g, were found later the same day by Ward, Larry Atkins, and Darryl Landry on Strawberry and Bass Lakes. Thirteen additional pieces were found within two weeks of the fall.
Physical characteristics: Most stones are fully covered by fusion crust.
Petrography: Metal-rich texture typical of H chondrites is apparent on cut surfaces. The metal volume estimate is 9% based on an Fe EDS map. Chondrules are visible in polished section. The average chondrule diameter is 0.4±0.2 mm (N=26). Several chondrules are well-defined and have sharp boundaries. Pyroxenes are mostly orthopyroxene and less abundant clinopyroxene as determined with Raman spectroscopy. Feldspar grains vary in size and measure 3.4±2.2 μm (n=64) in a representative field of view. Chromites are impact fractured. No chromite veinlets nor opaque veins are observed within the meteorite. Phosphates account for about 0.5% of the meteorite and occur mainly as merrillite (0.4%) and apatite (0.1%). In a representative field of view, grain sizes for merrillite average around 100 μm and range from <1 μm up to 430 μm (n=37); apatite ranges from 70 μm to 310 μm with an average of 150 μm (n=8). The meteorite appears very weakly shocked. Melt veins (Fe-sulfide) occur only in close proximity to the fusion crust.
Geochemistry: Mineral Compositions and geochemistry: Olivine $Fa_{18.7\pm0.7}$ (N=34). The average composition of Ca-poor px is $Fs_{16.3\pm0.4}Wo_{1.3\pm0.1}$ (n=80). Feldspar is present with an average composition of $An_{14.0\pm4.0}Ab_{81.1\pm3.0}Or_{4.8\pm1.3}$ (n=13). Chromite: TiO_2=2.0±0.4 wt% V_2O_3=0.8±0.2 wt% (N=25). Apatite contains about 5 wt% Cl and <1 wt% F.

Classification: The petrology, mineral chemistry and compositional hetereogeneity of the minerals listed is consistent with H4 chondrites. The meteorite is classified as H4, S2, W0.
Specimens: Type specimen 22.8 g and polished section at *FMNH*; 102.6 g specimen with Robert *Ward*; 44.5 g specimen with Terry *Boudreaux*.

Hami 007 42°08’4.55’’N, 93°25’31.72’’E
Xinjiang, China
Find: 2013 Oct 12
Classification: Ordinary chondrite (H5)
History: The meteorite was found during searching for meteorites near Yamasu ore mine on Oct. 12, 2013. Subsequently, it was purchased by Qiang Xu.
Physical characteristics: complete black fusion crust. The bottom on the desert shows rusty spots.
Petrography: (Y. Xu, N. Wang and Y. Lin, *IGGCAS*) The meteorite consists mainly of olivine, pyroxene, plagioclase, Fe-Ni metal, and troilite, with minor chromite, chlorapatite and whitlockite.
Geochemistry: Mineral compositions and geochemistry: The olivine, pyroxene and plagioclase have homogeneous chemical compositions. Olivine: $Fa_{18.6\pm0.6}$ (n=22), orthopyroxene: $Fs_{16.1\pm 0.6}Wo_{1.0\pm0.7}$ (n=27). Plagioclase: An_{12} (n=25)
Classification: H5 (Y Xu, N. Wang and Y. Lin, *IGGCAS*), probably paired with Hami 001, Hami 003, and Hami 005
Specimens: the main mass was hold by Q. Xu

Hami 008 42°27’51.71"N, 93°13’68.47"E
Xinjiang, China
Find: 16 Nov 2016
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) The meteorite was discovered by Zijian Wang 45 km SW of Hami city, Xinjiang province on 16 Nov 2016. Three fragments were discovered within a distance of 1.2 m.
Physical characteristics: (Ziyao Wang) Three brown heavy fractured irregular fragments of 475 g, 75.4 g, and 39 g, in total 589.4 g.
Petrography: (R. Bartoschewitz, *Bart*) brown stainted recrystallized matrix with poor defined chondrules (0.6-1.2 mm, av. 0.8 mm)
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.79
Classification: Ordinary chondrite (L~6, W3)
Specimens: 21.7 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 64 g with *Bart*.

Hermenegildo 33°39.07’S, 53°14.90’W

Rio Grande do Sul , Brazil
Find: 2004
Classification: Ordinary chondrite (H5)

History: After a large fireball was seen at 1997, several masses of meteorites were found near Santa Vitória do Palmar (RS, Brazil). This mass was found in the sand area of the swamp near the beach after light and thunder had been observed by the finder, who reported the phenomena as UFOs. Despite the great enthusiasm of the finder, he probably witnessed an ignis fatuus due to the marsh or ore deposits, with no relation to the meteorite.

Physical characteristics: A single small weathered irregular mass with about 300 g and lacking fusion crust.

Petrography: (M. E. Zucolotto, *MNRJ*, *IGEO-UFRJ* and C. Villaça, *IGEO-UFRJ*) Polished thin and microprobe sections show a chondritic texture. A variety of textural types of chondrules and chondrules fragments were observed, embedded in a fine to microcrystalline matrix. Plagioclase grains do not exceed 50 μm in size. Metal grains include kamacite, zoned taenite and zoneless plessite. Mono crystalline chromite is present. The presence of sets of planar fractures in olivine and undulatory extinction and mosaicism of olivine with no maskelynite indicate a S4 shock stage. Moderately weathered with the entire sample percolated by hydrated ferric oxide veins; the iron metal nickel is partly transformed into oxides indicatives of weathering grade W2

Geochemistry: A. Tosi, LABSONDA/*IGEO-UFRJ*) Olivine $Fa_{19.3\pm0.6}$ (n=29), pyroxene $Fs_{17.3\pm0.9}$ $Wo_{1.14\pm0.15}$ (n=9)

Classification: Ordinary chondrite (H5), shock stage S4, weathering (W2).

Specimens: Two samples (12 g and 15g) at *MNRJ*, 10 g Pulo Martini INPE. Main mass at Museu Tancredo Mello

Hoboksar 001 46°49'51.07"N, 85°42'4.33"E
Xinjiang, China
Find: 2018 Jun
Classification: Ordinary chondrite (L~6)

History: (Ziyao Wang) A 544 g meteorite fragment was discovered by Zijian Wang in Hoboksar Mongol Autonomous County, Tarbagatay Prefecture, Ili Kazak Autonomous Prefecture, Xinjiang province in Jun 2018. In October he searched for missing fragments and discovered some within a distance of 20 m. In November, the main mass of 6.9 kg was discovered 500 m away.

Physical characteristics: (Wang Ziyao) Black brown 6 kg broken individual with fresh black fusion crust and some smaller fragments of 2 kg that fit to a nearly complete stone. The main mass of 6.9 kg is a part individual with fresh fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (0.6-1.2 mm, av. 0.7 mm) and irregular metal and sulphide inclusions.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.95

Classification: Ordinary chondrite (L~6, W1)
Specimens: 22.9 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 58 g with *Bart*.

Ilafegh 018 21°20’31.93"N, 0°49’26.02"E
Adrar, Algeria
Find: 2001 Dec
Classification: Iron meteorite (IIIAB)
History: Compact, heavily sculpted mass with well-preserved fusion crust on large parts of the surface and only a thin layer of surface oxidation. The mass shows distinct regmaglypts and heavy ablation of edges. The iron was found by nomadic Berbers in 2001, "probed" for possible gold or silver content with negative results, and left in place, remembered only as a curiosity. Only in 2015, when the finders made contact with Moroccan meteorite dealers, was the iron was recovered from its find location and recognized as an iron Meteorite, and subsequently purchased by S. Buhl.
Physical characteristics: Single mass with regmaglypts and remnants of fusion crust on large parts of the surface. Minor surface oxidation.
Petrography: (J. Gattacceca, *CEREGE*): The etched section shows octahedrite texture with a 1-2 mm heat alteration zone. Only three kamacite bands are visible in the section, with average width 1.4 mm. Kamacite is polycristalline and in the epsilon form. Comb, black and net plessite are present. No accessory minerals were observed.
Geochemistry: (M. D’Orazio, *DST-PI*): Composition of the metal is Co=0.44, Ni=7.7 (both in wt%), Cu=184, Ga=20.3, Ge=41, As=4.9, Mo=6.5, Ru=10.8, Rh=1.85, Pd=3.10, Re=0.48, Ir=5.5, Pt=11.5, Au=0.67 (all in ppm). Ni and Co have been measured by hand-held XRF following Gemelli et al. 2015; all other elements by ICP-MS following D'Orazio and Folco (2003).
Classification: Iron, IIIAB.

Jeminay 47°52’59"N, 85°54’22"E
Xinjiang, China
Find: 6 June 2017
Classification: Iron meteorite (ungrouped)
History: Found by Ye Erbo Lati and his companions Wang Ziyao and Yang Guang on June 6, 2017, while they were using metal detectors to search for meteorites in the Gobi Desert. The location is near the small town of Qiake’er in the Xinjiang Uyghur Autonomous Region, Altay, Jeminay County, China.
Physical characteristics: The main mass is discoid in shape, approximately 3 cm thick, with a glossy brown to red-brown exterior.
Petrography: (C. Herd, *UAb*) Optical and SEM investigation of a ~1 × 2.5 cm polished and etched surface reveals a well-developed Widmanstatten pattern consistent with a finest octahedrite (0.06±0.02 mm; n=66), but having a matte

appearance typical of hatched ?-structure. In detail, shock-hatching predominates, grain boundaries are irregular, and low-Ni areas consist of irregular, wavy grains. Inclusions on cut surfaces of other samples were noted, but not available for study.
Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 16.7, Co = 0.93 (both wt%); Cu = 341, Ga = 8, As = 12, W = 0.7, Ir = 13.4, Pt = 20.0, Au = 0.99 (all μg/g).
Classification: (C. Herd, *UAb*): Ungrouped, finest octahedrite. Although high Ni and Ir are suggestive of the IVB group, other element concentrations fall outside of known ranges for IVB irons.
Specimens: Type specimen consisting of two representative slices (13.5 g and 12.8 g) at *UAb*. Wang Ziyao 3 kg, Ye Erbo Lati 1.5 kg, Yang Guang 1.5 kg, Mendy Ouzillou 300 g.

Jiddat al Harasis 846 (JaH 846) 19.839°N, 55.870°E
Al Wusta, Oman
Find: 2011
Classification: Ordinary chondrite (type 3)
History: Found by an anonymous prospector in Oman in 2011.
Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, well-formed, medium-sized chondrules (apparent diameter 560±380 μm, N = 40; some up to 2.2 mm) in a finer grained matrix. Minerals are olivine, orthopyroxene, clinopyroxene, sodic plagioclase, silica polymorph, chromite, troilite and altered kamacite. Some chondrules are devoid of olivine and are composed predominantly of orthopyroxene + a silica polymorph.
Geochemistry: Olivine ($Fa_{0.6\text{-}38.1}$; Cr_2O_3 in ferroan olivine 0.04-0.22 wt.%, mean 0.08 wt.%, sd 0.06 wt.%, N = 9), orthopyroxene ($Fs_{1.9\text{-}35.2}Wo_{0.5\text{-}4.4}$, N = 3), clinopyoxene ($Fs_{6.0\text{-}6.1}Wo_{43.6\text{-}44.8}$, N = 2). Oxygen isotopes (K. Ziegler, *UNM*): analyses of 7 acid-washed subsamples by laser fluorination gave $\delta^{17}O$ 4.988, 3.882, 4.098, 4.396, 4.262, 4.762, 4.838; $\delta^{18}O$ 8.668, 6.724, 6.533, 7.237, 6.999, 8.155, 8.124; $\Delta^{17}O$ 0.411, 0.332, 0.649, 0.575, 0.567, 0.456, 0.549 per mil. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.91.
Classification: Ordinary chondrite (OC3). Unusual features of this specimen include chondrules dominated by orthopyroxene + a silica polymorph, oxygen isotopic compositions closer to the TFL than for typical ordinary chondrites with similar degree of desert weathering and extending to very high $\delta^{18}O$ values.
Specimens: Type specimen plus one polished thin section are at *PSF*; main mass with the anonymous finder.

Jiddat al Harasis 1100 (JaH 1100) 19°42.31’N, 56°35.64’E
Al Wusta, Oman
Find: 15 Feb 2015
Classification: Ureilite

Physical characteristics: A 365 g sample supplied by the Sultan Qaboos University, which has a millimeter thick, dark brown-grey fusion crust present on all faces except one cut face. This fusion crust lacks remaglypts instead has a mainly rough surface. There are no contraction cracks present on this sample. This rock has already been cut and there is a clean face already present. Elongated grey laths can be identified on the cut face, with most less than 0.5 cm wide. The sample is also magnetic.
Petrography (P. Hill, *UWO*) The sample is composed of elongated, round grains of olivine and pyroxene that are ~1-2 mm wide and occasionally meet at 120° angles. Olivine (~60 vol%) is more modally abundant than pyroxene (30 vol %). The sample is fairly porous with large gaps between pyroxene and olivine grains; however, there is a lack of porosity between grains of the same mineralogy. Instead, iron oxides are present and have filled in most of the fractures. Within some of the larger pores, graphite is observed. The graphite is associated with the olivine grains, with only a few occurrences near the pyroxene. Pyroxene is often associated with small porous inclusions throughout the grains, often running perpendicular to the elongated nature of the grain and a plane of cleavage. These inclusions are often filled with iron oxides. The reduction rims observed in olivine grains are <50 μm thick fitting within the R2 grade put forward by Wittke et al. (2007). Very little kamacite or taenite are present, most are occurring as small inclusions. Most of the metal has oxidized, (>95%). Overall there is little evidence of the silicate phases weathering and no weathering phase was identified in abundance. Overall, this meteorite has experienced moderate terrestrial weathering with most of the Fe-Ni metal being oxides but no evidence of alteration in the silicates phases. The olivine within these samples does show undulose extinction and the mosaic texture of the olivines suggesting this sample has been highly shocked.
Geochemistry: Mineral composition and geochemistry (M. Beauchamp, P. Hill, *UWO*) Olivine ($Fa_{23.9\pm1.5}$), low-Ca pyroxene ($Fs_{15.5\pm2.8}Wo_{7.9\pm2.9}$)
Classification: Classificaiton: Ureilite, S5, W3.
Specimens: 365 g type specimen, including polished thin section, are on deposit at *SQU*.

Jiddat al Harasis 1101 (JaH 1101) 19°44.58’N, 56°41.22’E
Al Wusta, Oman
Find: 15 Feb 2015
Classification: Ureilite
Physical characteristics: A 460 g sample supplied by the Sultan Qaboos University, which has a millimeter thick, dark brown-gray fusion crust present on all faces except one cut face. This fusion crust lacks remaglypts instead has a mainly rough surface. There are no contraction cracks present on this sample. This rock has already been cut and there is a clean face already present. Rounded grey laths can be identified on the cut face, with most less than 0.5 cm wide. The sample is also magnetic.

Petrography (P. Hill, *UWO*) The sample is a composed of elongated grains of olivine and pyroxene that are ~1-2 mm wide. Olivine is much more prevalent than pyroxene (60 vol % vs. 30 vol %). The olivine grains show mocaicized texture with some grains of olivine exhibiting undulatory extinction suggesting high levels of shock. Pyroxene grains are fractured but still have clear and distinct extinction. The grain boundaries are defined by oxides and graphite. Pyroxene is often associated with small porous inclusions throughout the grains. Though distinct exsolution lamellae are not present, small blebs of a more Ca-rich pyroxene are present throughout the pyroxene grains. In particular, a single grain of pyroxene (100 μm wide) is surrounded by olivine and completely rimmed by iron oxide that in some places is 50 μm thick. The olivine contains reduction rims ~50 μm thick with significant amounts of graphite remaining. Based on the classification put forward by Wittke et al. (2007), this sample fits in the R2 grade. Though the grain boundaries are defined by iron oxides, kamacite and taenite are present as inclusions within grains where fractures have not exposed the metal to terrestrial weathering. In one occurrence an iron oxide rim surrounds a Fe-Ni core. Overall there is little evidence of the silicate phases weathering; however, several sulfate veins were observed. This sample has been moderately weathered based on the presence of sulfates, oxidization of most Fe-Ni metal, but the absence of any silicate weathering phase. The olivine within these samples does show undulose extinction and the mosaic texture of the olivines suggest higher levels of shock metamorphism.
Geochemistry: Mineral composition and geochemistry (M. Beauchamp, P. Hill, *UWO*) Olivine ($Fa_{23.8\pm3.0}$), low-Ca pyroxene ($Fs_{15.8\pm2.0}Wo_{7.5\pm1.7}$)
Classification: Classificaiton: Ureilite, S5, W3.
Specimens: 460 g type specimen, including polished thin section, are on deposit at *SQU*.

Jiddat al Harasis 1102 (JaH 1102) 19°25.34’N, 55°53.44’E
Al Wusta, Oman
Find: 15 Feb 2015
Classification: Ureilite
Physical characteristics: A 95 g sample supplied by the Sultan Qaboos University, which has a millimeter thick, dark brown-gray fusion crust present on all faces except one cut face. This fusion crust lacks remaglypts on 3 of faces, however a smooth face with small remaglypts is present. There are no contraction cracks present on this sample. This rock has already been cut and there is a clean face already present. Rounded grey laths can be identified on the cut face, with most less than 0.5 cm wide. The sample is also magnetic.
Petrography (P. Hill, *UWO*) The sample is a composed of elongated grains of olivine and pyroxene that are ~1-2 mm wide, often meeting at 120° angles. The olivine grains show mocaicized texture suggesting a high level of shock. Pyroxene grains are fractured but still have sharp, distinct extinction. The grain boundaries are defined by oxides, and there is little porosity between grain boundaries.

Pyroxene is often associated with small porous inclusions throughout the grains. Though the grain boundaries are defined by iron oxides, kamacite and taenite are present as inclusions within grains where fractures have not exposed the metal to terrestrial weathering. In one occurrence and iron oxide rim surrounds a Fe-Ni core; however, most of the iron oxide occurs as veins running along grain boundaries. Troilite was also observed as a large (200 μm) inclusion within a pyroxene grain. Though diamonds and carbide were not observed within these thin sections, graphite is observed. The reduction rims of olivine grains are ~50 μm thick. According to the classification system put forward by Wittke et al. (2007), this sample fits with the R2 grade. Overall there is little evidence of the silicate phases weathering except for the occurrence of several sulphate veins. The olivine within these samples does show undulose extinction and the mosaic texture of the olivines suggest high levels of shock metamorphism.
Geochemistry: Mineral composition and geochemistry (M. Beauchamp, P. Hill, *UWO*) Olivine ($Fa_{21.8\pm2.0}$), low-Ca pyroxene ($Fs_{16.6\pm1.6}Wo_{6.8\pm1.9}$)
Classification: Classificaiton: Ureilite, S5, W3.
Specimens: 95 g type specimen, including polished thin section, are on deposit at *SQU*.

Jiddat al Harasis 1103 (JaH 1103) 19°46.660’N, 56°32.840’E
Al Wusta, Oman
Find: 2014 May 7
Classification: Ureilite
History: The meteorite was found in 2014 during a field trip in the Oman desert.
Physical characteristics: Brownish individual lacking any fusion crust.
Petrography: The meteorite shows a cumulate texture of up to 1.8 mm sized olivine and pigeonite grains. Olivine appears to be recrystallized to small up to 15 μm sized crystallites and pigeonite grains display patchy compositional zoning. Olivine shows characteristic reduced rims. The meteorite also contains flaky graphite.
Geochemistry: Reduced rims in olivine: $Fa_{6.4\text{-}14.0}$; olivine contains 0.43±0.08 wt% Cr_2O_3 and 0.29±0.05 wt% CaO

Jinchang 001 38°24’45.56"N, 102° 2’48.71"E
Gansu, China
Find: 22 Aug 2015
Classification: Ordinary chondrite (H~6)
History: (Ziyao Wang) Discovered by Wang Ziyao in a Gobi desert area of Yongchang county, 15 km SW of Jinchang city, Gansu province, on Aug. 22, 2015.
Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Black-brown stone of 813 g with rusty fusion crust with adhering sand grains.
Petrography: (R. Bartoschewitz, *Bart*) Brown-stained, recrystallized matrix with poorly defined chondrules and irregular metal and sulfide specks up to 0.6 mm

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 5.27
Classification: Ordinary chondrite (H~6, W2)
Specimens: 20.5g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 114.8 g with *Bart*.

Karimati 25°54'N, 80°10'31"E
Uttar Pradesh, India
Confirmed fall: 28 May 2009
Classification: Ordinary chondrite (L5)
History: Around noon on 28 May 2009, an eyewitness in the village of Karimati heard a roaring sound and a blackish stone fell near a wall in his house, 1.5 m away from him. The fall created an 18 × 15 cm oval-shaped pit in the ground. Out of fear, villagers put the stone in a water tank for about 72 hrs. When the local authorities came to know about it, they took the material in their possession. Dr. H.C. Verma (*IIT*) visited the place on June 2, following a newspaper report and took possession of the sample. Dr. Verma sent the meteorite to *PRL*, and it was then transferred to *GSI*.
Physical characteristics: The stone is covered with a black crust, except on one face, where a piece has been broken off by the villagers. The sample has rounded to sub-rounded edges. Regmaglypts are also observed. A few chondrules are visible by naked eye.
Petrography: The meteorite is composed of olivine + orthopyroxene + feldspathic glass (plagioclase composition) + Fe-Ni metals (kamacite and taenite)+ troilite ± apatite ± merrillite. Clinopyroxene is rare. The chondrules are composed of olivine and orthopyroxene, whereas the interstitial spaces (mesostasis) are occupied by feldspathic glass. Chondrule range up to 1000 μm in diameter. The shape of chondrules varies from near circular to elliptical to sub-elliptical. Barred olivine (BO), granular pyroxene (GP), porphyritic olivine (PO), porphyritic olivine pyroxene (POP) and granular olivine (GO) chondrules are present. Matrix is relatively fine grained and thoroughly recrystallized in which a feldspathic melt mosaic is disseminated. The feldspathic melt (plagioclase composition) is fine grained (<50 μm), patchy and interconnected in the matrix. At places it forms melt veins. The matrix is also brecciated. Troilite forms rim around kamacite grains.
Classification: Ordinary chondrite (L5)
Specimens: Main mass at *GSI*.

Kumtag 040 41°53'15.67"N, 93°55'44.80"E
Xinjiang, China
Find: 18 Aug 2012
Classification: Ordinary chondrite (LL~4)
History: (Ziyao Wang) Discovered by Wang Ziyao in the Gobi Desert, 4 km E of Yamansu Town, near Hami city in Xinjiang province on Aug. 18, 2012.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) One dark-brown, stone broken into two pieces that fit together, totaling 560 g. No fusion crust recognizable.
Petrography: (R. Bartoschewitz, *Bart*) Gray, brecciated texture of microcrystalline matrix with well-defined deformed chondrules up to 2 mm and irregular metal and sulfide specks up to 0.5 mm.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.44
Classification: Ordinary chondrite (LL~4, W1)
Specimens: 22.7 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 54.4 g with *Bart*.

La'gad 002 27°14'25.7"N, 8°50'49.5"W
Saguia el Hamra, Western Sahara
Find: 2004
Classification: Pallasite (Main group, anomalous)
History: Near the end of 2004, Michael Farmer visited a site at the northeastern corner of Western Sahara in search of a newly discovered pallasite - www.meteoriteguy.com/catalog/almahbas.htm. This site yielded several large masses of a deeply weathered pallasite. In addition, Mr. Farmer collected and acquired several small fresh looking pallasite stones from the same site. The relationship between the large weathered masses and fresh stones is unknown. This pallasite is sold and traded under the name "Al Mahbas". The total mass of the weathered material is in the many kg range, whereas only a few grams, probably <100 g of the fresh stones was collected. *ASU* acquired one of the fresh stones upon which this classification is based.
Physical characteristics: Dark rounded stone with olivine grains visible at the surface.
Petrography: Cut, polished, and etched surface shows the following minerals (areal%) 70% metal, 20% olivine, and 5% troilite and schreibersite. Olivine grains are small (<5 mm) and well-rounded. They are light green and glassy clear. One grain contains oriented linear inclusions. Metal composed of approximately 50:50 kamacite:plessite. Kamacite mostly swathing the olivine. Troilite highly shocked and fine grained. Where troilite and olivine are in contact, the olivine appears brecciated and fragments are distributed throughout the troilite. Interior of the plessite composed of ~75% kamacite and 25% tetrataenite. Within the plessite, the kamacite is dominated by anhedral grains typically 5 to 15 microns across.
Geochemistry: (J. Wasson, *UCLA*) Metal composition by INAA (mean of two analyses) Ni=76.8 mg/g, Co=5.64 mg/g, Cr=11 μg/g, Cu=164 μg/g, Ga=20.6 μg/g, As=22.8 μg/g, Ru=0.8 μg/g, W=0.2 μg/g, Re=121 ng/g, and Ir=1.42 μg/g. The Ni concentration is the lowest PMG ever measured by *UCLA*; however, in pallasites Ni is strongly affected by random variations in the kamacite/taenite ratios. Our Ni replicates scattered (90.5 and 63.0 mg/g). The Ir content is the fifth highest in a PMG. No other PMG is closely similar to La'gad 002; the closest is Marjalahti,

which also has high Ir (2.1 µg/g) and relatively low Ni (88 mg/g, the eighth lowest). (K. Ziegler, *UNM*): Analyses of 2 acid-washed olivine subsamples by laser fluorination dual inlet mass spectrometry gave, respectively $\delta^{17}O$ 1.68, 1.777; $\delta^{18}O$ 3.623, 3.861; $\Delta^{17}O$ -0.295, -0.262 per mil (reference TFL slope = 0.528, values are linearized). (L. Garvie, *ASU*) EPMA analyses of eight olivine grains $Fa_{13.8\pm0.1}$, FeO/MnO=42.0±1.8, Cr_2O_3 to 0.05 wt%.
Classification: Main-group pallasite-anomalous. This stone is likely paired with NWA 10015, NWA 10023, NWA 10252 and NWA 11720 based on the similar Fa and oxygen isotopic values and the high proportion of plessite. The anomalous designation is based on the high proportion of plessitic metal, similar to that in NWA 10023, 10252 and 11720.

Lop Nur 003 40°5'N, 90°12'E
Xinjiang, China
Find: 2017
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Wang Ziyao from Zhao Tailu (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2017. This meteorite was discovered in the Lop Nur dense collection area in 2017. The reported coordinates were read from a map provided by the finder.
Physical characteristics: (Ziyao Wang) Black-brown stone of 27.2 g with fusion crust and adhering sand grains
Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (0.2-0.9 mm, av. 0.4 mm)
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.55
Classification: Ordinary chondrite (H~5, W1)
Specimens: 5.8 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 5.0 g with *Bart*.

Los Vientos 212 (LoV 212) 24°38.765'S, 69°53.048'W
Antofagasta, Chile
Find: 2017 Feb 21
Classification: HED achondrite (Eucrite, polymict)
History: Found by driving on small hills while meteorite prospecting.
Physical characteristics: Crusted stone. Cut surface reveals light grey interior with darker clasts to 5 mm.
Petrography: (Jérôme Gattacceca, *CEREGE*) Brecciated igenous rocks with clasts of varied textures (variolitic, subophitic, granulitic) set in a clastic matrix of plagioclase and pyroxene with typical grain size 20 µm. Some pyroxene in the matrix are zoned, others not, others are exsolved. Other minerals: FeNi metal, troilite, chromite, ilmenite, silica polymorph.

Geochemistry: Clastic matrix: low-Ca pyroxene $Fs_{31.2\pm8.5}Wo_{1.2\text{-}8.2}$, Fe/Mn=34.2 (N=7), plagioclase $An_{90.5}Ab_{8.8}Or_{0.7}$ (N=1). Granulitic clasts: low-Ca pyroxene $Fs_{56.0\pm0.6}Wo_{4.3\pm0.3}$, FeO/MnO=31.5, plagioclase $An_{80.0}Ab_{18.8}Or_{1.3}$ (N=2). Variolitic clasts: low-Ca pyroxene $Fs_{56.9}Wo_{5.0\pm1.1}$, FeO/MnO=35.6 (N=3), plagioclase $An_{89.0}Ab_{10.1}Or_{0.9}$ (N=2).
Classification: eucrite-pmict
Specimens: Type specimen at *CEREGE*. Main mass with Sergey Vasiliev.

Los Vientos 231 (LoV 231) 24°39.116'S, 69°53.708'W
Antofagasta, Chile
Find: 2017 Feb 21
Classification: Ordinary chondrite (LL7)
History: Found by a six-person team who were driving on small hills while meteorite prospecting.
Petrography: (J. Gatacceca, *CEREGE*) Highly recrystallized texture. Main minerals are olivine, pyroxene (to 200 μm), plagioclase (to 100 μm). No discernible chondrules. FeNi metal is rare. Troilite is almost entirely replaced by terrestrial weathering products.
Geochemistry: Olivine $Fa_{31.1}$ (N=1). Low-Ca pyroxene $Fs_{25.7\pm0.0}Wo_{2.0\pm0.3}$ (N=3)
Classification: LL7. Type 7 designation from texture, absence of chondrules and low-Ca pyroxene Wo content.
Specimens: Type specimen and polished section at *CEREGE*. Main mass with Sergey Vasiliev.

Los Vientos 250 (LoV 250) 24°41.093'S, 69°50.533'W
Antofagasta, Chile
Find: 8 Feb 2018
Classification: HED achondrite (Diogenite)
Physical characteristics: Single stone partially covered by fusion crust with flow lines. Sawn surface shows a yellowish-orange interior with abundant opaque grains and metal.
Petrography: Thin section shows pyroxene (95 vol%) grains up to 6 mm in the long dimension with abundant shock veins. Chromite spinel grains (3 vol%) are well scattered through the sample and measure up to 3 mm and are usually associated to iron oxide. Metal grains (2 vol%) are in the range 1-3 mm. Olivine occurrence is rare. Additional minerals are Si polymorphs, FeS and Ti-spinel.
Geochemistry: Low-Ca pyroxene composition in the range $Fs_{23.2\text{-}23.5}Wo_{0.9\text{-}1.2}$ (mean $Fs_{23.4\pm0.2}Wo_{1.0\pm0.2}$, N=8), with FeO/MnO=26.0±1.2. Mean olivine composition is $Fa_{35.3\pm0.2}$ (N=2). Chromite exhibits Cr/(Cr+Al) values of 0.82±0.05 (N=8). Metal is Ni-free. No plagioclase has been found in the section studied.

Los Vientos 258 (LoV 258) 24°41'S, 69°46'W

Antofagasta, Chile
Find: 2017 Nov
Classification: Ordinary chondrite (L6)
Petrography: (J. Gattacceca, *CEREGE*) Brecciated chondrite with abundnat shock veins and cm size melt pockets. The melt pockets contain abundant µm sized FeS/FeNi eutectic droplets. Plagioclase size >50 µm.
Classification: L6. Likely paired with Los Vientos 014.
Specimens: Type specimen at *CEREGE*. Main mass with *ARTMET*.

Loulan Yizhi 008 ~40°30'N, ~89°54'E
Xinjiang, China
Find: 2013
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Wang Ziyao from Bi Chunlin (Tangshan City,Hebei) in Bayingol/Xinjiang in 2013. This meteorite was discovered in the Lop Nur area, close to the ruins of Loulan Yizhi in 2013.
Physical characteristics: (Wang Ziyao) Black-brown stone of 29.3 g
Petrography: (R. Bartoschewitz, *Bart*) Brown stainted recrystallized matrix with poor defined chondrules (0.2-1.1 mm, av. 0.4 mm). Metal and sulphide are nearly complet oxidized and vugs are filled with gypsum.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.77
Classification: Ordinary chondrite (H~5, W4)
Specimens: 5.9 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 5.9 g with *Bart*.

MacKay Glacier 14005 (MCY 14005) 77°13.981'S, 158°13.450'
Antarctica
Find: 2015 Jan 15
Classification: Enstatite chondrite (EL6)
History: A 6 × 5 × 5 cm stone was found during the XXX PNRA Italian expedition, 2014-2015
Physical characteristics: Rounded shape, 80% crusted stone with a broken tip (6 × 5 × 5 mm)
Petrography: (M.Salvini, M. Gemelli, T. Di Rocco, *DST-PI*) The meteorite consists largely of prismatic (mainly subhedral) or granular enstatite (grain size 0.2-0.4 mm) and Fe-Ni metal, with minor amount of sulfides and plagioclase and a silica phase. Only vague traces of chondritic structure are discernable in thin section: in fact, only two poorly-defined relict chondrules (diameter of 0.8 and 1.5 mm) are visible. The sulfide phases are troilite, alabandite, daubreelite and oldhamite. Schreibersite and osbornite (TiN) have also been identified. No olivine has been found. Plotting our average mineral compositions on the diagrams of Zhang et al. (1995), we conclude that the meteorite is an EL6 chondrite.

Geochemistry: (M.Salvini, M. Gemelli, T. Di Rocco EMP at *IGG-CNR* Padua) Enstatite ($Fs_{0.2\text{-}0.8}En_{98\text{-}98.3}Wo_{1.4\text{-}1.5}$), plagioclase ($Ab_{80.5}An_{15.0}Or_{4.15}$), metal (Fe 93.5, Ni 6.6, Si 0.9). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 5.51.
Classification: Enstatite chondrite (EL6)
Specimens: Main mass (172.1g), type specimen and one thin section (*MNA-SI*).

Mahbas Arraid 27°38.333'N, 9°28.124'W
Guelmim Smara, Western Sahara
Probable fall: 2013 Dec 9
Classification: Ordinary chondrite (LL6)
History: (H. Chennaoui Aoudjehane *FSAC*, H. Lharbi) A fireball fall was reported in the southern part of Morocco by many eyewitnesses from Assa, Zag and Al Mahbes area on 9 December 2013 around 6:30 pm GMT. Ali Houmida, Cheggef, Jdi and many other Moroccan hunters, as well as people from the area, saw the fireball lasting several ". Collection of the testimonies of the fireball and their conciliation indicate a bolide moving from the northeast to southwest. The meteor terminated above the area south of Mahbas Aaraid. Three sonic booms were reported. Meteorite hunters traveled to the expected fall site as indicated by meteor termination. No meteorites were found, and hunting was stopped after a few days. In the beginning of September 2014 (nine months latter after the fireball), Fatma, a young nomad girl found two black stones, totally different from all the other rocks in the area. After news of the find spread, several meteorite hunters returned to the area and collected more pieces. Samples of this meteorite were sent to the Hassan II University of Casablanca Morocco by H. Lharbi on 30 December 2014 for classification. To date, the total known mass is about 5500 g. The meteorite is known under the name of "Al Mahbes" by Moroccan hunters.
Physical characteristics: Many fresh full stones with fusion crust. The interior is brecciated with clear and dark-gray clasts surrounded by lighter-colored regions. Neither troilite nor metal grains are clearly visible.
Petrography: Polished mount shows recrystallized matrix with a few poorly defined barred chondrules. Olivine and opx are fractured (mm-sized clasts). Plagioclase occurs as irregular grains to 0.1 mm. Troilite and taenite are evenly distributed in grains to 0.1 mm. Accessory chromite and ilmenite.
Geochemistry: Olivine $Fa_{26\pm0.4}$ (N=15); Opx $Fs_{25\pm0.2}Wo_{2\pm0.3}$ (N=11); Cpx $Fs_{10\pm1}Wo_{44\pm1}$ (N=5); plagioclase $An_{10\pm0.2}Or_{5\pm1}$ (N=7); taenite Ni52. Short-lived cosmogenic isotopes were measured by P. Weber at La Chaux de Fonds (La Vue-des-Alpes underground laboratory, Switzerland; Gonin et al 2003). Measurement was on a sample of 27.23 g during 6 days in April 2015, 478 days after the fireball. Long- and short-lived cosmogenic radionuclides were measured. The presence and amount of short-lived isotopes support a fall around the time of the witnesses fireball. ^{26}Al 43.6±2.2, ^{22}Na 79.4±4.5; ^{54}Mn 47.1±3.2, all calculated at 9 December 2013; the other short lived isotopes: ^{57}Co <1.5; ^{46}Sc <1.0; ^{56}Co <3.0; ^{58}Co <0.8; ^{51}Cr <6.2; ^{48}V <1.3. The $^{22}Na/^{26}Al$ ratio calculated at the time of the fireball 1.82 (compared to Mreira 2.4 or Tissint 2.3) is compatible with the estimated time

of fall. The activity of the cosmogenic isotopes was calculated according to the method described in Weber et al. (2017), with 3-sigma statistical errors. A 10% additional systematic uncertainty is estimated.
Classification: LL6, brecciated
Specimens: 26 g (21.4+3.9+1.6) provided by Hamza Lharbi and 24.1 g provided by Aaras Jonikas to *FSAC*.

Malotas (b) 28°56'S, 63°14'W
Santiago del Estero, Argentina
Find, doubtful fall: 22 Jun 1931
Classification: HED achondrite (Eucrite)
History: On the morning of 22 June 1931, a meteorite fall was reported in the province of Santiago del Estero, Argentina. Samples were given to Professor Juan Olsacher (Cordoba University) who decided to travel to the place of the fall and collect some pieces. Many of the studied pieces were H5 ordinary chondrites, named Malotas. However, during a visit to the small meteorite collection at *MMG-Cordoba* in 2015, Maria Eugenia Varela discovered two very different looking stones labeled as "Malotas, 1931" in the showcase. Recognizing that one of the stones was not an ordinary chondrite, Varela, in agreement with the director of the museum, made a detailed study of these stones. One of the samples was a piece of the ordinary chondrite, Malotas; the second one turned out to be a eucrite. The director of *MMG-Cordoba* provided Varela with a copy of Prof. Olsacher's paper, entitled: The meteorite of Salavina, 1931, in which he clearly indicates that the fall consisted of two different types of rocks (translated Spanish text, see attached pdf): "This meteorite, which represents a case of 'stone rain' is made up of fragments that correspond to two different types based on their composition and structure: one is chondritic, composed by olivine and pyroxene with abundant metallic minerals; the second one is feldspar-rich with scarce presence of the previous components and with an ophitic texture (1). (1) This feldspar-rich meteorite is mainly composed of anorthite with few olivine and troilite grains. As we do not have enough bibliography concerning feldspar-rich meteorites I have left the description for a complementary publication, to the one presented now in which only the chondrite is studied."
Physical characteristics: Single 62.4 g stone covered by fresh shiny fusion crust.
Petrography: The meteorite is a monomict breccia, mainly composed of pyroxene (pigeonite, often with augite lamellae) and plagioclase with coarse- and fine-grained domains. Accessory phases include: troilite, silica-polymorphs, ilmenite, chromite, F-apatite, merrillite, and zircon. There are only few shock features, with some minerals showing faint undulatory extinction. One of the thin sections (sample belonging to the *NHMV*) show a small melt vein. The state of shock is minimal. The rock is unaltered.
Geochemistry: Mineral composition and geochemistry: (J. Roszjar; *NHMV*) Electron Microprobe examination of two polished mounts show very similar plagioclase and pyroxene composition for the coarse-and fine-grained areas. Low-

Ca pyroxene $Fs_{62.5\pm0.8}Wo_{2.23\pm0.9}$, n= 96; Ca-rich Pyroxenes $Fs_{26.9\pm0.9}Wo_{43.9\pm1}$, n= 96. The composition of the rock-forming plagioclase is $An_{82.1\pm3.4}$, n=110 with minor, secondary anorthitic plagioclase with $An_{95.7\pm2.7}$, n= 50. Spinel composition is chromite ($Chr_{0.74}Her_{0.18}$), n=124. Oxygen Isotopes (R. Tanaka, *OkaU*): A cleaned sample was analyzed by laser fluorination. Replicate analyses are, respectively, $\delta^{17}O$ of 1.785 and 1.775 permil; $\delta^{18}O$ of 3.779 and 3.787 permil; $\Delta^{17}O$ of -0.208 and -0.222 permil.

Classification: Basaltic eucrite, type 4 (based on the chemical composition of spinels and characteristic of pyroxenes that are also diagnostic for this thermal metamorphic classification). Because this meteorite is fresh and the ordinary chondrite Malotas is weathered, this eucrite may actually be the meteorite that fell on June 22, 1931, and the ordinary chondrite may be an unrelated find. This hypothesis remains untested. Henceforth, Malotas (a) will be a synonym for the Malotas H5 chondrite.

Specimens: Type specimen of 20 g in deposit at the *MLP* and three thin sections are on deposit at *ICATE*. One thin section and another sample mount are in deposit at *NHMV*. The main mass is at the *MMG-Cordoba.*

Mangui 22°2’6"N, 100°10’29"E
Yunnan, China
Confirmed fall: 1 June 2018
Classification: Ordinary chondrite (L6)

History: A fireball was witness seen around 9 pm in Xishuangbanna region of Yunnan province on June 1, 2018. A piece of meteorite with black fusion crust broke through a farmer’s silt-roofed house. A number of pieces of the meteorite varying from 1 to 100s of g have been found by several farmers from Manlun, Manyan, Manlang villages from June 2 to 9. The largest mass (for which coordinates are provided) weighs 1.28 kg and was found near the village of Mangui.

Physical characteristics: Most fragments are partially or fully covered with black fusion. Thin black shock-induced melt veins can be seen in the exposed areas of most samples.

Petrography: (S. Hu, Y. Lin and J. Ji, *IGGCAS*; Q. Zhou, *NAOC*; Li Ye, *PMO*) Equilibrated ordinary chondrite texture with poorly defined chondrules and strongly recrystallized matrix. Main minerals are olivine, pyroxene, plagioclase (maskelinized), Fe-Ni metal, and troilite, with minor chromite, chlorapatite and whitlockite. Secondary feldspar grains are 50-100 μm in size. Shock veins and melt pockets are observed.

Geochemistry: Mineral compositions and geochemistry: (S. Hu, Y. Lin and J. Ji, *IGGCAS*; Q. Zhou, *NAOC*) The olivine and pyroxene have homogeneous chemical compositions. Olivine $Fa_{25.0\pm0.6}$ (n=109), orthopyroxene $Fs_{21.1\pm0.3}Wo_{1.6\pm0.3}$ (n=66).

Classification: Ordinary chondrite, L6 S5

Specimens: Type specimens at *PMO* (45 g) and *IGGCAS* (35 g). Main mass with various Chinese meteorite collectors.

Maryborough 37°05’21"S, 143°44’32"E
Victoria, Australia
Find: 2015 May
Classification: Ordinary chondrite (H5)
History: Found 2 km south of Maryborough.
Petrography: (A. Tomkins, *Monash*) Chondrule edges are indistinct, matrix and chondrule mesostases are strongly recrystallised, and plagioclase grains are up to 50 µm across, but mostly less than 20 µm. Discernible chondrule varieties include RP, BO, PO, PP, POP. Olivine has sharp optical extinction, there are irregular fractures and no melt pockets. About 20% of the metal has been destroyed by rusting, whereas most troilite remains.
Geochemistry: (W. Birch, *Vic*) Microprobe analyses: olivine $Fa_{19.3\pm0.5}$ (n=24); Low-Ca pyroxene $Fs_{17.1\pm0.5}Wo_{1.4}$ (n=27).
Classification: Ordinary Chondrite (H5, S1, W1)

Mazichuan 36.693°N, 108.30°E
Shaanxi, China
Confirmed fall: 2016 Sept 16
Classification: HED achondrite (Diogenite)
History: On 16 September 2016, at about 15:00 local time, many residents from several villages heard an airplane-like noise followed by three loud sonic booms. A woman in Mazichuan witnessed dusty smoke rising from a hillside 100 m away from her home. She went to the hillside and picked up a black stone in a hole. She then knocked off a corner of the stone and found greenish crystals inside. The stone was abandoned outside her yard and later picked up by her neighbor. Photos of the stone with black fusion crust and greenish crystals appeared on an amateur meteorite website in November 2016. A Chinese meteorite collector (Wang Ziyao) contacted the holders. He went to the fall site three times (April, June, and September 2017) and did a thorough investigation. Mr. Wang confirmed the fall account. A total of three stones (1302, 1100, and 880 g) were recovered by residents. The largest was bought from a local villager by a meteorite hobbyist (Liu Yukun) on December 1, 2017.
Physical characteristics: The hand specimen is covered with a fresh black fusion crust. Numerous mm-sized greenish crystals can be seen on the exposed section.
Petrography: A monomict breccia mainly consisting of coarse-grained orthopyroxene (a few mm) set in a fine-grained matrix of orthopyroxene. Accessory minerals are chromite, sulfide, FeNi metal and silica. Anorthite was not found.

Geochemistry: Orthopyroxene grains have very homogeneous compositions regardless their grain size. Orthopyroxene ($Fs_{20.9\text{-}22.5}Wo_{1.3\text{-}2.2}$), Fe/Mn (cation ratio) range from 25.2 to 33.6 with an average of 29.8±2.1 (n=32).
Specimens: 36 g at *PMO*, a 1.3 kg mass with Mr. Liu Yukun, and two other masses are in the possession of local finders.

Mount Yirtkuq Bulak 001 (MYB 001) 41°26’20.91"N, 90°42’25.67"E
XinJiang, China
Find: 01 May 2015
Classification: Ordinary chondrite (H~6)
History: (Ziyao Wang) The meteorite was discovered by Xu Jianjiang (Hami/Xinjiang), one of four meteorite hunters, in the Gobi Desert about 100 km N of Lop Nur, near the Paergang pass in Shanshan county, Tulufan city, Xinjiang province on May 1, 2015.
Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Dark-brown stone of 540 g, partly covered with fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) Brown-stained, recrystallized porous matrix with poorly developed chondrules (0.3-2 mm) and few irregular metal specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.30
Classification: Ordinary chondrite (H~6, W3)
Specimens: 22.4 g on deposit at *Kiel*, Xu Jianjiang (Hami/Xinjiang) holds the main mass, 80 g with Wang Ziyao, and 63.4 g with *Bart*.

Mukundpura 26º52’52.5’’N, 75º39’53.7’’E
Rajasthan, India
Fall: June 6, 2017
Classification: Carbonaceous chondrite (CM2)
History: A meteorite weighing approximately 2 kg fell in Mukundpura village at 05:15 hrs on June 6, 2017, on sandy soil in the agricultural field of Mr. Banshi Ram. The impact formed a nearly circular crater of ~40 cm diameter with a depth of 15 cm. Upon impact, the stone shattered into several large pieces and multiple gram and subgram-sized fragments. Mr. Banshi Ram observed a bright red-yellow colored burning fragment fall with a thundering sound about 100 m away from his house. They informed the nearby Bhankrota police station, where the large pieces were deposited. The fall of meteorite in the Mukundpura Village was reported in the media. Dr. Anil D. Shukla and Dr. D. Ray visited the fall site two days after the fall and acquired some fragments from the local villagers, with the help of police.
Physical characteristics: The meteorite is covered in well-developed matte fusion crust with a few broad regmaglypts. The interior of the stone is dark black with an abundance of small white spots. There are various clasts (angular to rounded and up to 4 cm across) embedded in the dark colored matrix.

Petrography: The modal abundances avearged from three thick sections include chondrule (~15%), matrix (~70%), refractory inclusions (~2%), carbonates (~7%), Fe-Ni metal (~2%), and sulfides (~4%). Matrix is dominated by serpentine with lesser tochilinite.
Geochemistry: The Fa content of granular porphyritic olivine chondrule is uniform and highly forsteritic (Fa<1, SD=0.13, n=16). The Fa content of barred olivine chondrule is ferroan and composition ranges Fa_{32-33}(SD=0.06, n=11). The Cr_2O_3 of granular and barred olivine is almost indistinguishable and ranges 0.36 to 0.61 wt%. The Fe/Mn ratios of type IIA chondrule follow the similar trend to the CO chondrites. The bulk chemical composition of Mukundpura chondrite was analysed using XRF and Q-ICPMS. The major oxides of Mukundpura show a very good match with Murchison and Paris CM carbonaceous chondrite. Following XRF data in wt%: SiO_2 29.5, TiO_2 0.13, Al_2O_3 1.3, Fe_2O_3 32.4, MnO 0.22, MgO 17.4, CaO 1.7, Na_2O 0.59, K_2O 0.05, and P_2O_5 0.21.
Classification: CM2 chondrite fall.
Specimens: Type specimen 30.5 g at *PRL*. Main mass ~2000 g with *GSI* (Based on the report on *GSI* web portal).

Mürtschenstock 47°4.285’N, 9°9.023’E
Glarus, Switzerland
Find: 2017 Jul 17
Classification: Ordinary chondrite (L6)
History: A black stone was found by Andreas Stucki on the return from a mountain hike during a chance meeting with another independently hiking person, Iris Landolt, who witnessed the discovery.
Physical characteristics: Single stone with dimensions 10.1 × 5.7 × 5.0 cm. The stone is nearly completely covered by black matte fusion crust. Small areas of approx. 1 cm square show exposed interior material, which is of yellowish brown color. The volume based on a shape model is 108.38 cm^3, yielding a bulk density of 3.27 g/cm^3.
Petrography: (B. Hofmann, E. Gnos): The rock shows a strongly recrystallized texture with poorly delineated large chondrules well recognizable. Typical size of plagioclase grains is 50-150 μm. Chromites are up to 0.6 mm in size, ilmenite is common, up to 0.1 mm. Shock stage is S4 based on partially mosaicized olivine and partially maskelynitized plagioclase. Some shock veins are present and show metal-troilite globules in silicate matrix. Weathering is low (W1), thickness of (hydr)oxide rims on metal ranges from a few μm to 100 μm.
Geochemistry: Electron microprobe analysis (E. Reusser, *ETH*) yielded: Olivine $Fa_{24.4\pm0.4}$ ($Fa_{24.0\text{-}26.7}$; n=48); low-Ca pyroxene $Fs_{20.6\pm0.4}Wo_{1.5\pm0.3}$ ($Fs_{20.2\text{-}22.2}Wo_{0.9\text{-}2.1}$; n=52); high-Ca pyroxene $Fs_{7.2\pm0.8}Wo_{45.8\pm1.0}$ ($Fs_{6.5\text{-}8.4}Wo_{44.3\text{-}46.8}$, N=9). Cosmogenic radionuclides: (Å. Rosén, *Bern*/GeMSE): Gamma-spectroscopy performed in August-September 2017 showed no detectable short-lived radionuclides (^{22}Na <0.5 dpm/kg), the ^{26}Al activity was 52.2(+4.6,-4.8) dpm/kg. The fall must have occurred before the year 2000.

Classification: All available data are consistent with a classification as L ordinary chondrite, petrographic grade 6, shock stage S4, low weathering (W1).
Specimens: 70 g and one polished thin section at *ETH*.

Nagara 35°26’33.9"N, 136°46’51.5"E
Chubu, Japan
Find: 2012 Oct
Classification: Iron meteorite (IAB-MG)
History: A 6.5 kg piece of iron was discovered by Mr. K. Mitsumura in October, 2012, among stones plowed from his chestnut yard in Nagara, Gifu city, Gifu prefecture, Japan. Mr. Mitsumura took the specimen to his home and kept it till June, 2017. Eventually, he considered that it might be a meteorite and the specimen was brought by his friend Mr. H. Iwasa to S. Kawakami at Gifu Shotoku Gakuen Univ. Then, the specimen was sent to T. Mikouchi, *UTok* for identification. A second 9.7 kg mass was found later.
Physical characteristics: The 6.5 kg mass has an exterior with several rounded ridges and shows a brownish dark surface color coated by rust.
Petrography: Polished sections (all ca. 12 × 6 mm in sizes) show no Widmanstatten pattern and >95% of the sections consist of kamacite with veins of terrestrial weathering products (up to 0.5 mm wide). Rare schreibersite is present at the interior of such weathered veins. Taenite is present as small elongated grains (~0.1 mm wide and ~0.5 mm long) with less than 0.1% abundance.
Geochemistry: Electron microprobe analysis (T. Mikouchi, *UTok*): Fe=92.0-94.5, Ni=5.5-6.5 and Co=0.55-0.65 for kamacite (N=549), Fe=45-54, Ni=30-38 and P=15 for schreibersite (N=26), and Fe=61-65, Ni=34-39 and Co=0.1-0.2 for taenite (N=9). LA-ICP-MS data (A. Yamaguchi, *NIPR* and N. Shirai at Tokyo Met. U.): Ni=6.10, (in wt%); Ir=4.25, Ga=91.6, Ge=402, Au=1.58 (all μg/g, average of ~5 mm long 4 traverses on the section).
Classification: IAB-MG
Specimens: *UTok*: 52.7 g slice (after cutting of small chips for polished mounts) and *NIPR*: 3 polished mounts

Nanbaxian 001 37°59’2.07"N, 94°18’6.72"E
Qinghai, China
Find: 07 June 2016
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) On June 7, 2016, the farmer Xu Zhong (Huzhu/Qinghai) and his colleges discovered a strange rock while they were on a desert walk about 0.5 km WNW of Nanbaxian village, Dachaidan Town, Qinghai province. Wang Ziyao purchased the complete stone in 2018.
Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Reddish-brown, heavily fractured, irregular rock of 3784 g without fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) Brown-stained, microcrystalline matrix with well developed chondrules (0.2-2 mm) and few metallic specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.83
Classification: Ordinary chondrite (L~4, W3)
Specimens: 22.2 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 103.5 g with *Bart*.

Ngare Sero 2°37.845'S, 35°53.353'E
Arusha, Tanzania
Find: 9 Sept 2017
Classification: Ordinary chondrite (L5)
History: Meteorite (2233 g) was found 9 Sept 2017 by Kirill Vlasov and Artyom Akshintsev while returning to the field camp from Ngare Sero village. The date of fall is unknown.
Physical characteristics: Total mass is 2233 g. Meteorite has roughly rounded shape. The surface and interior is light with dark brown crust up to 2 mm due to desert weathering. Cracks (up to 0.1 mm in thickness) occur in external part of meteorite.
Petrography: Classified by P. Yu. Plechov, *FMMR*. Petrographic observation of a polished section shows clearly delineated chondrules in a coarse recrystallized matrix. Chondrules are relatively rare and their sizes vary from 500 to 1200 μm. They have quenched or porphyritic texture, rarely cryptocrystalline, and consist of Ol+Pl, Opx+Pl, Ol+Opx+Cpx+Pl or Opx+Cpx+Pl. Olivine, low-Ca-pyroxene and plagioclase are main minerals in matrix. Plagioclase grains are larger than 50 μm. This indicates a petrological type of 5 for the meteorite. Olivine has no undulatory extinction, as well as the absence of opaque shock veins and melt pockets indicates a shock stage of S1. Fresh FeNi metals and troilite (up to 200 μm) occurs in recrystallized matrix. Some taenite-kamacite aggregates have thin rims of Fe-hydroxide. Kamacite-taenite-troilite aggregates (up to 20 μm) are observed in some cryptocrystalline chondrules. Weathering products (goethite, "hydrogoethite") occur as veins and in situ alteration of FeNi-metals and troilite near meteorite surface. Olivine, pyroxene, chromite and troilite are fresh and not weathered (weathering grade – W1). Clinopyroxene, chromite, chlorapatite and merrillite (up to 200 μm) occur locally in the matrix.
Geochemistry: EDS-WDS analyses (P. Yu. Plechov, *FMMR*). The primary chondrite paragenesis includes olivine $Fa_{25.24\pm0.6}$ (N=28), orthopyroxene $Fs_{22.8\pm0.53}Wo_{1.66\pm0.35}$ (N=19), plagioclase $Ab_{80.2}An_{10.6}Or_{6.3}$ (N=11), Cr-bearing clinopyroxene $En_{47.8}Fs_{8.1}Wo_{43.9}$ (N=6), chromite $Crt_{76.6\pm4.5}Spl_{10.5\pm1.3}$ (N=14), chlorapatite and merrillite. Chlorapatite contains Cl – 5.26 wt.% (N=5). Merrillite has wide range in FeO content (0.54-2.92 wt.%, N=13). Composition of kamacite (in wt.%, N=8): Fe 92.3±0.67, Ni – 6.3±0.7, Co – 1.45±0.17. Troilite is close to ideal FeS. Rare goethite contains 4.2-6.8 wt.% NiO and up to 1.12 wt.% CoO.
Classification: Ordinary chondrite. L5, S1, W1

Specimens: 2127 g – Kirill Vlasov; 106 g cut-offs and thin section – *FMMR*.

Northwest Africa 431 (NWA 431)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (H6)
Petrography: Chondrules are recrystallized and poorly defined. Olivine exhibits undulose extinction, but lacks planar fractures. Plagioclase grains are ~50 µm across. There are chromite-plagioclase assemblages and small chromite veinlets present.

Northwest Africa 432 (NWA 432)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (H3)
Petrography: Chondrules are sharply defined, but none contain isotropic mesostases. Low-Ca pyroxene phenocrysts exhibit prominent polysynthetic twinning. Olivine grains have sharp optical extinction.
Classification: H3 (estimated subtype 3.7/3.8).

Northwest Africa 435 (NWA 435)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (H4)
Petrography: Chondrules are wel defined. Olivine exhibits sharp optical extinction. Chondrules range in diamter from 0.25 to 2.7 mm.

Northwest Africa 436 (NWA 436)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (L6)
Petrography: Chondrules are recrystallized and poorly defined. Olivine exhibits undulose extinction; some grains contain planar fractures. Plagioclase grains range up to ~120 µm across. Weathering veins traverse the sample.

Northwest Africa 438 (NWA 438)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (LL5)
Petrography: Chondrules are recrystallized, but readily discernable. Olivine exhibits undulose extinction, but lacks planar fractures. Chondrules range up to 1.6

mm in diameter. Many metal and troiltie grains are 200-800 µm across. Some troilite grains are polycrystalline.

Northwest Africa 451 (NWA 451)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (H5)
Petrography: Numerous weathering veins transect the meteorite. A few patches of clay are present. More than 99% of the metal and troilite grains have been weathered to form oxide. Olivine exhbits undulose extinction. Chondrules are well defined.

Northwest Africa 452 (NWA 452)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (H4)
Petrography: A few metal grains contain some small, irregular grains of troilite. Chondrules are well defined. Olivine exhbits sharp optical extinction. A few chondrules are surrounded by thin rings of troilite. About 75% of the metal grains have been weathered to form oxides.

Northwest Africa 453 (NWA 453)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (H4)
Petrography: More than 99% of the metal and troilite grains have been weathered to form oxide. Some clay is present. Numerous weathering veins transect the meteorite. Chondrules are well defined. Olivine exhibits undulose extinction. Some low-Ca pyroxene phenocrysts exhibit polysynthetic twinning.

Northwest Africa 454 (NWA 454)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (L6)
Petrography: Some metal grains are elongated. A few chondrules are surrounded by troilite-rich rims. Some metal grains contain small, irregular grains of troilite. The troilite is polycrystalline. Chondrules are recrystallized and poorly defined. Some plagiolcase grains are 50-80 µm in size. Some olivine grains exhibit weak mosaic extinction.

Northwest Africa 660 (NWA 660)

(Northwest Africa)
Purchased: 2001
Classification: Ordinary chondrite (H4)
Petrography: The sample contains elongated metal grains; some metal grains contain small, irregular grains of troilite. Some kamacite and troilite grains are polycrytalline. Chondrules are well defined. Olivine exhibits weak mosaic extinction.

Northwest Africa 669 (NWA 669)
(Northwest Africa)
Purchased: 2001
Classification: Ordinary chondrite (L6)
Petrography: Chondrules are recrystallized and poorly defined. A few plagioclase grains reach 100 μm in diameter. Olivine has undulose extinction. Silicate-rich shock veins (~50 μm × 6 mm) including small metal blebs cut across the meteorite. Also present are small metal and sulfide veins. Some coarse metal grains are elongated. The sample was probably shocked and annealed.

Northwest Africa 671 (NWA 671)
(Northwest Africa)
Purchased: 2001
Classification: Ordinary chondrite (L6)
Petrography: Olivine exhibits weak-to-moderate mosaic extinction. Chondrules are recrystallized and poorly defined. Plagioclase grains range up to 120 μm in size. Maskelynite is absent. Metal grains are coarse, averaging ~400 μm. Some metal grains contain a few small, irregular grains of troilite.

Northwest Africa 674 (NWA 674)
(Northwest Africa)
Purchased: 2001
Classification: Ordinary chondrite (L5)
Petrography: Chondrules are moderately recrystallized, but readily delineated. Olivine exhibits undulose extinction, but lacks planar fractures. About 95% of the metal grains have been oxidized.

Northwest Africa 787 (NWA 787)
(Northwest Africa)
Purchased: 2001 Mar
Classification: Ordinary chondrite (L3-6)
History: Purchased by Michael Farmer in March 2001 from a dealer in Casablanca, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*; A. Rubin, *UCLA*) Breccia composed predominantly of type-6 chondrite clasts exhibiting some remnant chondrules in a recrystallized matrix containing stained metal and merrillite. Sparse, isolated enstatite-rich chondrules are present in this breccia, but no forsterite-rich chondrules were observed in the studied thin section.
Geochemistry: Olivine ($Fa_{24.3-27.3}$, N = 3), orthopyroxene ($Fs_{20.4}Wo_{1.1}$, N=2), enstatite in one unequilibrated chondrule ($Fs_{2.1}Wo_{0.7}$), clinopyroxene ($Fs_{1.4}Wo_{40.3}$).
Classification: Ordinary chondrite (L3-6, brecciated). Contains a few isolated enstatite-rich chondrules.
Specimens: 90 g including one polished thin section at *UCLA*; 5.89 g at *PSF*; remainder with Farmer.

Northwest Africa 1088 (NWA 1088)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (H6)
Petrography: Numerous weathering veins cut across the sample. Some chondrules are readily discernable; others are poorly defined. Some plagioclase grains are between 50 and 80 μm across. Olivine exhibits undulose extinction. Some troilite grains are elongated.

Northwest Africa 1089 (NWA 1089)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (H5)
Petrography: There are rapidly cooled, cellular, metal-troilite assemblages. Some metal and sulfide grains are elongated. Chondrules are recrystallized; some are readily discernable; others are poorly defined. Plagioclase grains average ~20 μm in size. Olivine exhibits weak mosaic extinction. Some low-Ca pyroxene grains display shock-induced polysynthetic twinning.

Northwest Africa 1091 (NWA 1091)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (L4)
Petrography: Several chondrules are partly surrounded by troilite-rich rims. Some metal grains contain small, irregular grains of troilite. Troilite is polycrystalline. Some metal and sulfide grains are elongated. Most chondrules are well defined, but some appear recrystallized. Some olivine grains contain planar fractures; a few olivine and low-ca pyroxene grains exhibit weak mosaic extinction.

Northwest Africa 1095 (NWA 1095)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (L5)
Petrography: Some metal grains are elongated and form parts of discontinuous veins. Small grains of metallic Cu are present within some metal grains. Some metal grains contain small, irregular grains of troilite. Chondrules are recrystallized, but readily discernable. Plagioclase grains average ~20 μm in size. Olivine exhibits weak mosaic extinction. Some low-Ca pyroxene grains exhibit shock-induced polysynthetic twinning.

Northwest Africa 1096 (NWA 1096)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (LL3)
Petrography: Many chondrules are surrounded by thin rims of troilite±metal. A few metal grains contain small, irregular troilite grains. Thin metal and sulfide veins also occur. Thin weathering veins are also present. Chondrules are very sharply defined. Some chondrules contain patches of brown isotropic mesostases. Olivine exhbits weak mosaic ectinction. Some low-Ca pyroxene phenocrysts exhibit polysynthetic twinning.
Classification: LL3 (estimated subtype 3.5).

Northwest Africa 1099 (NWA 1099)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (L4)
Petrography: Metal and sulfide grains are elongated; some metal grains contain small irregular grains of troiite. Chondrules are well defined. A few low-Ca pyroxene grains exhibit polysynthetic twinning. No glassy mesostases occur. Olivine grains exhibit weak mosaic extinction.

Northwest Africa 1108 (NWA 1108)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (L6)
Petrography: Some metal and sulfide grains are elongated. Metal and sulfide veins are present. Chondrules are poorly defined and very recrystallized. Some plagioclase grains are 50 μm in size. A few olivine grains contain planar fractures.

Northwest Africa 1292 (NWA 1292)

(Northwest Africa)
Purchased: Aug 2001
Classification: Carbonaceous chondrite (CO3)

History: Purchased by G. and A. Hupe in August 2001 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed, well-formed small chondrules (apparent diameter 190±100 μm) together with mineral fragments and fine grained CAI are set in a sparse matrix (~15 vol.%) containing stained kamacite and minor pleonaste.

Geochemistry: Olivine ($Fa_{0.5\text{-}39.9}$, Cr_2O_3 in ferroan examples 0.06-0.76 wt.%, mean 0.19±0.28 wt.%, N = 7), orthopyroxene ($Fs_{1.4}Wo_{2.9}$), pigeonite ($Fs_{6.5}Wo_{5.7}$), clinopyroxene ($Fs_{0.5\text{-}9.4}Wo_{49.3\text{-}49.0}$, N = 2).

Classification: Carbonaceous chondrite (CO3).

Specimens: 21.7 g including one polished thin section at *PSF*; 11.3 g at *UCLA*; remainder with *GHupé*.

Northwest Africa 1723 (NWA 1723)
Morocco
Find: unknown
Classification: Ordinary chondrite (L3)

Petrography: Olivine $Fa_{22.9}$, range $Fa_{10\text{-}24}$, PMD 6% (n=17) with average 0.05 wt% CaO. Low-Ca pyroxene $Fs_{19.4}$, range $Fs_{13\text{-}20}$, PMD 15% (n=15). Plagioclase $Ab_{95}Or_2$ (n=10). Metal includes kamacite, taenite and possible tetrataenite. Troilite and chromite are abundant. Contains a 2-cm sized dark inclusion.

Northwest Africa 2424 (NWA 2424)
(Northwest Africa)
Purchased: 2016
Classification: Martian meteorite (Shergottite)

Physical characteristics: Fresh, unstained, 20% covered by dull, smooth fusion crust, remaining surfaces polished by ventifaction. Cut appearance: uniform gray, fine-grained.

Petrography: (P. Warren, *UCLA*) The rock consists of about 20% olivine phenocrysts, up to 1 mm (2 mm as glomerocrysts), in a much finer-grained pyroxene-dominated groundmass. The minor feldspathic phase is entirely maskelynite.

Geochemistry: Mineral compositions and geochemistry: Olivines are zoned from $Fa_{21.5}$ to $Fa_{50.}$ Groundmass pyroxene compositions fan out from $Fs_{26}Wo_{3.7}$ toward $Fs_{25}Wo_{28}$ and $Fs_{44}Wo_{11.}$ Pyroxenes in melt inclusions within olivine are systematically more magnesian, e.g., $Fs_{21}Wo_{28.}$ Pyroxene FeO/MnO (wt.) averages 30.0±2.4. Maskelynite (N=31) is $An_{44\text{-}54}$, average $An_{51.5.}$ Bulk composition results from INAA and fused-bead EPMA include Ga = 14.4 ppm, Al_2O_3 = 5.1 wt%; this Ga/Al ratio confirms shergottite affinity.

Classification: Shergottite.

Northwest Africa 2425 (NWA 2425)
(Northwest Africa)
Purchased: 2016
Classification: Lunar meteorite (feldspathic breccia)
Physical characteristics: Weathered, red caliche stain, dull, no fusion crust, etched by ventifaction. Cut appearance: near-black matrix with gray clasts.
Petrography: (P. Warren, *UCLA*) The rock is a thoroughly polymict lunar highland breccia, mostly plagioclase, with clasts up to 10 mm but dominated by extremely fine-grained chaotic impact debris. A search for regolithic glass spheroids found only one, 0.2 mm, very round and undevitrified.
Geochemistry: Mineral compositions and geochemistry: Plagioclase: $An_{95.9+}$/-1.3 (N=19). Low-Ca pyroxene: $Fs_{33\pm8}Wo_{4.3\pm0.9}$ (N=11), high-Ca pyroxene: $Fs_{17\pm4}Wo_{40\pm2}$ (N=7). Pyroxene FeO/MnO (wt.) averages 55±8 (N=24). Bulk composition results from INAA and fused-bead EPMA include Al_2O_3 = 27.1 wt%, Mg# = 73 mol%, Th = 0.13 ppm. The glass spheroid is similarly anorthositic (26 wt% Al_2O_3).
Classification: The meteorite is a lunar highland polymict breccia.

Northwest Africa 2426 (NWA 2426)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, cumulate)
Physical characteristics: Weathered, red caliche stain, 80% covered by glossy fusion crust showing flow lines and scales. Cut appearance: mottled gray matrix with both lighter and darker gray clasts; one large (~12 mm) clast with white feldspar and deep brown mafic silicates.
Petrography: (P. Warren, *UCLA*) The rock is dominated by pyroxene and plagioclase. Its texture is for the most part severely brecciated and fine-grained, but scattered clasts preserve vestiges of a medium-grained (1-3 mm) equigranular igneous texture.
Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene: Fs_{37+}/-3,$Wo_{3.5+}$/-0.9 (N=35), high-Ca pyroxene: $Fs_{15.5\pm2}Wo_{43\pm1}$ (N=10). Pyroxene FeO/MnO (wt.) averages 28±3. Plagioclase: $An_{92.5\pm0.8}$ (N=11). Scattered tiny metals have Ni at margin of EPMA detectability: very approximately 0.04 wt%, along with 0.23±0.16 wt% Co (N=10). Bulk composition results from INAA and fused-bead EPMA include Al_2O_3 = 12.5 wt%, Mg# = 62 mol%, Sm = 0.6 ppm. Despite obscuration of texture by brecciation, high Mg# and low REE indicate cumulate origin.
Classification: Brecciated cumulate eucrite.
Specimens: manifestly paired stones of 254, 232 and 144 g.

Northwest Africa 2637 (NWA 2637)
(Northwest Africa)
Purchased: 2004
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Adam *Hupé* in 2004 from a dealer in Erfoud, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Granular chondrules (apparent diameter 710 ± 510 µm, N = 18) plus sparse, amoeboid very fine grained CAI are set in a fine grained matrix (orange-brown in thin section). Andradite garnet was observed in one CAI.
Geochemistry: Olivine ($Fa_{0.6\text{-}57.3}$, N = 3), orthopyroxene ($Fs_{0.7\text{-}51.2}Wo_{0.5\text{-}2.5}$, N = 2), clinopyroxene ($Fs_{0.8}Wo_{39.0}$).
Classification: Carbonaceous chondrite (CV3).
Specimens: 14.4 g including one polished thin section at *PSF*; remainder with *AHupé*.

Northwest Africa 2650 (NWA 2650)
Morocco
Find: 2004
Classification: HED achondrite (Eucrite, monomict)
History: A 2224 g complete stone that measures 189 mm × 112 mm × 82 mm at the widest points, with fresh crust was purchased in Erfoud, Morocco
Petrography: The meteorite has a texture of brecciated meteorite, with coarse-grained gabbro eucrite fragments and coarse-grained mineral fragments embedded in relatively fine-grained matrix composed of pyroxene and plagioclase fragments. Both shock-induced melt veins and pockets are observed. Mineralogically, this meteorite consists mainly of coarse-grained plagioclase (up to 7 mm) and pyroxenes (up to 5 mm). Other minerals include silica phase, chromite, ilmenite, troilite, and zircon. Almost all of the pyroxene grains exhibit exsolution lamella. Extensive albite, Carlsbad, and complex igneous twinning occur in plagioclase.
Geochemistry: The coarse-grained minerals in the coarse-grained gabbro eucrite fragments have compositions almost identical to those in the relatively fine-grained matrix. Orthopyroxene host ($En_{37.2\pm0.7}Fs_{60.1\pm1.5}Wo_{2.7\pm1.3}$, Fe/Mn=29.9±0.7 n=14), augite exsolution lamella ($En_{29.7\pm0.4}Fs_{26.4\pm0.5}Wo_{43.9\pm0.5}$, Fe/Mn=29.8±1.8, n=14), plagioclase ($An_{90.5\pm1.5}Ab_{9.2\pm1.4}$, n=17), and chromite (Cr/(Cr+Al)=0.79±0.01, n=8).

Northwest Africa 2730 (NWA 2730)
(Northwest Africa)
Purchased: 2004
Classification: Ordinary chondrite (L6)
History: A stone of several hundred grams was purchased by Mike Farmer and Jim *Strope* in 2004 from a dealer in Erfoud, Morocco, and a 24.5 g specimen was

submitted to Dr. Ted Bunch for classification. The whereabouts and exact weight of the original main mass are unknown, but the 24.5 g specimen was acquired by the Planetary Studies Foundation and subsequently classified at the University of Washington.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules. Accessory merrillite and chlorapatite are present.
Geochemistry: Olivine ($Fa_{24.8\text{-}24.9}$, N = 3), orthopyroxene ($Fs_{20.6\text{-}20.9}Wo_{1.5\text{-}1.4}$, N = 2), clinopyroxene ($Fs_{8.3\text{-}8.5}Wo_{45.1\text{-}44.3}$, N = 2).
Classification: Ordinary chondrite (L6).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 2887 (NWA 2887)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite)
Physical characteristics: Weathered, slight red caliche stain, 90% covered by dull black fusion crust.
Petrography: (P. Warren, *UCLA*) The rock is dominated by pyroxene and plagioclase. Its texture is unbrecciated and for the most part fine-grained, but uncommonly heterogeneous: locally coarse (laths up to 4 mm), and elsewhere locally equigranular with 120-degree triple junctions.
Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene: $Fs_{57.5\pm0.3}Wo_{6.3\pm0.2}$ (N=7), high-Ca pyroxene: $Fs_{28.8\pm0.1}Wo_{41.5\pm0.2}$ (N=3). Plagioclase: 5 analyses, range $An_{89.4\text{-}92.0.}$ For trace metal component, a single analysis found 0.34 wt% Co, 0.04 wt% Ni. Bulk composition results from INAA and fused-bead EPMA include Al_2O_3 = 12.5 wt%, Mg# = 40 mol%, Sm = 1.9 ppm.
Classification: The meteorite is a eucrite.
Specimens: manifestly paired stones of 570, 275 and 42 g.

Northwest Africa 4669 (NWA 4669)
(Northwest Africa)
Purchased: 2006
Classification: Carbonaceous chondrite (CV3)
History: In 2006, A. *Pani* purchased a single stone of 369 g in Erfoud, Morocco.
Physical characteristics: The stone is a compact rock with a wind-polished surface of grayish-black color. Fusion crust is not present.
Petrography: (F. Brandstätter, *NHMV*) The meteorite consists mainly of abundant chondrules (mean diameter 1.05 mm), minor AOAs and CAIs set in a fine-grained matrix. CAIs (fine-grained) are sparse and on average small (<2-3 mm). The matrix is dominated by Fe-rich olivine, magnetite, minor pentlandite, and very rare metal grains.

Geochemistry: Chondrule olivine ($Fa_{0.2\text{-}31.3}$, mean $Fa_{6.7}$, N=68), matrix olivine ($Fa_{8.9\text{-}63.8}$, mean $Fa_{47.3}$, mean NiO = 0.09 wt%, N = 26), magnetite (Al_2O_3 = 1.18 wt%, Cr_2O_3 = 0.31 wt%, TiO_2 = 0.15 wt%, NiO = 0.05 wt%, N = 10)
Classification: Carbonaceous chondrite (CV3)
Specimens: 21.7 g is on deposit at *NHMV*. *Pani* holds the main mass.

Northwest Africa 4838 (NWA 4838)
(Northwest Africa)
Purchased: 2006
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Marcin Cimala in 2006 from a dealer in Erfoud, Morocco, and subsequently acquired by *ROM*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Granular chondrules (apparent diameter 500±300 μm, N = 15) and fine-grained CAI are set in a very fine-grained matrix (~40 vol.%, black in thin section).
Geochemistry: Olivine ($Fa_{0.1\text{-}37.9}$, N = 3), orthopyroxene ($Fs_{0.4\text{-}0.5}Wo_{1.0\text{-}0.9}$, N = 3), clinopyroxene ($Fs_{1.0}Wo_{28.0}$), Al-Ti-diopside ($Fs_{0.8}Wo_{59.0}$, Al_2O_3 = 19.9 wt.%, TiO_2 = 2.0 wt.%).
Classification: Carbonaceous chondrite (CV3).
Specimens: All material from this stone including one polished thin section is at *ROM*.

Northwest Africa 5693 (NWA 5693)
(Northwest Africa)
Purchased: 2007
Classification: Pallasite
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Brownish, strongly altered individual lacking any fusion crust.
Petrography: The meteorite is composed of large up to 1 cm sized olivine crystals set into a matrix of iron oxides or hydroxides. Olivine is often crosscut by veins filled with brownish/reddish alteration products. No primary Fe-Ni metal was detected
Geochemistry: Olivine: $Fa_{13.1\pm0.1}$ ($Fa_{12.9\text{-}13.4}$, FeO/MnO=32-46, n=19)
Classification: Pallasite

Northwest Africa 5908 (NWA 5908)
(Northwest Africa)
Purchased: 2007
Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was purchased from a Moroccan meteorite dealer on the mineral fair in Munich, Germany.
Physical characteristics: Small dark-grayish individual partly covered with fusion crust.
Petrography: The meteorite is a fragmental breccia composed of basaltic clasts and up to 1 cm sized black impact melt clasts set into a fine-grained clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and plagioclase grains about 20 to 300 µm in size. Few matrix pyroxenes display magmatic zoning. Minor phases include chromite, ilmenite, pyrrhotite, silica and metallic iron.
Geochemistry: low-Ca pyroxene: $Fs_{42.1\pm3.6}Wo_{2.1\pm0.3}$ ($Fs_{34.7-45.8}Wo_{1.8-3.0}$, n=12, FeO/MnO=36-42); Ca-pyroxene: $Fs_{27.1\pm1.0}Wo_{40.8\pm1.3}$ ($Fs_{26.1-29.0}Wo_{37.9-42.1}$, n=12, FeO/MnO=31-36); calcic plagioclase: $An_{87.6\pm1.8}$ ($An_{84.1-90.0}$, n=14)

Northwest Africa 6023 (NWA 6023)
(Northwest Africa)
Purchased: 2009
Classification: Brachinite-an
History: The meteorite was bought from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish rock with patches of fusion crust.
Petrography: A polished surface of the meteorite shows sub-mm sized shiny crystals. It displays an equilibrium texture of 200-300 µm sized olivine (about 90 vol.%), some Ca-pyroxene and chromite typically showing triple junctions between adjoining crystals. Nearly all olivine crystals are surrounded by fine-grained intergrowths of low-Ca pyroxene and metallic Fe. Strikingly, olivine shows pronounced reduced rims and the meteorite contains flaky graphite. No plagioclase has been detected.
Geochemistry: olivine: $Fa_{32.3\pm0.7}$ ($Fa_{30.4-32.9}$, n=14, CaO=0.11±0.02, Cr_2O_3=0.03±0.01, FeO/MnO=70±5); reduced rims in olivine: $Fa_{12.6-16.2}$; Ca-pyroxene: $Fs_{11.4\pm0.2}Wo_{43.3\pm0.3}$ ($Fs_{11.1-11.8}Wo_{42.6-43.8}$, n=13, FeO/MnO=35±3); Oxygen isotopes (K. Ziegler, *UNM*): material analyzed by laser fluorination gave: $\delta^{18}O$=5.162, 5.226, 4.838, 5.110; $\delta^{17}O$=2.445, 2.491, 2.269, 2.402; $\Delta^{17}O$= -0.281, -0.268, -0.285, -0.296 (all per mil)
Classification: Brachinite-anomalous. Mineral chemistry, high abundance of olivine, equilibrium texture and oxygen isotopes are consistent with classification as brachinite, but reduced rims and high graphite-content are typical of ureilites.

Northwest Africa 6263 (NWA 6263)
(Northwest Africa)
Purchased: 2010
Classification: Ordinary chondrite (L3)
History: Purchased by Carsten Giessler in 2010 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, fairly closely packed chondrules (apparent diameter 680±350 μm, N = 12) are set in a finer matrix (dark brown in thin section).
Geochemistry: Olivine ($Fa_{4.7\text{-}26.5}$, Cr_2O_3 in ferroan examples 0.03-0.06 wt.%, mean 0.05±0.01 wt.%, N = 5), orthopyroxene ($Fs_{9.2\text{-}12.9}Wo_{0.9\text{-}1.1}$, N = 2), subcalcic augite ($Fs_{9.0}Wo_{32.5}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.46.
Classification: Ordinary chondrite (L3).
Specimens: 23 g including one polished thin section at *UWB*; remainder with Mr. C. Giessler.

Northwest Africa 6308 (NWA 6308)
(Northwest Africa)
Purchased: 2009
Classification: Primitive achondrite (Brachinite)
History: The meteorite was bought from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark-brownish rock without fusion crust.
Petrography: A sawn surface of the meteorite shows up to 1 mm sized shiny crystals. It displays an equilibrium texture of equally sized olivine (about 80 vol.%) and orthopyroxene with abundant triple junctions between adjoining crystals. Along the grain boundaries symplectic exsolutions of orthopyroxene and Fe-sulfides are frequently observed. Minor phases are chromite and some phosphates.
Geochemistry: olivine: $Fa_{28.5\pm0.4}$ ($Fa_{27.8\text{-}29.2}$, n=20, FeO/MnO=63±4); low-Ca pyroxene: $Fs_{25.4\pm0.1}Wo_{2.2\pm0.1}$ ($Fs_{25.1\text{-}25.6}Wo_{2.0\text{-}2.3}$, n=20, FeO/MnO=44±3)
Classification: Mineral chemistry, high abundance of olivine, equilibrium texture and grain size are consistent with classification as brachinite.

Northwest Africa 6827 (NWA 6827)
(Northwest Africa)
Purchased: 2008
Classification: Carbonaceous chondrite (CO3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Twenty five brownish fragments lacking any fusion crust.
Petrography: The meteorite shows a dark brownish interior and is composed of abundant small chondrules, CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are dominantly porphyritic type I and have an apparent mean diameter of about 0.2 mm. Some sulfides and FeNi metal are present in matrix and chondrules.

Northwest Africa 7055 (NWA 7055)

(Northwest Africa)
Purchased: 2007 Jan
Classification: Carbonaceous chondrite (CK4/5)

History: Purchased by Dr. David *Gregory* in January 2007 from a dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen consisting of separated chondrules (apparent diameter 0.2-2.0 mm) containing Cr-magnetite set within a relatively coarse grained matrix. The texture is transitional between type 4 and type 5.

Geochemistry: Olivine ($Fa_{30.9-31.1}$, N = 2), orthopyroxene ($Fs_{25.4-26.3}Wo_{0.5-0.9}$, N = 3), clinopyroxene ($Fs_{9.4-11.2}Wo_{46.5-42.6}$, N = 2), one exotic ferroan olivine grain ($Fa_{62.7}$).

Classification: Carbonaceous chondrite (CK4/5).

Specimens: The entire specimen plus a polished thin section and polished thick section at *ROM*.

Northwest Africa 8406 (NWA 8406)
(Northwest Africa)
Purchased: 2013 Feb
Classification: Carbonaceous chondrite (CV3)

History: Purchased by Marc Jost in February 2013 from a dealer in Rissani, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Medium sized, granular chondrules together with some amoeboid, fine to medium grained CAIs in a brown matrix.

Geochemistry: Olivine ($Fa_{0.4-16.8}$; Cr_2O_3 in ferroan olivine = 0.06-0.28 wt.%, mean 0.05±0.02 wt.%, N = 7), orthopyroxene ($Fs_{0.8-13.8}Wo_{0.9-3.5}$, N = 3), diopside ($Fs_{0.8-0.9}Wo_{47.3-46.0}$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 24 g including one polished thin section at *UWB*. The remaining material is held by *SJS*.

Northwest Africa 8671 (NWA 8671)
(Northwest Africa)
Purchased: 2014 May
Classification: HED achondrite (Eucrite)

History: Purchased in Morocco by Ali and Mohammed *Hmani* in May 2014 and said to have been found near Foum El Hisn, Morocco.

Physical characteristics: Single stone (164.2 g) lacking fusion crust. The fresh interior is relatively coarse grained and composed of subequal amounts of dark gray pyroxene and beige plagioclase.

Petrography: (A. Irving and S. Kuehner, *UWS*) This is a very unusual specimen consisting of dispersed, angular domains of coarse, polygranular, birefringent,

calcic plagioclase separated by regions of recystallized clinopyroxene. The plagioclase domains have irregular geometric shapes with re-entrant angles, and exhibit marginal reaction zones against clinopyroxene composed of ferropigeonite plus fayalitic olivine. The main regions of clinopyroxene contain numerous irregularly distributed, small patches with two distinctly different compositions: one low in Ca and the other higher in Ca. No high-Ca augite was found. Accessory minerals are silica polymorph, Al-bearing chromite and troilite.
Geochemistry: Low-Ca pyroxene ($Fs_{47.9-49.1}Wo_{5.5-4.4}$, FeO/MnO = 28-29, N = 3), pigeonite ($Fs_{36.3-34.7}Wo_{10.8-7.6}$, FeO/MnO = 26-28, N = 3), ferropigeonite rims ($Fs_{52.5-55.5}Wo_{21.6-16.5}$, FeO/MnO = 30, N = 2), fayalite ($Fa_{82.2-82.9}$, FeO/MnO = 39), plagioclase ($An_{91.4-93.0}Or_{0.1}$, N = 2). Oxygen isotopes (K. Ziegler, *UNM*): acid-washed subsamples analyzed by laser fluorination gave $\delta^{17}O$ = 1.736, 1.642, 1.694; $\delta^{18}O$ = 3.847, 3.688, 3.776; $\Delta^{17}O$ = -0.295, -0.305, -0.300 per mil
Classification: Eucrite (unbrecciated, partially melted). The overall texture and reaction zones on plagioclase aggregates are unique among eucrites, and indicate that this specimen underwent a partial melting event subsequent to its igneous crystallization.
Specimens: 20.1 g including one polished thin section at *UWB*. The remainder is held by *Hmani* Inc.

Reclassification of Northwest Africa 8671 (NWA 8671)
(Northwest Africa)
Find: 2014
Classification: Eucrite (anomalous). The disequilibrium textures in this specimen are unique among eucrites and the absence of high Ca augite is very unusual. Furthermore, the oxygen isotope composition plots to more negative $\Delta^{17}O$ values than for all other analyzed eucrites.

Northwest Africa 8676 (NWA 8676)
(Northwest Africa)
Purchased: 2014 May
Classification: Carbonaceous chondrite (CO3)
History: Purchased by John Higgins in May 2014 from a dealer in Laayoune, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Small chondrules (230±130 μm, N=20) and rare, very fine-grained CAI in a sparse, brown matrix (40 vol%) rich in ferroan olivine and containing sparse altered kamacite, taenite and troilite.
Geochemistry: Olivine ($Fa_{0.7-43.4}$; Cr_2O_3 in ferroan olivine 0.07-0.19 wt.%, N = 7), orthopyroxene ($Fs_{0.9-6.3}Wo_{0.9-4.4}$, N = 3), clinopyroxene ($Fs_{2.0-4.0}Wo_{47.2-45.2}$).
Classification: Carbonaceous chondrite (CO3).
Specimens: 9 g including one polished thin section at *UWB*. The remaining material is held by Mr. J. Higgins.

Northwest Africa 8681 (NWA 8681)
(Northwest Africa)
Purchased: 2014 Jun
Classification: HED achondrite (Eucrite, brecciated)
History: Purchased by Sergey Vasiliev from a Moroccan dealer at the Ensisheim Show in June 2014.
Physical characteristics: Single stone (590 g) with a light reddish-brown weathered exterior. The interior is dark gray with whitish clasts visible.
Petrography: (A. Irving and S. Kuehner), *UWS*) Breccia consisting of gabbroic eucrite clasts set in a very dark brown matrix containing related crystal debris plus minor unexsolved pigeonite. Gabbroic eucrite clasts are composed of exsolved pigeonite (commonly with wavy clinopyroxene exsolution lamellae), polycrystalline calcic plagioclase, silica polymorph, chromite, ilmenite and Ni-free metal. Secondary minerals from terrestrial weathering include, barite, calcite and iron hydroxides.
Geochemistry: Orthopyroxene host crystals ($Fs_{61.0\text{-}62.2}Wo_{4.4\text{-}2.1}$, FeO/MnO = 32-35, N = 3), clinopyroxene exsolution lamellae ($Fs_{26.8\text{-}28.3}Wo_{43.6\text{-}42.5}$, FeO/MnO = 30-33, N = 3), pigeonite ($Fs_{36.2}Wo_{5.6}$, FeO/MnO = 23).
Classification: Eucrite (brecciated). Likely paired with NWA 7989, NWA 8036, NWA 8588 and related stones.
Specimens: 24.8 g including one polished thin section at *UWB*; main mass with Mr. S. Vasiliev.

Northwest Africa 8781 (NWA 8781)
(Northwest Africa)
Purchased: 2014 Jul
Classification: Carbonaceous chondrite (Ungrouped)
History: Several black stones found together near Foum Zguid, Morocco, in July 2014 were purchased by Rachid Chaoui and were subsequently sold to Stefan *Ralew* and Darryl Pitt.
Petrography: (A. Irving and S. Kuehner, *UWS*, L. Garvie, *ASU*) Composed of very small chondrules (210±60 µm, N=20) and small mineral fragments in a black, very fine-grained matrix (~50 vol.%). No phyllosilicates were detected by powder-XRD in the matrix. No CAI were observed. Minerals are olivine, orthopyroxene, diopside, stained kamacite and troilite.
Geochemistry: Olivine ($Fa_{1.1\text{-}70.7}$, Cr_2O_3 in ferroan examples = 0.21-0.40 wt.%, N = 8), orthopyroxene ($Fs_{1.0\text{-}7.0}Wo_{1.2\text{-}0.4}$, N = 3), diopside ($Fs_{2.1}Wo_{40.8}$; $Fs_{0.4}Wo_{48.2}$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of five 1-2 mg acid-washed non homogenized subsamples by laser fluorination gave, respectively, $\delta^{17}O$ -10.020, -9.832, -6.298, -5.897, -4.490; $\delta^{18}O$ -6.085, -5.472, -1.822, -0.895, 1.221; $\Delta^{17}O$ -6.807, -6.943, -5.336, -5.424, -5.135 (all per mil). These compositions plot on the CCAM trend, but distinctly below the trend for CO chondrites

Classification: Carbonaceous chondrite (ungrouped). This specimen is not a CV3 chondrite (chondrule size much too small, no CAI), not a CK chondrite (no magnetite), not a CO3 chondrite (oxygen isotopes are different, no CAI), and not a CM chondrite (matrix apparently anhydrous, oxygen isotopes displaced to more ^{16}O-rich compositions). Therefore it seems to be an ungrouped carbonaceous chondrite.
Specimens: 20.1 g including one polished thin section at *UWB*; 170 g with *Kuntz*; other samples with Mr. S. *Ralew* and *DPitt*.

Northwest Africa 8791 (NWA 8791)
(Northwest Africa)
Purchased: 2011 Jun
Classification: Rumuruti chondrite (R3-5)
History: Purchased by Fabien *Kuntz* in June 2011 from a Moroccan dealer at the Ensisheim Show.
Physical characteristics: Single stone (241 g) with an overall light-brown color and composed of small clasts in a finer-grained matrix.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of equilibrated Type 5 clasts (containing sparse chondrules), separated well-formed, forsterite-bearing Type 3 chondrules ((apparent diameter 470±210 μm)) and angular mineral fragments in a finer grained matrix (orange-brown in thin section). Accessory minerals include Ti-V-Al-bearing chromite, troilite, Ni-bearing pyrrhotite and minor altered kamacite.
Geochemistry: Olivine in Type 5 clasts ($Fa_{39.2-39.9}$, N = 3), magnesian olivine in Type 3 chondrules ($Fa_{3.2-4.5}$, N = 2), orthopyroxene ($Fs_{2.2-30.3}Wo_{0.2-3.2}$, N = 3), augite ($Fs_{27.7}Wo_{39.2}$; $Fs_{12.1}Wo_{44.0}$, N = 2), fayalite ($Fa_{71.4}$).
Classification: R3-5 chondrite.
Specimens: 21.2 g plus one polished thin section at *PSF*; 21.29 g at *MGC*; main mass with *Kuntz*.

Northwest Africa 11112 (NWA 11112)
Morocco
Find: 2016
Classification: Ungrouped achondrite
History: Purchased by Ke Zuokai in Dec. 2016 from a Moroccan dealer.
Physical characteristics: The meteorite has a black fusion crust and partially covered by weathering products.
Petrography: A polished mount shows a medium-grained rock (mostly 0.1-1 mm) with granular texture. It is composed of ~47% olivine and ~42% pyroxene with intersertally ~4% plagioclase and 7% opaque minerals (FeNi metal, sulfide and chromite). No relic chondrules. Not brecciated.
Geochemistry: The compositions of olivine, pyroxene and plagioclase are quite uniform. Olivine $Fa_{36.4-38.5}$, Fe/Mn=80.2-108.1; orthopyroxene $Fs_{29.1-30.0}Wo_{2.8-3.2}$,

Fe/Mn=51.2-63.6; plagioclase $An_{52.3-55.7}Ab_{43.0-46.5}Or_{1.1-1.3}$; chromite TiO_2 1.51-1.80, $Al_2O_3$13.71-14.05, MgO 3.01-3.72 (all in wt%); taenite Ni 16.09-21.16 wt%; kamacite Ni 6.58-6.93 wt%.
Classification: Achondrite (ungrouped). No relic chondrules are found in this thin section, and the compositions of plagioclase (~$An_{52.3}$) are significantly different from those of chondrites. In this regard, we consider NWA 11112 is not an equilibrated chondrite. The petrography and mineral compositions (olivine, pyroxene, plagioclase, chromite and Fe-Ni metal) in this meteorite are very similar to those of the ungrouped achondrite NWA 3250.

Northwest Africa 11113 (NWA 11113)
Morocco
Find: 2016
Classification: Carbonaceous chondrite (CO3)
History: Purchased by Ke Zuokai in Dec. 2016 from a Moroccan dealer.
Physical characteristics: The meteorite has a black fusion crust.
Petrography: Abundant small well-defined chondrules (50-300 μm) and a few fine-grained CAIs set in fine-grained matrix. Most chondrules appear to be Type I with or without pyroxene, and a small amount of Type II chondrules are present. Metal and sulfide occur within and around the chondrules.
Geochemistry: Olivine $Fa_{0.6-49.7}$, Cr_2O_3 in ferroan olivine 0.01-0.15 wt.%, mean 0.0±0.03 wt.%, N = 25; In detail, the cores of olivine in Type I chondrules are rich in magnesium, and the Fa values are between 0.6-10.6. In comparison, the rims of olivine in some Type I chondrules and the grains in Type II chondrules have higher Fe contents ($Fa_{22.9-49.7}$). Cr_2O_3 in ferroan olivine 0.01-0.15 wt.%, mean 0.07±0.03 wt.%, N = 25; orthopyroxene $Fs_{0.9-4.3}Wo_{0.7-5.3}$; clinopyroxene $Fs_{1.0-9.5}Wo_{30.1-40.0}$, $Fs_{1.0-6.1}Wo_{43.1-49.5}$.
Classification: CO3

Northwest Africa 11254 (NWA 11254)
(Northwest Africa)
Purchased: 2016 Oct
Classification: Carbonaceous chondrite (CM, anomalous)
History: Purchased by Dustin Dickens in October 2016 from a dealer in Laayoune, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS* ; L. Garvie, *ASU*) Very small chondrules (apparent diameter 200±100 μm), mineral fragments and some very fine grained CAI are set in an extremely fine grained matrix (~30 vol.%, black in thin section) containing pyrrhotite, kamacite, and taenite. No phyllosilicates were detected by X-ray diffraction.
Geochemistry: Olivine ($Fa_{0.8-58.6}$, N = 3), orthopyroxene ($Fs_{1.8-3.1}Wo_{1.1-0.4}$, N = 3), clinopyroxene ($Fs_{1.5-2.0}Wo_{45.3-42.6}$, N = 2). Oxygen isotopes (Karen Ziegler, *ASU*) of

acid-washed subsamples: $\delta^{17}O$ 0.241, -0.423; $\delta^{18}O$ 9.268, 8.823; $\Delta^{17}O$ -4.653, -5.082 (all per mil).
Classification: Carbonaceous chondrite (CM-an). The anomalous character comes from the absence of phyllosilicates, and the oxygen isotopes that plot below the trend for CM chondrites.
Specimens: 3.6 g including one polished thin section at *UWB*; remainder with Mr. D. Dickens.

Northwest Africa 11303 (NWA 11303)
(Northwest Africa)
Purchased: 2017 Mar
Classification: Lunar meteorite (feldspathic breccia)
History: Material excavated from a site near Tindouf, Algeria, was purchased by Dustin Dickens in March 2017 from a Mauritanian dealer. The coordinates of the site are unknown.
Physical characteristics: Many small fragments coated by pale reddish-brown terrestrial weathering products. The fresh interiors of the largest fragments exhibit white to beige clasts in a dark gray, fine-grained matrix.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular mineral grains of anorthite, olivine, orthopyroxene, exsolved pigeonite, ferroan pigeonite, augite, ilmenite, Ti-chromite and fayalite in a partly vesicular matrix containing minor kamacite and barite.
Geochemistry: Olivine ($Fa_{26.7\text{-}47.2}$, FeO/MnO = 75-81, N = 2), orthopyroxene ($Fs_{24.1}Wo_{3.6}$, FeO/MnO = 67), orthopyroxene host ($Fs_{47.1}Wo_{3.3}$, FeO/MnO = 68), ferroan pigeonite ($Fs_{52.4}Wo_{18.8}$, FeO/MnO = 67), augite ($Fs_{8.0}Wo_{44.3}$, FeO/MnO = 35), plagioclase ($An_{96.7\text{-}97.4}Or_{0.2\text{-}0.1}$, N = 2).
Classification: Lunar (feldspathic regolith breccia).
Specimens: 20.0 g including one polished endcut at *UWB*; remainder with Mr. D. Dickens.

Northwest Africa 11304 (NWA 11304)
(Northwest Africa)
Purchased: 2017 April
Classification: Rumuruti chondrite (R4)
History: Purchased by Dustin Dickens in April 2017 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) The specimen is a breccia mostly composed of well-formed, relatively small chondrules (apparent diameter 250±150 μm, N = 12) in a finer grained matrix (~30 vol.%), but some petrologically-similar, angular lithic clasts (including type 3 and type 4 clasts) are also present. Both olivine and orthopyroxene have very magnesian cores, but the predominant mafic minerals are much more ferroan. Other minerals are clinopyroxene, sodic plagioclase, pentlandite, pyrrhotite and magnetite.

Geochemistry: Olivine (cores $Fa_{1.0-1.2}$; predominantly $Fa_{39.1-41.6}$; N = 4), orthopyroxene (core $Fs_{4.5}Wo_{0.4}$; mantle $Fs_{16.3}Wo_{2.7}$), clinopyroxene ($Fs_{11.0-12.4}Wo_{45.5-41.7}$, N = 2), plagioclase ($Ab_{85.7}An_{12.3}Or_{14.6}$).
Classification: R4. May contain R3 material.
Specimens: 21.2 g including one polished thin section at *UWB*; remainder with Mr. D. Dickens.

Northwest Africa 11354 (NWA 11354)
Morocco
Purchased: Feb. 2017
Classification: Enstatite achondrite (ungrouped)
History: Purchased by Ke Zuokai in Feb. 2017 from a Moroccan dealer.
Physical characteristics: The meteorite is covered by a dark brown fusion crust.
Petrography: The meteorite is composed of medium-grained (~0.1-0.5 mm) silicates, metal and sulfide. Enstatite is the dominant silicate phase. Other silicates are olivine, albitic plagioclase and fine-grained diopside (4-20 μm). No chondrules or clasts are observed. Some regions of the thin section exhibite triple junctions. Metal and sulfide include kamacite, tanite, troilite, alabandite, daubreelite and schreibersite. Daubreelite often presents as lamellae within troilite.
Geochemistry: Enstatite $Fs_{0.7-2.0}Wo_{0.7-1.7}$ (n=19), Fe/Mn (cation ratio)=8.0±3.9; minor fine-grained Ca-rich pyroxene $Fs_{43.1-47.2}Wo_{43.1-47.2}$ (n=9), Fe/Mn (cation ratio)=16.6±10.8; plagioclase $Ab_{71.5-83.6}Or_{0.01-3.4}$ (n=9); olivine grains are almost pure fosterite $Fo_{99.3-100}$ (n=18), Fe/Mn (cation ratio)=3.1±1.6. This meteorite lacks Si content in metal. Kamacite (wt%) Fe 92.49, Ni 5.99, Co 0.51, P 0.05. Taenite (wt%) Fe 75.71, Ni 23.55, Co 0.31. Troilite (wt%) Fe 63.11, S 36.07, Co 0.13, Ti 0.18, Cr 0.29, V 0.06. Daubreelite (wt%) Fe 19.69, Cr 36.44, S 44.28, Ni 0.07, Ti 0.01, P 0.04, Co 0.05. Sulfide is low in Si (below 0.01 wt%).
Classification: Enstatite achondrite ungrouped. The meteorite is chemically similar to equilibrated EL chondrites. However, it is distinguished from EL6 chondrite by the lack of chondrules and presence of olivine. Moreover, this meteorite has low Si content in metal (below detection limit) and low Ti content in troilite (0.16±0.02 wt%), similar to those in NWA 10519 (Enst achon-ung).

Northwest Africa 11511 (NWA 11511)
Algeria
Purchased: 2017 Jun
Classification: Ureilite (anomalous)
History: Purportedly found near Adrar, Algeria, and purchased by Darryl Pitt in June 2017 from a dealer in Mauritania.
Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate composed predominantly of mafic silicates (orthopyroxene with subordinate olivine, grainsize 0.2-0.7 mm) with accessory sodic plagioclase, tabular graphite and rare

schreibersite. Both orthopyroxene and olivine have thin reduced, magnesian rims containing minor blebs of Fe metal.
Geochemistry: Orthopyroxene ($Fs_{10.4-10.5}Wo_{4.5-4.4}$, FeO/MnO = 13; rim $Fs_{1.1}Wo_{0.4}$, FeO/MnO = 20; N = 3), olivine ($Fa_{12.6-12.7}$, FeO/MnO = 22-23; rim $Fa_{6.8}$, FeO/MnO = 10; N = 3). Oxygen isotopes (K. Ziegler, UNM): analyses of acid-washed subsamples by laser fluorination gave, respectively, d17O 2.018, 1.933, 1.622; d18O 6.632, 6.506, 6.128; D17O -1.484, -1.502, -1.614 per mil.
Classification:Ureilite (anomalous). Originally thought to be an orthopyroxene-rich lodranite. Oxygen isotopes show this graphite-rich achondrite is a ureilite, different from typical ureilites in being orthopyroxene-rich, containing unusually magnesian olivine and most significantly in containing sodic plagioclase.
Specimens: 20.3 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11517 (NWA 11517)
Northwest Africa
Purchased: 2017
Classification: Lunar meteorite (feldspathic breccia)
History: Four individuals weighing a total of 88 g were found near Tindouf, Algeria. John Sinclair purchased the stones from a Moroccan meteorite hunter at the Sainte Marie Aux Mines mineral show in France during June of 2017.
Physical characteristics: Sample is irregular-ovoid shaped and lacks fusion crust. The exterior surface is weathered and light orangish-gray in color. The stone shows brecciated texture composed of dominant light-colored clasts in a dark grey matrix. FeNi grains are present in several slices. Pits from weathering of clasts and vesicles contain orange caliche.
Petrography: Description and classification (A. Love, *App*) Sample is a polymict breccia composed of 0.5-3 mm irregularly shaped lithic and mineral clasts set within a micro-vesiclar, melt matrix. Clasts are composed of poikilitic gabbro, vitrophyric, anorthosite, crystalline impact melt, and basaltic lithologies. Minerals clasts include olivine, exsolved Ca-rich and Ca-poor pyroxene, baddeleyite, ulvospinel, ilmenite, chromite, FeS, kamacite, taenite, Si-polymorph.
Geochemistry: (A. Love, *App*) Olivine ($Fa_{18.65-53.01}$, FeO/MnO=83.29-109.49, N=12), Opx ($Fs_{16.43-42.54}Wo_{2.92-4.47}$, FeO/MnO=53.16-60.73, N=5), pigeonite ($Fs_{40.64-67.00}Wo_{5.14-11.16}$, FeO/MnO=54.93-67.00, N=8); augite ($Fs_{17.44-36.61}Wo_{19.71-43.48}$, N=8); pyroxeferroite $Fs_{70.28}Wo_{5.8}$, FeO/MnO=60.5, N=1); plagioclase $An_{95.55-98.72}Or_{0.00-0.27}$, N=15).
Classification: Lunar (feldspathic breccia). Textures and mineral compositions indicate this sample is a feldspathic breccia. FeO/MnO ratios from olivine and pyroxene and An-content of plagioclase suggest this sample is a lunar feldspathic breccia.
Specimens: J. Sinclair holds the main masses. An individual and a slice weighing 17.6 g and one polished thin section are on deposit at *App*.

Northwest Africa 11521 (NWA 11521)
Moroco
Purchased: 2017
Classification: Carbonaceous chondrite (CO3)
History: A single piece with a mass of 50 g was bought in 2017 from a Moroccan meteorite dealer in Ensisheim, France.
Physical characteristics: Fresh-looking individual with black (fusion) crust.
Petrography: The meteorite shows a chondritic texture of abundant small chondrules, metals, sulfides, CAIs, and mineral fragments embedded into a fine-grained greyish and porous matrix. Chondrules are dominantly porphyritic and typically 0.1-0.2 mm in diameter. Sulfides and FeNi metal are fresh and present in matrix and chondrules.
Geochemistry: Mineral compositions and geochemistry: Olivine (mean: $Fa_{18.7\pm14.6}$, range: $Fa_{0.4\text{-}38.4}$, n=33), low-Ca pyroxene (mean $Fs_{4.8\pm3.4}Wo_{2.7\pm2.2}$, range: $Fs_{0.6\text{-}11.8}Wo_{0.4\text{-}7.4}$, n=24)
Classification: The textural observations suggest a CO3 classification of this rock. The olivines show undulatory extinction. Thus, the rock is of shock stage S2. The sample is only slightly weathered.

Northwest Africa 11550 (NWA 11550)
(Northwest Africa)
Purchased: 2017 Jan 29
Classification: HED achondrite (Eucrite)
History: Purchased NWA stone at the Tucson Gem show from Sidi Mohamad Ismaily
Physical characteristics: Exterior surfaces partly covered by black fusion crust; non-crusted surfaces are gray with portions covered by pinkish dust.
Petrography: In thin section dominated by many small mineral clasts, and some lithic clasts
Geochemistry: Low-Ca pyroxene $Fs_{60.0\pm1.7}Wo_{2.1\pm0.8}$ (N=47).
Classification: Monomict, largely equilibrated, brecciated eucrite based on texture and mineral composition.
Specimens: *Cascadia* holds the entire sample, consisting of 157.8 g, a polished thin section, and potted butt.

Northwest Africa 11551 (NWA 11551)
Mauritania
Purchased: 2017 Jan 30
Classification: HED achondrite (Howardite)

History: Type specimen donated to *Cascadia* by Mohammed *Hmani* at the Tucson Gem Show in 2017. Mr. *Hmani* stated that the meteorite was found in 2014 in Mauritania.
Physical characteristics: Exterior surfaces partly covered by black fusion crust; non-crusted surfaces show obvious breccia texture with variegated clasts up 1o 1 cm across. Most surfaces appear relatively unweathered but rust spots are present
Petrography: In thin section appears to be a roughly 50-50 mixture of diogenitic (coarse orthopyroxene) and eucritic (plagioclase, pyroxene-dominated) clasts. Some eucritic pyroxene shows zoning.
Geochemistry: Diogenitic orthopyroxene $Fs_{27.1\pm3.8}Wo_{2.4\pm1.0}$ (N=182), eucritic low-Ca pyroxene $Fs_{41.6\pm6.0}Wo_{3.1\pm1.0}$ (N=40), augite $Fs_{26.8\pm7.8}Wo_{41.5\pm2.5}$ (N=30), uninverted pigeonite $Fs_{48.8\pm5.8}Wo_{8.0\pm2.3}$ (N=36), bulk inverted pigeonite $Fs_{50.5\pm5.4}Wo_{10.7\pm3.0}$ (N=24).
Classification: Howardite based on textures and mineral proportions.
Specimens: *Cascadia* holds 20.0 g and two polished thin sections and a potted butt. The main mass is held by HMANI Inc. (13 Rue Joules Hardouin Mansart, 92600 Asnieres, France).

Northwest Africa 11552 (NWA 11552)
(Northwest Africa)
Purchased: 2016 Nov 16
Classification: HED achondrite (Eucrite)
History: Donated to *Cascadia* in February, 2017 by Dr. Baecker, who had purchased the sample as an unclassified NWA on eBay.
Physical characteristics: Single oriented cone mostly covered by black fusion crust. Interior cut faces show clastic texture ranging from small fragments to sub-cm subophitic-textured clasts. Brownish rust spots visible.
Petrography: Clastic texture in thin section, including mineral, lithic, and melt breccia clasts. Relatively abundant calcite veining
Geochemistry: Most pyroxene analyses are mixtures of low- and high-Ca pyroxene. Low-Ca pyroxene $Fs_{66.1\pm1.7}Wo_{4.9\pm0.3}$ (N=6); augite $Fs_{34.1\pm2.0}Wo_{39.4\pm2.4}$ (N=9).
Classification: Monomict, largely equilibrated, brecciated eucrite based on texture and mineral composition.
Specimens: *Cascadia* holds 21.5 g, two polished thin sections, and potted butt. Main mass is held Dr. Bastian Baecker (Huntsville, AL)

Northwest Africa 11556 (NWA 11556)
(Northwest Africa)
Purchased: 2017 Mar
Classification: Carbonaceous chondrite (C2, ungrouped)
History: Purchased in Agadir, Morocco by Aziz Habibi in March 2017.

Physical characteristics: A single, very soft jet black stone (61 g) containing some visible but tiny, clear crystalline objects. During preparation for powder X-ray diffraction by immersing sample fines in methanol a strong organic odor was emitted.
Petrography: (A. Irving and S. Kuehner, *UWS*; L. Garvie, *ASU*) Sparse very small, subspherical polycrystalline objects (apparent diameter 180±150 μm, N = 18) and angular mafic silicate mineral grains are set in a very fine grained matrix. The dominant matrix (~90 vol.%, jet black in thin section) contains prominent open shrinkage cracks and is composed mainly of indeterminate mafic silicates plus minor chromite, pentlandite and calcite. X-ray diffraction shows the specimen to be dominated by tochilinite and well-crystallized serpentine. No CAI were observed despite a careful search.
Geochemistry: Olivine ($Fa_{1.2\text{-}56.0}$, Cr_2O_3 in ferroan examples 0.10-0.40 wt.%, mean 0.25±0.11 wt.%, N = 8), orthopyroxene ($Fs_{0.9\text{-}1.0}Wo_{1.0\text{-}3.6}$, N = 3), clinopyroxene ($Fs_{1.1}Wo_{42.2}$; $Fs_{0.9}Wo_{48.0}$; N = 2). Oxygen isotopes (K. Ziegler, *UNM*): analyses of untreated subsamples by laser fluorination gave, respectively, $\delta^{17}O$ -2.789, -3.797; $\delta^{18}O$ 1.421, -0.319; $\Delta^{17}O$ -3.539, -3.629 per mil.
Classification: Carbonaceous chondrite (type 2, ungrouped). The paucity of chondrule-like objects, high abundance of matrix, and more 16O-rich bulk oxygen isotope composition distinguish this specimen from CM chondrites.
Specimens: 12.3 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.

Northwest Africa 11558 (NWA 11558)
(Northwest Africa)
Purchased: 2017 Sep
Classification: Ungrouped achondrite
History: Two identical small samples of an unusual achondrite were sent by two separate Moroccan dealers to Dr. Anthony Irving in January 2017. Later in September 2017 the remainder of one of these specimens was purchased from one of the original dealers by Ben Hoefnagels.
Physical characteristics: The friable specimens (total weight 3.92 g) are both composed of abundant white and green grains.
Petrography: (A. Irving and S. Kuehner, *UWS*; I. Barker and D. Moser, *UWO*) The specimens have a porphyritic plutonic igneous texture. The mineralogy is dominated by larger grains (1.6-2.1 mm) of anorthite, strongly zoned clinopyroxene and tridymite (identified by electron backscatter diffraction analysis). More sodic (bytownitic) plagioclase and more ferroan clinopyroxenes occur in the groundmass together with accessory orthopyroxene, ilmenite, ulvöspinel, troilite, cristobalite, minor quartz, rare low-Ni kamacite and rare baddeleyite. Some silica occurs as graphic intergrowths with clinopyroxene in the groundmass, or as very small inclusions accompanied by clinopyroxene within plagioclase.
Geochemistry: Diopside cores ($Fs_{5.1\text{-}5.3}Wo_{38.8\text{-}39.0}$, FeO/MnO = 6, N = 2), subcalcic augite ($Fs_{37.0}Wo_{30.9}$, FeO/MnO = 8), subcalcic ferroaugite ($Fs_{67.3}Wo_{25.8}$, FeO/MnO

= 10), ferropigeonite($Fs_{69.7-78.7}Wo_{22.3-15.4}$, FeO/MnO = 7-10, N = 2), plagioclase ($An_{69.2-91.9}Or_{1.2-0.2}$, N = 3). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ 2.716, 3.020, 3.525; $\delta^{18}O$ 6.990, 7.573, 8.530; $\Delta^{17}O$ -0.975, -0.979, -0.979 per mil.
Classification: Ungrouped achondrite. This material is paired with NWA 11119 on the basis of closely similar mineralogy and identical oxygen isotopic composition. According to the IUGS nomenclature for igneous rocks (Le Maitre et al., 1989), this specimen would be a porphyritic quartz gabbro. However, given that the dominant silica polymorph is tridymite, a more appropriate designation would be tridymite gabbro.
Specimens: 2.56 g including one polished epoxy mount at *UWB*; 1.36 g with Mr. B. Hoefnagels.

Northwest Africa 11559 (NWA 11559)
Algeria
Purchased: 2017 Jun
Classification: Carbonaceous chondrite (CO3)
History: Purportedly found near the Algeria/Libya border and purchased by Darryl Pitt in June 2017 from a dealer in Mauritania.
Petrography: (A. Irving and S. Kuehner, *UWS*) Small, well-formed chondrules (apparent diameter 420 ± 190 µm, N = 20) accompanied by sparse angular mineral grains are set in a finer grained matrix (~40 vol.%, brown in thin section) containing accessory chromite, altered kamacite and pyrrhotite. No CAI were observed.
Geochemistry: Olivine ($Fa_{0.9-41.4}$, Cr_2O_3 in ferroan examples <0.02 wt.%, N = 8), orthopyroxene ($Fs_{12.6-23.8}Wo_{2.1-0.6}$, N = 3), clinopyroxene ($Fs_{9.1-10.9}Wo_{46.8-45.9}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.02.
Classification: Carbonaceous chondrite (CO3). The below detection limit Cr_2O_3 contents in ferroan olivines indicate a petrologic subtype >3.6.
Specimens: 9.5 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11560 (NWA 11560)
(Northwest Africa)
Purchased: 2017 Oct
Classification: HED achondrite (Diogenite)
History: Purchased in Temara, Morocco by Adam *Aaronson* in October 2017.
Physical characteristics: A single large stone (13060 g) composed predominantly of vitreous yellow-green pyroxene with sparse opaque grains.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate (mean grainsize 0.9 mm) of predominantly orthopyroxene plus minor chromite and rare olivine. Minor calcite accompanied by iron hydroxide occurs along grain boundaries.

Geochemistry: Orthopyroxene ($Fs_{22.7-23.5}Wo_{1.5-2.0}$, FeO/MnO = 28-30, N = 3), olivine ($Fa_{26.2-26.3}$, FeO/MnO = 44-46, N = 2).
Classification: Diogenite.
Specimens: 20.2 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 11561 (NWA 11561)
(Northwest Africa)
Purchased: 2016 Dec
Classification: Carbonaceous chondrite (CR6)
History: Purchased in December 2016 by Ben Hoefnagels from a French dealer, who had obtained the stone from a source in Niger.
Petrography: (A. Irving and S. Kuehner, *UWS*) Metamorphic texture. Larger (up to 3.6 mm) pyroxene poikiloblasts containing numerous rounded olivine chadacrysts are present within a dominant finer-grained, recrystallized matrix exhibiting triple grain junctions. Pyroxene is mostly orthopyroxene, but blebby inclusions of clinopyroxene are present in places. Accessory phases are chromite, kamacite, Ni-poor taenite and troilite.
Geochemistry: Olivine ($Fa_{29.0-29.8}$, FeO/MnO = 64-67, N = 3), orthopyroxene host ($Fs_{23.0-23.6}Wo_{3.8-3.6}$, FeO/MnO = 40-42, N = 2), clinopyroxene exsolution lamellae ($Fs_{10.7-12.0}Wo_{41.8-39.8}$, FeO/MnO = 28-31, N = 2), plagioclase ($An_{42.0-50.3}Or_{1.6-1.8}$, N = 2). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ -0.259, -0.450, -0.344; $\delta^{18}O$ 2.659, 2.297, 2.506; $\Delta^{17}O$ -1.663, -1.663, -1.667 per mil.
Classification: Carbonaceous chondrite (CR6). In terms of textural, mineralogical and isotopic characteristics, this specimen is very similar to Tafassasset and NWA 7531.
Specimens: 53.0 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11562 (NWA 11562)
(Northwest Africa)
Purchased: 2017 Oct
Classification: Ungrouped achondrite
History: Purchased in Temara, Morocco, by Adam *Aaronson* in October 2017.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen consists of coarser, protogranular regions (mean grainsize 0.25 mm) composed of forsterite and enstatite with some interstitial diopside, altered kamacite and blade-like cohenite, plus much finer-grained, quench-textured regions with the same mineralogy.
Geochemistry: Olivine ($Fa_{1.0-1.1}$, FeO/MnO = 3-4, N = 3), orthopyroxene ($Fs_{0.9-1.0}Wo_{1.0-2.3}$, FeO/MnO = 2-3, N = 3), diopside ($Fs_{0.2-0.9}Wo_{36.3-40.5}$, Al_2O_3 = 2.0-3.6 wt.%, TiO_2 = 0.5-0.6 wt.%, N = 3). Oxygen isotopes (K. Ziegler, *UNM*): analyses

of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}O$ 1.567, 1.396, 1.479; $\delta^{18}O$ 6.345, 6.084, 6.291; $\Delta^{17}O$ -1.783, -1.816, -1.843 per mil.
Classification: Achondrite (ungrouped). The oxygen isotope composition plots between the trends for CR and CV chondrites, and far from the trends for most achondrites (except for some ureilites); however, the highly magnesian silicates and evidence for partial melting would seem to preclude any affinity to ureilites.
Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Ke Zuokai.

Northwest Africa 11563 (NWA 11563)
(Northwest Africa)
Purchased: 2016 Jun
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased by Ben Hoefnagels in June 2016 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of mineral clasts of anorthite, labradorite, olivine, orthopyroxene, pigeonite, subcalcic augite, exsolved pigeonite, ilmenite, fayalite and silica polymorph in a finer grained, partly vesicular matrix containing minor troilite and kamacite.
Geochemistry: Olivine ($Fa_{23.0\text{-}37.4}$, FeO/MnO = 94, N = 2), orthopyroxene ($Fs_{29.5}Wo_{4.5}$, FeO/MnO = 45), pigeonite ($Fs_{29.6}Wo_{7.4}$, FeO/MnO = 83), subcalcic augite ($Fs_{22.7}Wo_{25.1}$; $Fs_{34.2}Wo_{32.4}$, FeO/MnO = 71-77, N = 2), anorthite ($An_{95.0}Or_{0.2}$), labradorite ($An_{50.9\text{-}54.1}Or_{3.6\text{-}1.0}$, N = 2).
Classification: Lunar (feldspathic regolith breccia).
Specimens: 11.8 g in the form of a polished endcut at *UWB*; remainder of the stone with Mr. B. Hoefnagels.

Northwest Africa 11564 (NWA 11564)
(Northwest Africa)
Purchased: 2017 Sep
Classification: Carbonaceous chondrite (CO3)
History: Purchased by Habib Naji in September 2017 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Small, rounded to irregularly shaped chondrules (apparent diameter 165 ± 80 μm, N = 20) accompanied by sparse angular mineral grains and some very fine grained CAI are set in a finer grained matrix (~30 vol.%, brown in thin section).
Geochemistry: Olivine ($Fa_{1.2\text{-}64.7}$, Cr_2O_3 in ferroan examples <0.02 wt.%, N = 7), orthopyroxene ($Fs_{0.8\text{-}27.5}Wo_{0.8\text{-}3.0}$, N = 3), clinopyroxene ($Fs_{1.5\text{-}4.4}Wo_{43.7\text{-}47.7}$, N = 2).
Classification: Carbonaceous chondrite (CO3). The below detection limit Cr_2O_3 contents in ferroan olivines indicate a petrologic subtype >3.6.
Specimens: 24.05 g including one polished thin section at *UWB*; remainder with H. Naji.

Northwest Africa 11565 (NWA 11565)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CK6)
Petrography: The stone is very recrystallized with a groundmass coarseness of 50-100 µm, typical of CK6 chondrites. It is rather weathered; ~80% of the silicates are stained brown. The rock contains ~15 vol.% discernable chondrules. Plagioclase grains are approxcimately 50 µm in size. The plagioclase is heterogeneous (typical of CKs): $Ab_{44.1\pm19.4}Or_{1.5\pm1.3}An_{54.4\pm20.6}$ (n=9) with an overall range $An_{27.2\text{-}85.8.}$ Also present are diopside ($Fs_{9.2\pm0.6}Wo_{45.9\pm0.9}$, n=4) and augite ($Fs_{14.8}Wo_{27.1}$, n=1). As in some other CK chondrites, there is more Ca pyroxene than low-Ca pyroxene. Olivine ($Fa_{30.1\pm0.5}$, n=17) is also in the CK-chondrite range.

Northwest Africa 11570 (NWA 11570)
(Northwest Africa)
Purchased: March 2017
Classification: Ordinary chondrite (H/L4)
History: Purchased by Sean Tutorow and Brahim Tahiri from several diferent meteorite hunters in Morocco.
Petrography: The olivine in the rock is fairly homogeneous and is in between the Fa ranges for H ($Fa_{17.3\text{-}20.2}$) and L ($Fa_{23.0\ -\ 25.8}$) chondrites, leading to a classification of H/L. Although the mean low-Ca pyroxene composition ($Fs_{17.6}$) is within the range of H chondrites, it is heterogeneous and is thus not definitive. Also present is rare Ca-pyroxene: $Fs_{8.7}Wo_{21.0}$ (n=1). The rock has well-defined chondrules. A few low-Ca pyroxene grains exhibit polysynthetic twinning. Chondrules haev devitrified mesostases. There is minor recrystallization apparent in the rock; there is some integration of chondrules with the matrix. Some troilite grains are polycrystalline.

Northwest Africa 11571 (NWA 11571)
(Northwest Africa)
Purchased: March 2017
Classification: Rumuruti chondrite (R4)
History: Purchased by Sean Tutorow and Brahim Tahiri from several diferent meteorite hunters in Morocco.
Petrography: Pyroxene is rare, but some low-Ca pyroxene grains exhibit polysynthetic twinning. The only two grains that were analyzed are both Ca-pyroxene. Opaque phases consist of small grains of metal and both small and large grains of pyrrhotite. Chondrules are well defined; chondrule types include BO, PP, PO, POP, C, GOP and RP. Some

Northwest Africa 11572 (NWA 11572)

(Northwest Africa)
Purchased: March 2017
Classification: Ordinary chondrite (H4, melt breccia)

History: Purchased by Sean Tutorow and Brahim Tahiri from several diferent meteorite hunters in Morocco.

Petrography: The rock is an impact-melt breccia. Melted regions are very dark; they contain numerous metal-sulfide veins, polycrystalline troilite and rare cellular, rapidly cooled metal-sulfide assemblages. There are rare grains of coarse troilite. Most metal grains are not attached to sulfide grains. Some low-Ca pyroxene grains exhibit polysynthetic twinning, perhaps caused by post-shock quenching. There is strong mosaic extinction evident in the olivine grains.

Northwest Africa 11573 (NWA 11573)
(Northwest Africa)
Purchased: 2017
Classification: Enstatite achondrite (Aubrite)

History: Three uncrusted stones weighing a total of 107 g were found in Morocco prior to 2016. J. Donald Cline and John Sinclair acquired the samples from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.

Physical characteristics: Specimen is dark orange-brown-colored, has a pitted irregular-shape and lacks fusion crust. Interior shows a brecciated texture composed of light orange-brown crystals, lithic fragments and metallic grains are visible on the cut surface.

Petrography: Description and Classification (A. Love, *App*): Sample is a breccia composed of angular to subrounded crystals of enstatite (up to 5 mm) and cumulate-textured clasts. Clasts show poikolitic texture composed of subhedral to anhedral, polysynthetically twinned enstatite and anhedral plagioclase feldspar set within birefringent, nonstoichiometric albitic glass. Additional minerals are; daubréelite; Si-polymorph; schreibersite; Si-bearing (4.88 wt%) kamacite; perryite; graphite; niningerite; troilite and oldhamite.

Geochemistry: (A. Love, *App*) Enstatite ($Fs_{0.2\pm0.2}Wo_{0.4\pm0.1}$, N=18); plagioclase ($An_{2.4\pm0.5}Or_{5.0\pm0.4}$, N=11).

Classification: Achondrite (aubrite). Textures, mineralogy and mineral compositions suggest this is a aubrite.

Specimens: *PARI* holds the main mass. A whole individual and an endcut weighing 20.6 g, a polished mount and thin section are on deposit at *App*.

Northwest Africa 11574 (NWA 11574)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (L3.10)

History: Purchased by Marcin Cimala in Morocco, 2017.

Physical characteristics: Single stone with weathered exterior, saw cuts shows many densely packed chondrules set in a dark brown matrix.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous porphyritic chondrules, most with mesostasis or glass. Adundant opaque matrix. Apparent mean chondrule diameter 700±390 μm, n=31, consistent with L.
Geochemistry: (C. Agee, *UNM*) All olivine $Fa_{16.4\pm12.5}$, Fe/Mn=50±25, n=40; Ferroan chondrule olivine $Fa_{19.7\pm11.3}$, Fe/Mn=55±23, Cr_2O_3=0.21±0.21 (wt%), n=33; low-Ca pyroxene $Fs_{13.0\pm10.6}Wo_{1.8\pm1.9}$, n=13.
Classification: Ordinary chondrite (L3.10), type 3.10 based on mean value of Cr_2O_3 in ferroan chondrule olivine and the 1-sigma standard deviation, near the boundary between 3.10 and 3.15 in figure 13 (Grossman and Brearley, 2005), however closest to values of Adrar 003 (L/LL3.10) with Cr_2O_3=0.23±0.21 (n=47).
Specimens: 29 g including a probe mount on deposit at *UNM*, Marcin Cimala holds the main mass.

Northwest Africa 11575 (NWA 11575)
Mali
Purchased: 2016 Sept
Classification: Ungrouped achondrite
History: Found in June 2016 at the border region of Mali and Algeria; purchased in Mauritania in September 2016.
Physical characteristics: Single stone, 80% covered by fusion crust. Saw cut reveals a surface of approximately 12 square cm with a light colored, felsic-appearing, aphanitic texture. A single, ~1 mm wide, dark colored shock melt vein crosscuts this surface. Also present are a few smaller xenoliths which are dark in color, angular, mafic-appearing, and aphanitic; the largest of which is approximately 1 cm across.
Petrography: (C. Agee, *UNM*) Microprobe and SEM examinations were performed on a polished probe mount and on the saw-face of the deposit sample respectively. An ophitic texture of pyroxene and plagioclase grains, making up approximately 90-95% of the model mineralogy, was observed. Pyroxenes were typically 300-500 μm in size and showed significant igneous zoning. The pyroxene grains had cores of magnesian pigeonite, outwardly transitioning to a zone of augite, and rimmed by a zone of sub-calcic ferroaugite to ferropigeonite. Plagioclase grains were oligoclase, mostly lath-like in shape, and typically 200x50 μm in size. We also observed ubiquitous potassium feldspar and silica, which were commonly found in contact with each other, and together made up ~5% of the modal mineralogy. Opaque phases made up ~1% of the modal mineralogy; these included ilmenite, iron sulfide, iron metal (nickel not detected), chromite, and iron oxide. The mafic xenolith clasts were basaltic in major mineralogy and lacked K-feldspar. The shock melt vein composition within the host felsic lithology plots in the andesite field of the TAS diagram, whereas the composition of the fusion crust of the meteorite, plots in the basaltic andesite field.

Geochemistry: (C. Agee, *UNM*) Magnesian pigeonite $Fs_{28.3\pm3.3}Wo_{7.3\pm1.6}$, Fe/Mn=37±4, n=5; augite $Fs_{24.4\pm4.2}Wo_{30.0\pm3.8}$, Fe/Mn=33±4, n=21; sub-calcic-ferroaugite/ferropigeonite $Fs_{57.3\pm6.2}Wo_{14.7\pm3.7}$, Fe/Mn=48±3, n=19; plagioclase $Ab_{81.3\pm1.9}An_{17.4\pm2.0}Or_{1.3\pm0.2}$, n=20; potassium feldspar $Ab_{4.0\pm0.9}An_{0.4\pm0.3}Or_{95.6\pm1.1}$, n=23; shock melt vein (proxy for felsic lithology bulk composition) SiO_2=59.1±5.7, Al_2O_3=10.1±1.5, MgO=4.5±1.3, FeO=15.6±5.9, CaO=6.5±1.5, Na_2O=3.8±1.2 (all wt%), n=11.; fusion crust (proxy for meteorite bulk composition) SiO_2=55.8±3.7, Al_2O_3=8.2±3.4, MgO=6.7±1.0, FeO=16.2±6.2, CaO=7.2±0.7, Na_2O=2.6±0.5, K_2O=0.5±0.2 (all wt%), n=8. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$= 4.875, 5.583, 5.349; $\delta^{17}O$= 3.760, 4.137, 4.006; $\Delta^{17}O$= 1.186, 1.189, 1.182 (linearized, all per mil, TFL slope=0.528).
Classification: Ungrouped achondrite. Pyroxene compositional core-rim zoning trends are similar to that observed in Martian basalt QUE 94201 (Papike et al. 2009) and Apollo 15 Mare basalts (Kushiro, 1973). Oxygen isotopes plot within the field defined by LL-chondrites, however the 3 measured data points, from different fragments of the meteorite, form a slope of 0.53, parallel to the mass dependent terrestrial fractionation line. The andesite to basaltic andesite compositions of the shock melt vein and fusion crust of this meteorite plot on the TAS diagram in a broadly similar location to the estimated bulk composition of ungrouped achondrites GRA 06128/GRA 06129; and this meteorite and GRA 06128/06129 have similar oligoclase plagioclase. However, GRA 06128/06129 are not likely related to this meteorite since they are olivine-bearing, lack K-feldspar, and have oxygen isotopes that plot below the TFL.
Specimens: 22.1 g on deposit at *UNM*, Darryl Pitt holds the main mass.

Northwest Africa 11576 (NWA 11576)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite, melt breccia)
History: Reportedly found in Mali, September 2017, purchased in Morocco.
Physical characteristics: Single stone, no fusion crust, exterior shows numerous light colored clasts set in a dark matrix of shock melt.
Petrography: (C. Agee, *UNM*) Microprobe examination shows basaltic clasts with approximately 60% pyroxene and 35% plagioclase grains most in the range 100-200 μm. Many pyroxene grains have exsolution lamellae.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{62.1\pm1.1}Wo_{2.7\pm0.8}$, Fe/Mn=32±1, n=7; high-Ca pyroxene $Fs_{28.3\pm1.6}Wo_{42.2\pm1.8}$, Fe/Mn=31±1, n=6; plagioclase $An_{88.9\pm0.4}$, n=3.
Classification: Eucrite-melt breccia, eucrite clasts are consistent with type 6 (Takeda and Graham, 1991) showing clear compositional separation of low and high calcium pyroxenes.
Specimens: 24.5 g on deposit at *UNM*, Mohamed Aid holds the main mass.

Northwest Africa 11577 (NWA 11577)
Morocco
Purchased: 2017 Jan
Classification: Iron meteorite (IAB-sHL)
History: Reportedly found in Algeria by nomads in December 2016, subsequently sold to a Moroccan merchant in Ouarzazate, from whom it was purchased by J. Shea.
Physical characteristics: The main mass consists of two tabular specimens approximately 1 cm thick, both having dark brown exteriors.
Petrography: (C. Herd, *UAb*) SEM investigation of a ~2 × 3 cm polished surface reveals a well-developed Widmanstatten pattern consistent with a finest octahedrite (0.025±0.005 mm; n=16). Some areas of kamacite are coarser, and some kamacite has been replaced by terrestrial oxidation.
Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 12.5, Co = 0.55 (both wt%); Ir = 0.12, Ga = 17, Ge = 38, As = 24, W = 0.38, Re = 0.01, Os = 0.22, Cu = 276, Au = 2.7 (all μg/g).
Classification: (C. Herd, *UAb*): IAB iron, sHL subgroup according to Wasson and Kallemeyn (2002).
Specimens: Type specimen consisting of two representative slices (16.6 and 2.1 g) at *UAb*. Main mass with Shea.

Northwest Africa 11584 (NWA 11584)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (L5)
History: Purchased from a Moroccan meteorite dealer in Tucson, 2017. Reportedly found in Morocco in 2016.
Physical characteristics: Single stone, broken surface shows numerous well defined chondrules, some oxidation present, desert caliche on exterior.
Petrography: (C. Agee, *UNM*) Microprobe examination shows distinct chondrules throughout, plagioclase grain size is ~20 μm, a significant portion of the matrix appears to be recrystallized. Kamacite, troilite, and oxidized iron are ubiquitous.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{24.8\pm1.2}$, Fe/Mn=48±7, n=11; low-Ca pyroxene $Fs_{21.5\pm0.5}Wo_{1.8\pm0.2}$, Fe/Mn=29±1, n=6.
Classification: Ordinary chondrite (L5)
Specimens: 20.5 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 11585 (NWA 11585)
North West Africa, Morocco
Purchased: October 2015
Classification: Ureilite

Petrography: (H. Downes, Birkbeck) Equigranular, anhedral, slightly poikilitic crystals of olivine and low-Ca pyroxene, with minor interstitial metal and very rare carbon. There is no evidence of zoning in minerals. This meteorite does not exhibit a typical ureilite texture, but is more similar to the Hughes Type.
Geochemistry: Mineral compositions and geochemistry: (N. Rai, N.V. Almeida, *NHM*). All analyses by EPMA. Olivine cores $Fa_{10.8\pm0.6}$, 0.45 to 0.52 wt% MnO, 0.50 to 0.55 wt% Cr_2O_3, 0.14 to 0.68 wt% CaO, < 0.01 wt% Ni, (N=32). Pyroxene $Fs_{10.1\pm0.8}Wo_{8.3\pm0.6}$, 0.38 to 0.52 wt% MnO, 0.89 to 0.92 wt% Cr_2O_3, (N=11).
Classification: Ureilite
Specimens: 14.2 g on deposit at the *NHM*. M. Bilet holds the main mass.

Northwest Africa 11586 (NWA 11586)
Algeria
Purchased: 2016 May
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in May 2016 from Morocco.
Physical characteristics: Meteorite has residual visible black fusion crust and weak magnetic properties. Additionally, hand specimen is unbrecciated.
Petrography (B. Miao, C. Zhang, *GUT*): This meteorite, with weak magnetic properties and residual visible black fusion crust, whose rock structure is dense and section is full of small metal (Fe). Within polished thin section, mineral is slightly broken, rock structure is igneous but not brecciated. The mineral modal abundance is as follows: Low-Ca pyroxene (36.2 vol%), high-Ca pyroxene (10.6 vol%), plagioclase (44.3 vol%), SiO_2 (6.1 vol%), metal-Fe (0.3 vol%), chromite (0.6 vol%), other minerals such as ilmenite, troilite, apatite and zircon (1.9 vol%).
Geochemistry (B. Miao, C. Zhang, *GUT*, EPMA): Low-Ca pyroxene: Fe/Mn=27.5 Mg#=39.4;$Fs_{57.8}Wo_{4.7}En_{37.5}$(n=50). High-Ca pyroxene: Fe/Mn=26.5 Mg#=51.8;$Fs_{28.2}Wo_{41.5}En_{30.3}$(n=60). Plagioclase: $An_{90.9}Or_{0.5}Ab_{8.62}$(n=29).
Classification: Basaltic unbrecciated eucrite
Specimens: 21.8 g specimen and a polished thin section are deposited in *GUT*

Northwest Africa 11587 (NWA 11587)
(Northwest Africa)
Purchased: 2017
Classification: Rumuruti chondrite (R3-5)
History: A single stone weighing 714 g was found in Morocco prior to 2017. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.
Physical characteristics: Sample is dark brown and has a rounded shape with an irregular surface composed of pits and protrusions. The cut face shows the sample is a breccia composed of 3-4 distinct chondritic lithologies that are light orange to dark-brown in color.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of 0.5-4 cm unequilibrated equilibrated chondritic clasts (type 4-5) and a shock-darkened, unequilibrated lithology set within a host of unequilibrated chodrules, fragments and fragmental matrix. Chondrules in host and clasts have an average diameter of 340 µm (n=81). Additional minerals are: apatite, FeS, pentlandite and chromite.
Geochemistry: (A. Love, *App*) Type 5: Olivine ($Fa_{38.9\pm0.3}$, Fe/Mn=76.1, N=6); high-Ca pyroxene ($Fs_{11.1\pm0.9}Wo_{45.9\pm1.0}$, N=6); low-Ca pyroxene ($Fs_{30.5\pm0.6}Wo_{4.12}$/-2.8, n=2). Type 3: Olivine ($Fa_{13.7\pm9.9}$, range $Fa_{0.4\text{-}33.8}$, CV=72%, Fe/Mn=2.3-85.6, N=36, Cr_2O_3 in ferroan olivine 0.2±0.1, N=22); low-Ca pyroxene $Fs_{12.2\pm9.7}Wo_{1.6\pm1.2}$ ($Fs_{0.7\text{-}31.7}Wo_{0.3\text{-}4.1}$, N=15).
Classification: Rumuruti chondrite (R3.2-5, S3, wi-2). Based on Fa and Fe/Mn compositions of olivines, chondrule diameter and texture this sample is a Rumuruti chondrite breccia. Based on the coefficient of variation of olivines within unequilibrated clast, the petrologic subtype is estimated at 3.2 (Bischoff, 2000).
Specimens: *PARI* holds the main mass. One 20.2g endcut and a polished thin section are on deposit at *App*.

Northwest Africa 11588 (NWA 11588)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM2)
Physical characteristics: Dark-brown fragments. Cut surface reveals a dark interior with abundant matrix and small chondrules.
Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*; L. Bonal, *IPAG*) Chondrules (average apparent diameter about 200 µm) and chondrules fragments set in a fine-grained iron-rich matrix. Modal abundances: matrix 71 vol%, chondrules and chondrule fragments 29% (point counting, N=317). Infrared transmission spectra of matrix grains reveal the presence of phyllosilicates dominating the mineralogical assemblage and are comparable to those of CM chondrites (Beck et al., 2010. The 3-µm band, whose spectral characteristics are reflecting the chemistry of the phyllosilicate phases and are correlated with the alteration classification scheme of Rubin et al. (2007), shows that this meteorite experienced a relatively low extent of aqueous alteration, comparable to Murray (2.4/2.5).
Geochemistry: Olivine $Fa_{16.6\pm13.1}$, PMD 66%, range $Fa_{0.9\text{-}37.9}$ (N=5). Orthopyroxene $Fs_{0.8}Ws0.8$ and $FS7.2Wo_{3.8}$ (N=2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.23.
Classification: CM2
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11589 (NWA 11589)
(Northwest Africa)

Purchased: 2017
Classification: Carbonaceous chondrite (CV3)
Physical characteristics: Dark stone. Cut surface reveals a dark-gray interior with mm-sized chondrules and CAIs.
Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE* ; Lydie Bonal, *IPAG*) Chondrules (average apparent diameter 1.1 mm, N=18), mostly of type I, and CAIs set in a fine-grained iron-rich matrix. Main opaque minerals are troilite and metal. Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy, this meteorite appears to be as metamorphosed as Axtell (3.6/3.7). The Raman spectroscopy parameters of interest are FWHM-D (cm-1)=69.2±4.0, ID/IG=1.41±0.06 (see Bonal et al. 2006, GCA 70:1849-1863, figure 4).
Geochemistry: Olivine $Fa_{10.0\pm10.5}$, PMD 68% (N=11). Orthopyroxene $Fs_{1.2\pm0.4}Wo_{0.9\pm0.1}$ (N=2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.91.
Classification: Carbonaceous chondrite (CV3, reduced subgroup). Estimated subtype 3.6/3.7.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11590 (NWA 11590)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL3)
Physical characteristics: Brownish stone. Cut surface reveals a brownish interior with packed, well-defined, mm-sized chondrules, and cm-sized darker clasts with smooth contours.
Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*) Packed chondrules with average size 850 μm (N=24). Contains cm-sized clasts with very closely packed and indented chondrules, and abundant compound chondrules ("cluster chondrite" texture as defined by Metzler 2012, MAPS 47:2193-2217). These clasts are more weathered than the host lithology (W5 against W4).
Geochemistry: Olivine $Fa_{14.2\pm8.8}$, range $Fa_{4.0\text{-}26.6}$, PMD 57% (N=9), Cr_2O_3 in ferroan olivine 0.14±0.14 wt% (N=9). Orthopyroxene $Fs_{13.4\pm8.4}Wo_{0.9\pm0.7}$, Fs PMD 50% (N=10).
Classification: LL3. Contains cm-sized "cluster chondrite" LL3 clasts.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11591 (NWA 11591)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: The fusion crust has been largely weathered from the surface of the sample. In the area where it remains, it is thin (<0. 5mm) and shiny black. The interior of the stone is medium gray and contains inclusions that range from whitish-gray to black. There are several clasts and small fractures in the stone.

A small amount of oxidation is present in the interior of the sample. The sample is approximately 6.8 × 8.6 × 3.8 cm.
Petrography (L.Huang, B. Miao, H. Chen, *GUT*): This meteorite is a pigeonite-plagioclase rock with fine to medium grain size. Breccia composed of mineral and lithic fragments set in a fine-grained, generally fragmental matrix. Lithic clasts are generally ophitic with medium-grained pyroxenes and skeletal plagioclase grains (width ~30-200 μm) and a fine-grained recrystallized mesostasis. Pyroxene generally contain pigeonite with augite lamellae (width ~3 μm). A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare phosphate (apatite and merrillite.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=30.2; Low-Ca pyroxene: median compositions are Mg#=36.5; $Fs_{58.2}Wo_{8.4}$ (n=30). augite lamellae: median compositions are Mg#=40.1, $Fs_{43.9}Wo_{26.7}$ (n=25). Plagioclase: $An_{86.0}Or_{0.7}$ to $An_{92.4}Or_{0.4.}$
Classification: Basaltic polymict brecciated eucrite
Specimens: 35.1 g and polished thin section are deposited in *GUT*

Northwest Africa 11592 (NWA 11592)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: This achondrite is covered on two surfaces with a shiny black fusion crust (~2 mm thick). The interior appears massive and is a smokey gray color. Many cracks penetrate the interior of this meteorite. A minute amount of white deposit lines one crack. Dimensions: 2.5 × 2.0 × 4.5 cm.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is an unbrecciated pigeonite-plagioclase rock with medium grain size. Textures are ophitic with medium-grained (~0.3-0.8 mm) pyroxenes and granular to lath-shaped plagioclase grains. Pyroxenes generally contain pigeonite with augite lamellae. It also contains a shock vein (width ~4 mm) and a vein associated with formation of medium-grained ferroan olivine (~50-250 μm) and sometimes fine-grained ilmenite, chromite and rare very fine-grained phosphate (apatite and merrillite). Accessories are silica, ilmenite, chromite, troilite.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=31.7; low-Ca pyroxene: median compositions are Mg#=37.5; $Fs_{59.9}Wo_{4.2}$ (n=25). Augite lamellae: median compositions are Mg#=50.1, $Fs_{29.9}Wo_{40.9}$ (n=12). Plagioclase: $An_{87.2\text{-}90.0}Or_{0.5\text{-}0.9}$, median $An_{88.1}Or_{0.7}$ (n=8).
Classification: Basaltic unbrecciated eucrite
Specimens: 4.2 g and polished thin section are deposited in *GUT*

Northwest Africa 11593 (NWA 11593)
Algeria

Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: A single stone of 44.37 g, partly covered by fusion crust. Many cracks penetrate the interior of this meteorite. Dimensions: 4.5 × 4.0 × 5.0 cm.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic lithologies; also contains <10 vol% cumulate lithologies. Cumulate eucrite lithologies are coarse-grained (~0.5-1 mm) gabbros composed principally of low-Ca zoned clinopyroxene and calcic plagioclase. Basaltic breccia lithologies have fine to medium grain size, textures are subophitic to ophitic, and they contain very fine-grained vitrophyric textured basaltic lithologies. A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare iron metal.

Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=34.9. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=51.9, $Fs_{46.3}Wo_{3.8}$ (n=20). Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=41.5, $Fs_{55.3}Wo_{5.6}$ (n=36). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=43.4, $Fs_{47.6}Wo_{16.6}$ (n=45). Plagioclase: $An_{83.9-92.9}Or_{0.32-2.63}$, median $An_{90.1}Or_{0.9}$ (n=25).

Classification: Basaltic polymict brecciated eucrite

Specimens: 12.1 g and polished thin section are deposited in *GUT*

Northwest Africa 11594 (NWA 11594)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)

History: Purchased by Miao Bing-an in 2016 in Morocco.

Physical characteristics: On the unbroken surfaces, black fusion crust is partly preserved. The meteorite is a polymict breccia consisting of fragments of medium- to coarse-grained metamorphosed gabbroic rocks and fine-grained subophitic basaltic rocks. Dimensions: 5.5 × 6.0 × 7.2 cm.

Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic lithologies, with <10 vol % cumulate lithologies. Cumulate eucrite lithologies are coarse grained (~0.6-1 mm) gabbros composed principally of low-Ca zoned clinopyroxene and calcic plagioclase. Basaltic breccia lithologies are fine grained, have mostly subophitic textures, and contain very fine-grained vitrophyric textured basaltic lithologies. A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare iron metal.

Geochemistry (L.Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=35.2. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=51.7, $Fs_{46.6}Wo_{3.7}$ (n=20). Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=45.2, $Fs_{52.6}Wo_{4.1}$ (n=43). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=47.7, $Fs_{38.5}Wo_{27.7}$ (n=45). Plagioclase: $An_{73.2-94.1}Or_{0.23-2.17}$,median $An_{88.2}Or_{0.76}$ (n=10).

Classification: Basaltic polymict brecciated eucrite
Specimens: 34.6 g and polished thin section are deposited in *GUT*

Northwest Africa 11595 (NWA 11595)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: The fusion crust has been largely weathered from the surface of the sample. The meteorite is a polymict breccia consisting of fragments of medium- to coarse-grained metamorphosed gabbroic rocks and medium- to fine-grained subophitic basaltic rocks. Dimensions: 4.5 × 6.0 × 6.4 cm.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic lithologies, with <10 vol % cumulate lithologies. Cumulate eucrites lithologies are coarse grained (~0.4-0.6 mm) gabbros composed principally of low-Ca zoned clinopyroxene and calcic plagioclase. Basaltic breccia lithologies are fine grained, have mostly subophitic textures, and contain very fine-grained vitrophyric textured basaltic lithologies. A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare iron metal.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=34.1. Low-Ca pyroxene cumulate lithologies: median compositions are Mg#=50.9, $Fs_{48.0}Wo_{2.2}$ (n=13). Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=42.6, $Fs_{54.6}Wo_{4.9}$ (n=12). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=44.4, $Fs_{45.3}Wo_{19.1}$ (n=28). Plagioclase: $An_{87.2-95.1}Or_{0.41-1.56}$, median $An_{92.6}Or_{0.78}$ (n=12).
Classification: Basaltic polymict brecciated eucrite
Specimens: 25.3 g and polished thin section are deposited in *GUT*

Northwest Africa 11596 (NWA 11596)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: A black fusion crust coveres the surface of the stone. The meteorite is a polymict breccia consisting of fragments of medium- to coarse-grained metamorphosed gabbroic rocks and medium- to fine-grained subophitic basaltic rocks. Dimensions: 3.5 × 5.0 × 5.4 cm.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic lithologies, with <10 vol% cumulate lithologies. Cumulate eucrite lithologies are coarse grained (~0.3-1 mm) gabbros composed principally of low-Ca zoned clinopyroxene and calcic plagioclase. Basaltic breccia lithologies are fine- to medium-grained, have textures that are mostly subophitic, and contain very

fine-grained vitrophyric textured basaltic lithologies. A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare iron metal.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=36.6. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=51.3, $Fs_{46.7}Wo_{4.2}$ (n=10). Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=45.1, $Fs_{52.9}Wo_{3.8}$ (n=8). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=43.8, $Fs_{47.5}Wo_{16.0}$ (n=18). Plagioclase: $An_{79.8\text{-}89.0}Or_{0.5\text{-}1.9}$, median $An_{85.1}Or_{1.1}$ (n=11).
Classification: Basaltic polymict brecciated eucrite
Specimens: 16.9 g and polished thin section are deposited in *GUT*

Northwest Africa 11597 (NWA 11597)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: The interior of the meteorite is medium gray. Dimensions: 2.5 × 3.0 × 3.4 cm.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic lithologies, with <10 vol% cumulate lithologies. Cumulate eucrites lithologies are coarse grained (~0.3-0.6 mm) gabbros composed principally of low-Ca clinopyroxene and calcic plagioclase. Basaltic breccia lithologies are fine grained, and have textures that are mostly subophitic. A silica phase is commonly present. Accessories are ilmenite, chromite and troilite.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=35.5. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=45.1, $Fs_{52.3}Wo_{2.9}$ (n=10). Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=40.8, $Fs_{57.2}Wo_{3.7}$ (n=8). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=43.2, $Fs_{46.6}Wo_{18.6}$ (n=21). Plagioclase: $An_{90.0\text{-}91.9}Or_{0.5\text{-}0.7}$, median $An_{91.9}Or_{0.7}$ (n=6).
Classification: Basaltic polymict brecciated eucrite
Specimens: 11.1 g and polished thin section are deposited in *GUT*

Northwest Africa 11598 (NWA 11598)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Howardite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: No fusion crust.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of diogenite lithologies with ~40 vol% eucrite lithologies (mostly basaltic lithologies). Basaltic eucrite detritus (composed of granular pyroxene and plagioclase) as veins

invade the orthopyroxenitic diogenite lithologies (mainly composed of orthopyroxene). Accessories are silica, ilmenite, chromite, troilite.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=30.9; Orthopyroxene of diogenite lithologies: median compositions are Mg#=65.5, $Fs_{33.6}Wo_{2.6}$ (n=24). Low-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=37.1, $Fs_{61.5}Wo_{2.2}$ (n=15). High-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=48.5, $Fs_{30.9}Wo_{40.0}$ (n=12). Plagioclase: median $An_{91.7}Or_{0.3}$ (n=11).
Classification: Polymict brecciated howardite
Specimens: 1.5 g and polished thin section are deposited in *GUT*. The remaining material is held by the anonymous finder.

Northwest Africa 11599 (NWA 11599)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: Single stone with black fusion crust. A saw cut reveals a mosaic of gray, coarse-grained, interlocking crystals.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Unbrecciated cumulate lithologies containing coarse-grained (~0.5-1.1 mm) gabbros composed principally of low-Ca clinopyroxene and calcic plagioclase (~20-40 vol%) with minor chromite (coarse-grained ~0.5-1.0 mm). Texture is equigranular with subequal amounts of pyroxene and plagioclase grains.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=28.6. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=63.1, $Fs_{36.0}Wo_{2.4}$ (n=29). High-Ca pyroxene of cumulate lithologies: median compositions are Mg#=73.2, $Fs_{14.5}Wo_{46.0}$ (n=23). Plagioclase: $An_{89.4\text{-}91.4}Or_{0.1\text{-}0.7}$, median $An_{90.2}Or_{0.5}$ (n=18).
Classification: Gabbroic cumulate eucrite
Specimens: 8.9 g and polished thin section are deposited in *GUT*

Northwest Africa 11600 (NWA 11600)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: Single stone with black fusion crust. A saw cut reveals a mosaic of gray, coarse-grained, interlocking crystals.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Unbrecciated cumulate lithologies containing coarse-grained (~0.8-1.5 mm) gabbros composed principally of low-Ca clinopyroxene and calcic plagioclase (~20-40 vol%) with minor

chromite (coarse-grained ~0.5-0.8 mm) and accessory phosphate. Texture is equigranular with subequal amounts of pyroxene and plagioclase grains.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=29.9. Low-Ca pyroxene of cumulate lithologies: median compositions are Mg#=63.7, $Fs_{35.4}Wo_{2.7}$ (n=24). High-Ca pyroxene of cumulate lithologies: median compositions are Mg#=73.7, $Fs_{14.6}Wo_{44.4}$ (n=20). Plagioclase: $An_{87.8\text{-}91.1}Or_{0.2\text{-}0.7}$, median $An_{89.7}Or_{0.5}$ (n=26).
Classification: Gabbroic cumulate eucrite
Specimens: 16.2 g and polished thin section are deposited in *GUT*

Northwest Africa 11601 (NWA 11601)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: The meteorite has pitted irregular surfaces and is light to dark gray to pale brown in overall color. Most of the stones have partial coatings of greenish to whitish lichens.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is a pigeonite-plagioclase rock with fine to medium grain size. Breccia composed of mineral and lithic fragments set in a fine-grained, generally fragmental matrix. Lithic clasts are generally subophitic with fine to medium-grained (~0.1-0.4 mm) pyroxenes and skeletal plagioclase grains and a fine-grained mesostasis. A silica phase is commonly present. Accessories are ilmenite, chromite, troilite and rare iron metal.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=32.1. Low-Ca pyroxene of basaltic lithologies: median compositions are Mg#=38.2, $Fs_{57.1}Wo_{5.6}$ (n=16). High-Ca pyroxene of basaltic lithologies: median compositions are Mg#=37.5, $Fs_{45.5}Wo_{27.5}$ (n=13). Plagioclase: $An_{85.2\text{-}87.7}Or_{0.5\text{-}1.3}$, median $An_{86.3}Or_{0.9}$ (n=14).
Classification: Basaltic unbrecciated eucrite
Specimens: 8.4 g and polished thin section are deposited in *GUT*

Northwest Africa 11602 (NWA 11602)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: Thin, shiny, black fusion crust covers 60% of the exterior of this sample. No fractures exist. Cleaving this achondrite revealed an interior with coarse-grained matrix containing an even distribution of white laths. The specimen is coherent and weathering is minimal.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is an unbrecciated pigeonite-plagioclase rock with medium grain size. With rhyolitic

structure, it contains fine to medium-grained (~0.05-0.5 mm) pyroxenes and granular plagioclase grains. Pyroxenes generally contain pigeonite with augite lamellae. Accessories are silica, ilmenite, troilite and rare iron metal.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=31.7. Low-Ca pyroxene: median compositions are Mg#=37.3, $Fs_{60.6}Wo_{3.5}$ (n=34). augite lamellae : median compositions are Mg#=50.7, $Fs_{27.9}Wo_{43.4}$ (n=35). Plagioclase: $An_{88.4\text{-}90.2}Or_{0.1\text{-}0.4}$, median $An_{90.6}Or_{0.3}$ (n=22).
Classification: Basaltic unbrecciated eucrite
Specimens: 10.8 g and polished thin section are deposited in *GUT*

Northwest Africa 11603 (NWA 11603)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Eucrite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: Black fusion crust covers 40% of the exterior of this sample. No fractures exist. Cleaving this achondrite revealed an interior with coarse-grained matrix containing an even distribution of white laths.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): This meteorite is a unbrecciated pigeonite-plagioclase rock with medium grain size. Ophitic-gabbro texture with fine to medium-grained (~0.05-0.45 mm) pyroxenes and granular to lath-shaped plagioclase grains. Pyroxenes generally contain pigeonite with augite lamellae. Accessories are silica, ilmenite, troilite.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=32.7. Low-Ca pyroxene: median compositions are Mg#=36.5, $Fs_{60.5}Wo_{4.8}$ (n=26). Augite lamellae : median compositions are Mg#=51.2, $Fs_{27.4}Wo_{43.9}$ (n=14). Plagioclase: $An_{89.8\text{-}91.5}Or_{0.1\text{-}0.8}$, median $An_{90.6}Or_{0.3}$ (n=23).
Classification: Basaltic unbrecciated Eucrite
Specimens: 4.6 g and polished thin section are deposited in *GUT*

Northwest Africa 11604 (NWA 11604)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Howardite)
History: Purchased by Miao Bing-an in 2016 from Morocco.
Physical characteristics: The medium gray matrix contains a variety of clasts and the fusion crust is not found in this small sample.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of basaltic eucrite lithologies (~55 vol%) and cumulate eucrite lithologies (~30 vol%), with ~15 vol% diogenite lithologies. Basaltic eucrite lithologies mostly have a fine-grained recrystallized or subophitic texture. The texture of cumulate eucrite lithologies is equigranular with subequal amounts of pyroxene and plagioclase

grains. Diogenite lithologies mostly contain orthopyroxene. Accessories are silica, ilmenite, chromite, troilite.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=30.9; Orthopyroxene of diogenite lithologies: median compositions are Mg#=66.9, $Fs_{32.3}Wo_{2.3}$ (n=10). Low-Ca pyroxene of cumulate eucrite lithologies: median compositions are Mg#=54.3, $Fs_{44.8}Wo_{2.0}$ (n=12). Low-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=38.8, $Fs_{59.5}Wo_{2.6}$ (n=10). High-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=51.6, $Fs_{28.1}Wo_{41.8}$ (n=8). Plagioclase: median $An_{92.5}Or_{0.3}$ (n=8).
Classification: Polymict brecciated howardite
Specimens: 1.2 g and polished thin section are deposited in *GUT*

Northwest Africa 11605 (NWA 11605)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Howardite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: The medium-gray matrix contains a variety of clasts and fusion crust is not found in this small sample.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of eucrite lithologies with ~10-15 vol% of diogenite lithologies. Basaltic eucrite lithologies mostly have a fine-grained recrystallized or subophitic texture and contain very fine-grained vitrophyric textured basaltic lithologies. Diogenites lithologies are mostly a orthopyroxene. The matrices are mostly basaltic detritus. Accessories are silica, ilmenite, chromite, troilite.
Geochemistry (L.Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=32.5; Orthopyroxene of diogenite lithologies: median compositions are Mg#=67.1, $Fs_{31.9}Wo_{3.2}$ (n=16). Low-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=37.4, $Fs_{60.4}Wo_{3.6}$ (n=14). High-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=54.1, $Fs_{26.3}Wo_{42.7}$ (n=8). Plagioclase: median $An_{91.3}Or_{0.4}$ (n=10).
Classification: Polymict brecciated howardite
Specimens: 0.6 g and polished thin section are deposited in *GUT*

Northwest Africa 11606 (NWA 11606)
Algeria
Purchased: 2016 May 1
Classification: HED achondrite (Howardite)
History: Purchased by Miao Bing-an in 2016 in Morocco.
Physical characteristics: The medium-gray matrix contains a variety of clasts and fusion crust is not found in this small sample.
Petrography (L. Huang, B. Miao, H. Chen, *GUT*): Breccia containing a variety of eucrite lithologies with ~20%-40 vol% diogenite lithologies. Basaltic eucrite

lithologies mostly have subophitic texture. The texture of cumulate eucrite lithologies is equigranular with subequal amounts of pyroxene and plagioclase grains. Diogenites lithologies are mostly orthopyroxene. The matrices are mostly basaltic detritus. A higher C content chondritic clast (carbonaceous chondrite) was found in this section. Accessories are silica, ilmenite, chromite, troilite.
Geochemistry (L. Huang, B. Miao, H. Chen, *GUT*): Bulk pyroxene: Fe/Mn=30.1; Orthopyroxene of diogenite lithologies: median compositions are Mg#=65.0, $Fs_{34.2}Wo_{2.4}$ (n=12). Low-Ca pyroxene of cumulate eucrite lithologies: median compositions are Mg#=46.2, $Fs_{53.1}Wo_{1.3}$ (n=8). Low-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=36.3, $Fs_{61.9}Wo_{2.9}$ (n=15). High-Ca pyroxene of basaltic eucrite lithologies: median compositions are Mg#=51.8, $Fs_{27.6}Wo_{42.7}$ (n=8). Plagioclase: median $An_{90.5}Or_{0.4}$ (n=10).
Classification: Polymict brecciated howardite
Specimens: 1.3 g and polished thin section are deposited in *GUT*

Northwest Africa 11607 (NWA 11607)
Northwest Africa
Purchased: 2017
Classification: Carbonaceous chondrite (CK3-6)
History: The meteorite was bought from a meteorite dealer in Morocco.
Physical characteristics: Dark grayish to black individual partly covered with fusion crust.
Petrography: The meteorite is a chondritic breccia composed of angular to subrounded type 3-6 clasts set into a more fine-grained clastic matrix. The different clasts are up to 2 cm in size and vary in color from light greenish to almost black. Matrix dominates over chondrules which are on average about 1.2 mm in diameter. Ferroan, Ni-rich olivine is the most abundant mineral in all lithologies. While highly unequilibrated in type 3 clasts and matrix it is equilibrated at $Fa_{29.6}$ in type 5 and 6 lithologies. One type 6 fragment with more Fe-rich olivine (Fa_{35}) has been encountered. Less abundant are Ca-pyroxene, low-Ca pyroxene, and intermediate feldspar. Feldspar is up to 200 µm in size in type 6 lithologies and often intergrown with Ca-pyroxene. The meteorite containes abundant Cr-bearing magnetite and some FeNi-sulfides.
Geochemistry: Type 3 lithology: olivine: $Fa_{22.4\pm12.7}$ ($Fa_{1.7\text{-}34.0}$, NiO=0.3±0.2; FeO/MnO=103±31, n=32); low-Ca pyroxene: $Fs_{16.3\pm8.0}Wo_{0.9\pm0.9}$ ($Fs_{2.9\text{-}27.7}Wo_{0.5\text{-}4.1}$, n = 15), Ca-pyroxene: $Fs_{10.9\pm4.8}Wo_{33.8\pm6.5}$ ($Fs_{2.4\text{-}17.6}Wo_{23.1\text{-}45.1}$, n = 9); type 6 lithology: olivine: $Fa_{29.6\pm0.6}$, NiO=0.4±0.1, FeO/MnO= 105±9, n=42; low-Ca pyroxene: $Fs_{26.9\pm0.8}Wo_{1.1\pm0.4}$, n=9, Ca-pyroxene: $Fs_{11.6\pm2.6}Wo_{39.3\pm6.6}$, n=13; Fe-rich fragment: olivine: $Fa_{35.0\pm0.3}$, NiO=0.4±0.1, FeO/MnO= 143±13, n=38; Ca-pyroxene: $Fs_{12.6\pm1.3}Wo_{46.5\pm1.6}$, n=29; plagioclase: $An_{78.8}Ab_{20.9}Or_{0.3}$, n=3; andesitic feldpar: $An_{35.0}Ab_{64.3}Or_{0.7}$, n=3; Cr_2O_3 in magnetite is about 4.9 wt%.

Northwest Africa 11608 (NWA 11608)

(Northwest Africa)
Purchased: 2017 Aug
Classification: Ureilite

History: Purchased in Temara, Morocco by Adam *Aaronson* in August 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate (mean grainsize 1.7 mm) composed almost entirely of olivine (with dark, reduced magnesian rims) with minor accessory Fe metal and graphite. Multiple linear deformation boundaries are visible in some olivine grains viewed in cross-polarized light. A thorough search of the thin section revealed no pyroxene.
Geochemistry: Olivine (cores $Fa_{17.3\text{-}17.5}$, rims $Fa_{7.1\text{-}9.4}$, N = 5).
Classification: Ureilite (dunitic).
Specimens: 10.7 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11609 (NWA 11609)
Northwest Africa
Purchased: 2017 Oct
Classification: Ordinary chondrite (L4/5)

History: Purchased by Ben Hoefnagels in October 2017 from a dealer in Marrakech, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly well-formed chondrules are present within a recrystallized matrix containing stained metal.
Geochemistry: Olivine ($Fa_{25.5\text{-}25.6}$, N = 3), orthopyroxene ($Fs_{20.9\text{-}21.0}Wo_{1.4\text{-}1.5}$, N = 2), clinopyroxene ($Fs_{6.7}Wo_{46.0}$).
Classification: Ordinary chondrite (L4/5).
Specimens: 21.2 g including one polished thin section at *UWB*; main mass with Mr. B. Hoefnagels.

Northwest Africa 11610 (NWA 11610)
(Northwest Africa)
Purchased: 2017 Jun
Classification: Carbonaceous chondrite (CO3)

History: Purchased by Ke Zuokai in June 2017 from Moroccan dealer Habib Naji.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed small chondrules (apparent diameter 220±110 μm, N = 18), angular mineral fragments and sparse very fine grained CAI are set in a finer grained matrix (brown in thin section).
Geochemistry: Olivine ($Fa_{0.2\text{-}41.0}$, Cr_2O_3 in ferroan examples 0.06-0.27 wt.%, mean 0.12±0.08 wt.%, N = 8), orthopyroxene ($Fs_{2.3\text{-}23.2}Wo_{0.8\text{-}0.9}$, N = 3), clinopyroxene ($Fs_{0.7\text{-}4.5}Wo_{42.2\text{-}41.0}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.07.
Classification: Carbonaceous chondrite (CO3).
Specimens: 40.1 g including one polished thin section at *UWB*; main mass with Mr. K. Zuokai.

Northwest Africa 11611 (NWA 11611)
(Northwest Africa)
Purchased: 2017 Aug
Classification: Ordinary chondrite (LL(L)3)
History: Purchased in Temara, Morocco, by *Aaronson* in August 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed, well-formed chondrules (apparent diameter 580±310 μm, N = 18) are set in a finer-grained matrix containing altered kamacite and chlorapatite.
Geochemistry: Olivine ($Fa_{0.8\text{-}56.1}$, Cr_2O_3 in ferroan examples 0.05-0.10 wt.%, mean 0.08±0.02 wt.%, N = 8), orthopyroxene ($Fs_{0.7\text{-}16.0}Wo_{0.7\text{-}0.1}$, N = 3), clinopyroxene ($Fs_{11.8}Wo_{37.3}$; $Fs_{8.7}Wo_{45.2}$; N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.20.
Classification: Ordinary chondrite (LL(L)3).
Specimens: 22 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11612 (NWA 11612)
(Northwest Africa)
Purchased: 2017 Aug
Classification: HED achondrite (Howardite)
History: Purchased in Temara, Morocco, by *Aaronson* in August 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular grains of diogenitic orthopyroxene (~60 vol.%), exsolved pigeonite, bytownitic plagioclase and some polycrystalline diogenite clasts in a finer grained matrix containing silica polymorph, Ti-poor chromite, ilmenite, Ni-free metal, troilite, zircon and minor secondary calcite.
Geochemistry: Orthopyroxene host ($Fs_{52.0}Wo_{1.3}$; $Fs_{36.8\text{-}39.6}Wo_{1.7\text{-}1.6}$; FeO/MnO = 30-31; N = 3), clinopyroxene exsolution lamellae ($Fs_{14.4\text{-}14.5}Wo_{45.1\text{-}43.1}$, FeO/MnO = 23, N = 2), diogenitic orthopyroxene ($Fs_{34.8}Wo_{2.5}$, FeO/MnO = 30), plagioclase ($An_{74.6\text{-}83.0}Or_{1.0\text{-}0.6}$, N = 2).
Classification: Howardite.
Specimens: 24 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11613 (NWA 11613)
(Northwest Africa)
Purchased: 2017 Aug
Classification: Ordinary chondrite (H7)
History: Purchased in Temara, Morocco, by *Aaronson* in August 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Recrystallized and equilibrated specimen lacking chondrule remnants, but containing some orthopyroxene

poikiloblasts enclosing smaller olivine grains. Primary metal is partly altered and some cross-cutting iron hydroxide veinlets are present.
Geochemistry: Olivine ($Fa_{18.2\text{-}18.3}$, N = 3), orthopyroxene ($Fs_{16.0\text{-}16.1}Wo_{3.5\text{-}4.3}$, N = 2), clinopyroxene ($Fs_{6.9\text{-}7.2}Wo_{43.4\text{-}41.4}$, N = 2).
Classification: Ordinary chondrite (H7).
Specimens: 21.5 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11614 (NWA 11614)
(Northwest Africa)
Purchased: 2017 Sep
Classification: Rumuruti chondrite (R3-5)
History: Purchased by Gary Fujihara in September 2017 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of separated unequilibrated chondrules (apparent diameter 440±180 μm, N = 15) together with equilibrated type 5 chondrite clasts in a finer grained matrix. Accessory minerals include sodic plagioclase, pentlandite, troilite and Ti-bearing chromite.
Geochemistry: Olivine in equilibrated clasts ($Fa_{40.2\text{-}42.4}$, N = 3), forsterite in type 3 chondrules ($Fa_{2.9\text{-}3.3}$, N = 2), orthopyroxene ($Fs_{1.1\text{-}31.0}Wo_{0.3\text{-}2.2}$, N = 3), clinopyroxene ($Fs_{0.8\text{-}10.0}Wo_{45.8\text{-}46.3}$, N = 2), plagioclase ($An_{9.4\text{-}12.0}Or_{6.4\text{-}3.5}$, N = 2).
Classification: R3-5 chondrite breccia.
Specimens: 25.7 g including one polished thin section at *UWB*; main mass with Mr. G. Fujihara.

Northwest Africa 11615 (NWA 11615)
Northwest Africa
Purchased: 2017 Aug
Classification: Ordinary chondrite (LL3)
History: Purchased in Temara, Morocco by Adam *Aaronson* in August 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules (apparent diameter 710±420 μm, N = 18) are set in a finer grained matrix containing altered kamacite.
Geochemistry: Olivine ($Fa_{0.7\text{-}41.7}$, Cr_2O_3 in ferroan examples 0.06-0.10 wt.%, mean 0.08±0.02 wt.%, N = 8), orthopyroxene ($Fs_{2.8\text{-}21.2}Wo_{0.2\text{-}3.0}$, N = 3), pigeonite ($Fs_{17.8\text{-}21.9}Wo_{20.9\text{-}16.2}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.73.
Classification: Ordinary chondrite (LL3).
Specimens: 32.8 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11616 (NWA 11616)
(Northwest Africa)
Purchased: 2017 Mar

Classification: Lunar meteorite
History: Purchased by *DPitt* in March 2017 from a Mauritanian dealer.
Physical characteristics: A single very fresh specimen (2550.8 g) containing separate olivine gabbro and olivine-free basaltic clasts in a fragmental matrix.
Petrography: (A. Irving and S. Kuehner, *UWS*; S. Valencia and P. Carpenter, *WUSL*) Polymict breccia with two different clast types. Olivine gabbro clasts (mean grainsize 1.1 mm) consist of equant grains of olivine, zoned clinopyroxene (pigeonite, ferroan pigeonite, subcalcic augite) and maskelynite with accessory chromite, ilmenite, troilite, fayalite, taenite and baddeleyite. A basalt clast has porphyritic texture and is composed mainly of larger prismatic grains (up to 2.5 mm long) of zoned clinopyroxene and smaller lath-like grains of maskelynite with accessory ilmenite, chromite, troilite, silica polymorph, rare baddeleyite, rare K-feldspar and rare Ni-poor kamacite. The remainder of the breccia consists of related crystalline debris.
Geochemistry: Olivine gabbro clasts: olivine ($Fa_{34.6-59.8}$, FeO/MnO = 83-108, N = 9), pigeonite ($Fs_{26.4-39.4}Wo_{9.7-11.7}$, FeO/MnO = 51-70, N = 6), ferroan pigeonite ($Fs_{43.4-71.4}Wo_{15.4-25.0}$, FeO/MnO = 57-94, N =3), subcalcic augite ($Fs_{17.6-28.4}Wo_{27.2-35.6}$, FeO/MnO = 51-59, N = 5), maskelynite (85.2-95.6$Or_{2.2-0.1}$, N = 10). Basalt clast: pigeonite ($Fs_{26.2-26.3}Wo_{6.4-6.5}$; $Fs_{29.1}Wo_{11.7}$; $Fs_{49.8}Wo_{19.1}$; FeO/MnO = 55-73; N = 4), augite ($Fs_{21.9-25.6}Wo_{34.7-35.2}$, FeO/MnO = 49-50, N = 2), ferropigeonite rims ($Fs_{78.0-78.2}Wo_{18.9-20.3}$, FeO/MnO = 83-86, N = 2), maskelynite ($An_{84.4-86.2}Or_{3.6-2.0}$, N = 2). Bulk composition (R. Korotev, *WUSL*) INAA of breccia subsamples gave (in wt.%) FeO 19.1, Na_2O 0.25 (in ppm) Sc 42.0, Cr 3230, La 13.6, Nd 22.9, Sm 6.73, Eu 0.578, Tb 1.37, Yb 1.37, Lu 0.66, Hf 5.1, Th 2.0.
Classification: Lunar meteorite (polymict breccia with olivine gabbro and basalt clasts). The olivine gabbro lithology is paired with other magnesian gabbro material present in breccia stones such as NWA 773, NWA 2727 and NWA 3333 and also as discrete meteorites such as NWA 2977, NWA 6950 and NWA 8127. The olivine-free basalt lithology differs from the olivine-phyric basalt lithology represented by NWA 3160, and is a new member of the complex NWA 773 clan of lunar meteorites.
Specimens: 20.9 g including a polished thin section and polished endcut at *UWB*; remainder with *DPitt*.

Northwest Africa 11617 (NWA 11617)
(Northwest Africa)
Purchased: 2017 Nov
Classification: Ordinary chondrite (LL(L)3)
History: Purchased in Temara, Morocco, by *Aaronson* in November 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules (apparent diameter 680±420 µm, N = 18) are set in a finer grained matrix containing altered kamacite.

Geochemistry: Olivine ($Fa_{0.8-48.0}$, Cr_2O_3 in ferroan examples 0.03-1.04 wt.%, mean 0.24±0.40 wt.%, N = 8), orthopyroxene ($Fs_{0.2-21.4}Wo_{0.4-3.9}$, N = 3), subcalcic augite ($Fs_{6.9-12.4}Wo_{30.4-25.0}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.21.
Classification: Ordinary chondrite (LL(L)3).
Specimens: 21.2 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11629 (NWA 11629)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL4-6)
Petrography: Chondritic breccia consisting of clastic LL4 type matrix and abundant LL6 clasts. Plagioclase grain size in LL6 clasts is about 80 μm.
Geochemistry: type 4 lithology: olivine: $Fa_{29.2±0.3}$, n=12; pyroxene: $Fs_{20.6±4.6}Wo_{2.4±0.8}$, ($Fs_{8.6-24.5}Wo_{0.5-3.5}$, n = 17); type 6 lithology: olivine: $Fa_{30.0±0.5}$, n=12; pyroxene: $Fs_{24.2±0.2}Wo_{3.5±0.4}$, n=9

Northwest Africa 11636 (NWA 11636)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CK6)
Physical characteristics: Sixteen small dark brownish individuals partly covered with fusion crust.
Petrography: The meteorite predominantly consists of fine-grained recrystallized matrix mainly composed of Ni-bearing ferrous olivine. Chondrules are only rarely encountered. Minor phases include intermediate plagioclase, low-Ca pyroxene, and troilite. Cr-rich magnetite is abundant; metal is virtually absent.
Geochemistry: Olivine: $Fa_{29.5±0.2}$, NiO=0.4±0.1, FeO/MnO=100±11, n=12; magnetite Cr_2O_3 is about 3.8 wt%.

Northwest Africa 11637 (NWA 11637)
Morocco
Purchased: May 2017
Classification: Iron meteorite (IIAB)
History: On May 21, 2017, during the China (Hunan) Mineral and Gem Show in Chenzhou, China, Wang Chen purchased 3 individual specimens (3096 g, 1100 g, 172.3 g) from a Moroccan dealer attending the show.
Physical characteristics: The three pieces have a dark brown exterior with minor rust-colored spots.
Petrography: (C. Herd, *UAb*) Optical investigation of a ~4 × 5 cm polished and etched surface reveals a well-developed Widmanstatten pattern consistent with a

coarsest octahedrite (3.6±1 mm; n=6). No obvious inclusions were noted. Terrestrial alteration has occurred along fractures connecting to the exterior.
Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 5.7, Co = 0.47 (both wt%); Ir = 2.3, Ga = 54, Ge = 137, As = 4.8, W = 2.5, Re = 0.15, Pt = 18.3, Cu = 139, Au = 0.5 (all μg/g).
Classification: (C. Herd, *UAb*): IIAB iron, through comparison of bulk composition with data from Wasson et al. (2007).
Specimens: Type specimen consisting of two representative slices (13.5 and 11.8 g) at *UAb*. Wang Chen holds the main mass (2910 g), Wang Ziyao the 1100 g individual, and Mendy Ouzillou holds the 172.3 g individual and a 117.5 g end cut from the main mass.

Northwest Africa 11638 (NWA 11638)
(Northwest Africa)
Purchased: 2017
Classification: CM2.0
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Many small and dark-grayish fragments lacking any fusion crust.
Petrography: The meteorite is a carbonaceous chondrite that is composed of chondrule and CAI pseudomorphs set into a fine-grained Fe-rich matrix dominated by phyllosillicates, carbonates and sulfides. It does not contain any anhydrous silicates. Low totals of defocused matrix analyses attest to porosity and the presence of hydrous phases, i.e., phyllosilicates. Abundant mineral phases are up to 50 μm sized Ca-carbonates, often fibrous phyllosilicates, and Ni-bearing pyrrhotite.
Geochemistry: Mean values of defocused (10 μm beam diameter) matrix analyses (all wt%; N=35): SiO_2: 26.5, TiO_2: 0.12; Na_2O: 0.19; Cr_2O_3: 0.46, MgO: 20.5, MnO: 0.25, CaO: 0.68, FeO: 29.5, Al_2O_3: 2.59, NiO: 0.69, P_2O_5: 0.14, S: 0.38, Total: 82.0; Ca-carbonates contain about 1 wt% FeO.
Classification: CM2.0. Subtype following the classification scheme of Rubin et al. (2007)).

Northwest Africa 11639 (NWA 11639)
(Northwest Africa)
Purchased: 2017
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish fragment lacking any fusion crust.
Petrography: The meteorite displays a characteristic cumulate texture of up to 2 mm sized olivine and orthopyroxene crystals. Reduced rims in olivine are abundant. The meteorite contains flaky graphite.
Geochemistry: reduced rims in olivine: $Fa_{3.6\text{-}5.8}$; olivine contains 0.32±0.02 wt% Cr_2O_3 and 0.25±0.02 wt% CaO

Northwest Africa 11640 (NWA 11640)
(Northwest Africa)
Purchased: 2017
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish fragment lacking any fusion crust.
Petrography: The meteorite shows a cumulate texture of up to 2.5 mm sized olivine and pigeonite grains. Olivine crystals appear to consists of smaller subgrains and pigeonite shows patchy compositional zoning. Olivine displays characterisitic reduced rims. The meteorite contains diamond and shows some foliation.
Geochemistry: reduced rims in olivine: $Fa_{2.0\text{-}7.7}$; olivine contains 0.65±0.04 wt% Cr_2O_3 and 0.35±0.02 wt% CaO

Northwest Africa 11641 (NWA 11641)
(Northwest Africa)
Purchased: 2017
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Mali.
Physical characteristics: Dark bownish fragment lacking any fusion crust.
Petrography: The meteorite shows a cumulate texture composed of up to 1 mm sized olivine and pigeonite grains. Olivine displays characteristic reduced rims and the meteorite contains abundant flaky graphite.
Geochemistry: reduced rims in olivine: $Fa_{4.7\text{-}8.8}$; olivine contains 0.61±0.02 wt% Cr_2O_3 and 0.34±0.01 wt% CaO

Northwest Africa 11643 (NWA 11643)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL5)
Petrography: The meteorite is an ordinary chondrite predominantly composed of densely packed chondrules with a mean diameter of about 1 mm. Matrix and metal are rare; plagioclase grain size is about 20 μm. Olivine and pyroxene are completely equilibrated.

Northwest Africa 11644 (NWA 11644)
(Northwest Africa)
Purchased: 2017
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Two small dark brownish fragments lacking any fusion crust.
Petrography: The meteorite displays a coarse-grained cumulate texture of predominant up to 2 mm sized olivine grains and less abundant pigeonite. Contains some graphites flakes; olivine displays characteristic reduced rims.
Geochemistry: reduced rims in olivine: $Fa_{1.6\text{-}5.3}$; olivine contains 0.73±0.02 wt% Cr_2O_3 and 0.33±0.02 wt% CaO

Northwest Africa 11645 (NWA 11645)
(Northwest Africa)
Purchased: 2015
Classification: Ordinary chondrite (LL4-6)
Petrography: Chondritic breccia consisting of LL6 type fragments set into a clastic LL4 type matrix. Plagioclase grain size in LL6 clasts is about 70 μm.
Geochemistry: type 4 lithology: olivine: $Fa_{29.7\pm0.2}$, n=12; pyroxene: $Fs_{23.4\pm2.4}Wo_{2.3\pm0.9}$, ($Fs_{13.0\text{-}25.6}Wo_{0.5\text{-}3.5}$, n = 21); type 6 lithology: olivine: $Fa_{30.0\pm0.3}$, n=13; pyroxene: $Fs_{25.2\pm0.1}Wo_{2.8\pm0.2}$, n=13

Northwest Africa 11647 (NWA 11647)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, polymict)
History: The meteorite was bought from a meteorite dealer at the mineral fair in St. Marie-aux Mines, France.
Physical characteristics: Grayish fragment partly covered with fusion crust.
Petrography: The meteorite is a polymict breccia with basaltic and black melt clasts set into a clastic mineral matrix. Dominant minerals are magmatically zoned low-Ca pyroxenes, Fe-rich low-Ca pyroxenes with augite exsolution lamellae and calcic plagioclase. Minor phases include silica, chromite, FeS, and ilmenite. No metallic Fe has been found.
Geochemistry: zoned low-Ca pyroxene $Fs_{26.7\pm2.3}Wo_{2.9\pm0.8}$ ($Fs_{23.5\text{-}29.2}Wo_{2.0\text{-}5.1}$, n=15, FeO/MnO=27-33); low-Ca pyroxene host to augite exsolution lamellae: $Fs_{43.4\pm0.3}Wo_{2.9\pm0.3}$ ($Fs_{43.0\text{-}44.1}Wo_{2.6\text{-}3.5}$, n=12, FeO/MnO=32-36); Ca-pyroxene: $Fs_{21.0\pm0.3}Wo_{40.0\pm0.2}$ ($Fs_{20.3\text{-}21.5}Wo_{40.3\text{-}41.1}$, n=13, FeO/MnO=26-32); calcic plagioclase: $An_{90.7\pm1.1}$ ($An_{89.3\text{-}92.4}$, n=14)

Northwest Africa 11648 (NWA 11648)
(Northwest Africa)
Purchased: 2002 Feb
Classification: Ordinary chondrite (L6)
History: A single stone was purchased by Edwin *Thompson* at the Tucson Gem Show and donated to *Cascadia*.

Petrography: About a dozen readily identifiable chondrules are visible in thin section, but their edges grade into surrounding granular regions. Approximately 2% metal present. Minimal weathering. Shock stage (conventional) estimated from olivine deformation; plagioclase deformed.
Geochemistry: (A. Ruzicka and K. Farley, *Cascadia*) Olivine ($Fa_{24.9\pm0.2}$, N=13), low-Ca pyroxene ($Wo_{1.5\pm0.3}Fs_{21.1\pm0.2}En_{77.4\pm0.2}$, N=12), plagioclase ($Ab_{85.1\pm0.6}Or_{3.2\pm0.4}An_{11.4\pm0.8}$, N=13).
Classification: L6 chondrite based on texture and mineral chemistry.
Specimens: *Cascadia* holds the main mass and type specimen, consisting of 28.7 g in two pieces plus one thin section.

Northwest Africa 11649 (NWA 11649)
Morocco
Purchased: 2005
Classification: Iron meteorite (IAB-MG)
History: Purchased from a Moroccan dealer at the 2005 Munich show.
Physical characteristics: The meteorite is oblong, approximately 20 cm in longest dimension, and is characterized by a dark brown to black, regmaglypted exterior.
Petrography: (C. Herd, *UAb*) Optical investigation of a ~1.5 × 3 cm polished and etched surface reveals cm-scale, equant kamacite grains with Neumann lines. Sulfide inclusions are present; no other inclusions are visible, although the surface area examined is relatively small. Terrestrial alteration has occured along fractures connecting to the exterior.
Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 6.7, Co = 0.46 (both wt%); Ir = 3.5, Ga = 88, As = 12.5, W = 1.4, Re = 0.31, Pt = 8.6, Cu = 134, Au = 1.3 (all μg/g).
Classification: (C. Herd, *UAb*): IAB iron, Main Group, through comparison of bulk composition with data from Wasson and Kallemeyn (2002).
Specimens: Type specimen consisting of one representative piece (22.8 g) at *UAb*. Main mass in the Hollis Meteorite Collection.

Northwest Africa 11667 (NWA 11667)
(Northwest Africa)
Purchased: 2017
Classification: Enstatite chondrite (EL6)
History: The meteorite was bought by the main mass holder from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish individual with some patches of fusion crust.
Petrography: The meteorite displays a fine-grained, recrystallized texture of predominantly enstatite, less abundant albitic feldspar, often intergrown daubreelite and troilite, and FeNi metal. No chondrules are visible.

Geochemistry: Feldspar: $An_{15.3}Ab_{80.2}$, n= 12; FeNi metal contains about 1.2 wt% Si

Northwest Africa 11668 (NWA 11668)
(Northwest Africa)
Purchased: 2018
Classification: Martian meteorite (Shergottite)
History: The meteorite was purchased in Tindouf, Algeria, from a Sahrawi dealer.
Physical characteristics: Four dark-green pieces partly covered with fusion crust.
Petrography: The meteorite is a medium grained basalt predominantly composed of up to 1.5 mm sized pyroxene and plagioclase grains. Pyroxene is intensely fractured pigeonite and augite displaying mottled compositional zoning. Plagioclase is completely transformed into compositionally homogeneous maskelynite. Minor phases are ilmenite, ulvöspinel, pyrrhotite and some Si-rich mesostasis.
Geochemistry: pigeonite: $Fs_{53.7\pm4.4}Wo_{14.3\pm2.4}$ ($Fs_{35.5\text{-}59.6}Wo_{9.7\text{-}20.0}$, n=38, FeO/MnO=33-43); augite: $Fs_{26.2\pm7.0}Wo_{32.2\pm3.9}$ ($Fs_{21.1\text{-}48.9}Wo_{20.6\text{-}37.8}$, n=32, FeO/MnO=27-40); feldspar: $An_{56.8}Ab_{42.0}Or_{1.2}$, n=15
Classification: Martian (basaltic shergottite)

Northwest Africa 11669 (NWA 11669)
(Northwest Africa)
Purchased: 2013 Dec
Classification: Ordinary chondrite (LL3)
History: Purchased in Rissani, Morocco by Adam *Aaronson* in December 2013.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed, well-formed chondrules (apparent diameter 580±340 μm, N = 18) are set in a recrystallized matrix containing altered kamacite.
Geochemistry: Olivine ($Fa_{0.5\text{-}61.4}$, Cr_2O_3 in ferroan examples 0.07-0.18 wt.%, mean 0.12±0.04 wt.%, N = 8), orthopyroxene ($Fs_{3.0\text{-}14.9}Wo_{0.3\text{-}3.6}$, N = 3), subcalcic augite ($Fs_{14.5}Wo_{33.0}$), diopside ($Fs_{1.0}Wo_{45.9}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 3.22.
Classification: Ordinary chondrite (LL3).
Specimens: 26.4 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11670 (NWA 11670)
(Northwest Africa)
Purchased: 2017 Mar
Classification: Carbonaceous chondrite (CK4)
History: Purchased in Zagora, Morocco, by Adam *Aaronson* in March 2017.

Petrography: (A. Irving and S. Kuehner, *UWS*) Equilibrated specimen composed of separated, medium-sized chondrules (containing rounded grains of stained Cr-magnetite) set in a finer grained matrix containing Cr-magnetite, chlorapatite and pentlandite.
Geochemistry: Olivine ($Fa_{32.1-32.4}$, N = 3), orthopyroxene ($Fs_{26.7-29.7}Wo_{0.8-1.8}$, N = 3), clinopyroxene ($Fs_{11.5-14.6}Wo_{47.6-48.3}$, N = 2).
Classification: CK4 chondrite.
Specimens: 21 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11671 (NWA 11671)
(Northwest Africa)
Purchased: 2017 Aug
Classification: Ureilite
History: Purchased in Temara, Morocco, by Adam *Aaronson* in August 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate (mean grainsize 1.5 mm) composed entirely of olivine (with relatively thick dark, reduced magnesian rims). Multiple planar deformation lamellae are visible in some olivine grains viewed in cross-polarized light. A thorough search of the thin section revealed no pyroxene.
Geochemistry: Olivine (cores $Fa_{20.6-20.8}$, rim $Fa_{5.8}$, N = 4).
Classification: Ureilite (dunitic).
Specimens: 20.6 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11672 (NWA 11672)
(Northwest Africa)
Purchased: 2017 Jun
Classification: Ordinary chondrite (L3)
History: Purchased by Gary Fujihara in June 2017 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed, unequilibrated chondrules (apparent diameter 620±340 μm, N = 18) are set in a recrystallized matrix containing slightly stained kamacite.
Geochemistry: Olivine ($Fa_{1.8-64.0}$, Cr_2O_3 in ferroan examples 0.02-0.84 wt.%, mean 0.19±0.33 wt.%, N = 8), orthopyroxene ($Fs_{3.3-18.8}Wo_{0.2-2.0}$, N = 3), augite ($Fs_{8.7-11.8}Wo_{41.3-36.7}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.73.
Classification: Ordinary chondrite (L3).
Specimens: 21.8 g including one polished thin section at *UWB*; main mass with Mr. G. Fujihara.

Northwest Africa 11674 (NWA 11674)
(Northwest Africa)

Purchased: 2017 Nov
Classification: Ordinary chondrite (L4)
History: Purchased in Temara, Morocco by Adam *Aaronson* in November 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules are set in a recrystallized matrix containing stained kamacite and chlorapatite.
Geochemistry: Olivine ($Fa_{24.9-25.3}$, N = 3), orthopyroxene ($Fs_{20.6-20.8}Wo_{0.9-0.7}$, N = 3), clinopyroxene ($Fs_{6.7-7.6}Wo_{45.6-44.3}$, N = 2).
Classification: Ordinary chondrite (L4).
Specimens: 21 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11675 (NWA 11675)
(Northwest Africa)
Purchased: 2017 Mar
Classification: Ureilite
History: Purchased by Bob Falls in March 2017 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate (mean grainsize 1.9 mm) composed of olivine (~75 vol.%) and pigeonite (~25 vol.%). Olivine grains have relatively thick, dark, reduced magnesian rims associated with Fe metal (extensively altered to hydroxides). Minor secondary gypsum is present.
Geochemistry: Olivine (cores $Fa_{19.6-19.9}$, rim $Fa_{6.3}$, N = 3), pigeonite ($Fs_{13.0}Wo_{5.5}$; $Fs_{15.5}Wo_{11.7}$; N = 2).
Classification: Ureilite.
Specimens: 22.4 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11676 (NWA 11676)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L6)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and donated to *PSF*. In 2018 the specimen was acquired by the Kenosha Public Museum, Wisconsin.
Physical characteristics: A single broken stone (1664 g) partly coated with dark brown fusion crust. The fresher interior exhibits some partly weathered shiny metal and indistinct chondrules.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare chondrule remnants and altered metal.
Geochemistry: Olivine ($Fa_{26.1-26.2}$, N = 3), orthopyroxene ($Fs_{20.9-21.2}Wo_{1.3-1.5}$, N = 3), clinopyroxene ($Fs_{7.8-8.3}Wo_{44.2-44.7}$, N = 2).
Classification: Ordinary chondrite (L6).

Specimens: 39.1 g including one polished thin section at *PSF*; main mass housed at the Kenosha Public Museum, Wisconsin, USA.

Northwest Africa 11677 (NWA 11677)
(Northwest Africa)
Purchased: 2017 Nov
Classification: HED achondrite (Eucrite, polymict)
History: Purchased by Darryl Pitt in November 2017 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Polymict breccia consisting predominantly of eucrite clasts (exhibiting intersertal, subophitic, diabasic and gabbroic textures) and related crystalline debris, together with ~10 vol.% of diogenitic orthopyroxene (exhibiting more ferroan reaction rims against the matrix). Other minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, Ti-chromite and troilite.
Geochemistry: Diogenitic orthopyroxene (cores $Fs_{31.3-33.5}Wo_{3.6-5.3}$, FeO/MnO = 35-36; rim $Fs_{53.8}Wo_{3.8}$, FeO/MnO = 32; N = 3), orthopyroxene host ($Fs_{61.2}Wo_{1.5}$, FeO/MnO = 36), clinopyroxene exsolution lamella ($Fs_{26.0}Wo_{42.9}$, FeO/MnO = 34), low-Ca pyroxene host ($Fs_{45.1}Wo_{7.1}$, FeO/MnO = 31), augite exsolution lamella ($Fs_{22.6}Wo_{39.1}$, FeO/MnO = 30), augite ($Fs_{30.1}Wo_{37.4}$, FeO/MnO = 35), plagioclase ($An_{88.7-89.1}Or_{0.3-0.6}$, N = 2).
Classification: Eucrite (polymict breccia).
Specimens: 21.1 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 11678 (NWA 11678)
(Northwest Africa)
Purchased: 2017 Nov
Classification: Ordinary chondrite (L4)
History: Purchased in Temara, Morocco by Adam *Aaronson* in November 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules are set in a recrystallized matrix containing altered kamacite and merrillite.
Geochemistry: Olivine ($Fa_{25.5-25.6}$, N = 3), orthopyroxene ($Fs_{20.9-21.0}Wo_{1.4-1.5}$, N = 3), clinopyroxene ($Fs_{7.4-7.7}Wo_{45.1-45.4}$, N = 2).
Classification: Ordinary chondrite (L4).
Specimens: 35.4 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11679 (NWA 11679)
Morocco, Laayoun, (Northwest Africa)
Purchased: May 2014
Classification: Enstatite chondrite (EL6)

History: Collected by nomads in Western Sahara and purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.
Physical characteristics: A single piece weighing 98 g with no fusion crust.
Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); A fine-grained texture, with a pyroxene-dominant matrix and minor plagioclase is visible in thin section. No relic chondrules are visible. Kamacite and troilite are the main opaque phases, partially weathered to iron oxides. Accessory phases are alabandite and daubreelite as blades in troilite.
Geochemistry: EMP (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Orthopyroxene ($Fs_{0.3}En_{98.1}Wo_{1.6}$), plagioclase ($An_{17.9}Or_{4.8}$); Si in kamacite = 0.5 wt.%, Ti in troilite = 6.2 wt.%
Classification: Enstatite chondrite (EL6); strong weathering. EL classification is suggested by the presence of alabandite, An content of plagioclase and Si content of kamacite. Possibly paired with NWA 11413, NWA 11414, NWA 11415, NWA 11416.
Specimens: A total of 19.6 g specimen is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 11695 (NWA 11695)
Algeria
Purchased: 2017
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased from a Moroccan meteorite dealer in 2017. Reportedly found by nomads in Algeria, March 2017.
Physical characteristics: Many identical appearing pieces. Weathered exterior, no fusion crust, saw cut reveals a fragmental breccia with numerous white feldspathic clasts set in a dark-gray ground mass.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows primarily feldspathic clasts and shock melt with lesser amounts of fragmental pyroxene and olivine. Z. Kerensky made 6 thin sections and also identified minor amounts of troilite and Fe-metal.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{35.7\pm10.2}$, Mn/Fe=90±8, n=15; pigeonite $Fs_{30.0\pm6.8}Wo_{10.1\pm7.6}$, Mn/Fe=56±6, n=9; augite $Fs_{26.7\pm15.3}Wo_{37.0\pm7.7}$, Mn/Fe=54±11, n=7; plagioclase $An_{96.5\pm0.5}$, n=7; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): SiO_2=43.5±0.1, TiO_2=0.19±0.01, Al_2O_3=28.9±0.1, Cr_2O_3=0.11±0.01, MgO=6.2±0.0, FeO=4.1±0.1, MnO=0.06±0.00, CaO=16.0±0.1, Na_2O=0.34±0.01, K_2O=0.02±0.00, n=3 (all wt%).
Classification: Lunar, feldspathic breccia
Specimens: 20.85 g on deposit at *CSFK*, probe mount at *UNM*, Zsolt Kereszty holds the main mass.

Northwest Africa 11696 (NWA 11696)
(Northwest Africa)

Purchased: 2017 Sep
Classification: HED achondrite (Diogenite)

History: Portions of the same disaggregated stone were purchased separately by Habib Naji (540 g) and Rachid Chaoui (2166 g) from a Mauritanian dealer in September 2017. In February 2018 the material obtained by Rachid Chaoui was acquired by Terry *Boudreaux* and Bob Falls.

Physical characteristics: A disaggregated and quite brittle stone (2706 g); very fresh, mostly dark gray and in part exhibiting a vitreous luster.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) The fresh specimen is composed predominantly of orthopyroxene with accessory troilite, chromite and minor kamacite. Larger orthopyroxene grains are surrounded by regions of finer grained, crushed grains in a cataclastic texture.

Geochemistry: Orthopyroxene ($Fs_{24.5\text{-}25.6}Wo_{1.9\text{-}2.1}$, FeO/MnO = 27-30, N = 5).

Classification: Diogenite.

Specimens: 24.8 g including one polished thin section and one polished mount at *UWB*; remaining material with Mr. T. *Boudreaux*, Mr. H. Naji and Mr. R. Falls.

Northwest Africa 11697 (NWA 11697)
(Northwest Africa)
Purchased: 2017 Nov
Classification: Rumuruti chondrite (R3-6)

History: Purchased by Bob Falls in November 2017 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of small unequilibrated Type 3 lithic clasts (containing separated chondrules with apparent diameter 560±350 μm, N = 10) and related debris (including isolated chondrules), plus rare fine grained, recrystallized Type 5 and Type 6 chondrite clasts, in a finer grained matrix. Minerals in addition to olivine and pyroxenes include albitic plagioclase, pentlandite, troilite and minor ilmenite. Metal is absent. No CAI were observed in the studied thin section, but several chondrules were found to contain highly aluminous pyroxenes.

Geochemistry: Olivine in Type 3 clasts and isolated chondrules ($Fa_{1.5\text{-}48.4}$, N = 4), orthopyroxene ($Fs_{1.9\text{-}14.5}Wo_{0.3\text{-}2.9}$, N = 3), augite ($Fs_{10.7}Wo_{45.4}$), Al-rich subcalcic clinopyroxene in chondrule ($Fs_{3.5}Wo_{29.2}$, Al_2O_3 = 7.7 wt.%, TiO_2 = 1.0 wt.%), Al-rich diopside in chondrule ($Fs_{1.8}Wo_{41.9}$, Al_2O_3 = 7.7 wt.%, TiO_2 = 0.9 wt.%), Al-rich low-Ca pyroxene in chondrules ($Fs_{1.9\text{-}2.2}Wo_{2.9\text{-}3.2}$, Al_2O_3 = 11.6-13.8 wt.%, TiO_2 0.5-0.7 wt.%; $Fs_{16.6}Wo_{3.7}$, Al_2O_3 = 16.0 wt.%, TiO_2 = 0.4 wt.%; N = 4), plagioclase ($An_{6.5\text{-}10.0}Or_{2.0\text{-}2.9}$, N = 2).

Classification: R3-6 chondrite. The high content of Mg-Tschermak's component in low-Ca pyroxenes in some chondrules is an anomalous feature of this specimen.

Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11698 (NWA 11698)
(Northwest Africa)
Purchased: 2017 Feb
Classification: HED achondrite (Eucrite, monomict)
History: Purchased by Bob Falls in February 2017 from a Moroccan dealer at the Tucson Gem and Mineral Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Monomict breccia consisting of closely packed, subophitic eucrite clasts in a sparse matrix of related debris. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite and troilite.
Geochemistry: Orthopyroxene host ($Fs_{60.8-62.5}Wo_{3.6-1.8}$, FeO/MnO = 33-35, N = 3), clinopyroxene exsolution lamellae ($Fs_{26.3-26.8}Wo_{44.2-43.7}$, FeO/MnO = 33-35, N = 2), plagioclase ($An_{84.5-84.6}Or_{0.8-0.6}$, N = 2).
Classification: Eucrite (monomict breccia).
Specimens: 25.5 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11699 (NWA 11699)
(Northwest Africa)
Purchased: 2017 Oct
Classification: Carbonaceous chondrite (CM2)
History: Purchased by Ben Hoefnagels in October 2017 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*; L. Garvie, *ASU*) Very small, well-formed granular chondrules (apparent diameter 200±70 µm, N = 14), mineral fragments and sparse very fine grained CAI are set in a finer grained matrix (deep sepia brown in thin section) containing clay minerals and serpentine (both confirmed by powder X-ray diffraction) plus accessory phosphorian Fe-Ni sulfides.
Geochemistry: Olivine ($Fa_{0.4-58.8}$, N = 3), orthopyroxene ($Fs_{0.6-0.7}Wo_{1.3-0.8}$, N = 2), clinopyroxene ($Fs_{0.7-0.8}Wo_{44.6-40.1}$, N = 2). Oxygen isotopes (K. Ziegler, *ASU*) $\delta^{17}O$ -0.850, -1.728; $\delta^{18}O$ 6.238, 5.426; $\Delta^{17}O$ -4.144, -4.593 (all per mil).
Classification: Carbonaceous chondrite (CM2). The presence of phosphoran Fe-Ni sulfides in this specimen is notable and represents only the second such confirmation among northwest African specimens. Phosphorian Fe-Ni sulfides were previously described in CM chondrites by Nazarov et al. (2009) and in CM-related clasts within polymict eucrite NWA 5232 by Kuehner et al. (LPSC 40, #2314, 2009).
Specimens: 15.2 g including one polished thin section at *UWB*; main mass with Mr. B. Hoefnagels.

Northwest Africa 11700 (NWA 11700)
(Northwest Africa)
Purchased: 2017 Nov
Classification: Ordinary chondrite (H4)

History: Purchased in Temara, Morocco by Adam *Aaronson* in November 2017.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed, relatively small chondrules are set in a recrystallized matrix containing altered kamacite and merrillite.
Geochemistry: Olivine ($Fa_{18.8\text{-}18.9}$, N = 3), orthopyroxene ($Fs_{15.5\text{-}17.0}Wo_{0.5\text{-}1.2}$, N = 3), clinopyroxene ($Fs_{7.5\text{-}9.4}Wo_{40.5\text{-}42.4}$, N = 2).
Classification: Ordinary chondrite (H4).
Specimens: 29.2 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 11701 (NWA 11701)
(Northwest Africa)
Purchased: 2017 Sep
Classification: HED achondrite (Eucrite, polymict)
History: Purchased by Bob Falls in September 2017 from a Moroccan dealer at the Denver Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of intersertal to gabbroic eucrite clasts plus ~5 vol.% diogenitic orthopyroxene grains in a quench-textured melt matrix (partly vesicular with minor calcite infillings). Eucrite clasts consist of exsolved pigeonite and calcic plagioclase (polycrystalline) with accessory silica polymorph, ilmenite, fayalite, troilite, Ni-poor metal and zircon.
Geochemistry: Orthopyroxene host ($Fs_{61.4\text{-}61.5}Wo_{2.8\text{-}2.0}$, FeO/MnO = 32, N = 3), clinopyroxene exsolution lamellae ($Fs_{27.0\text{-}27.3}Wo_{43.4\text{-}41.4}$, FeO/MnO = 32-33, N = 2), diogenitic orthopyroxene ($Fs_{30.8\text{-}32.6}Wo_{5.4\text{-}3.1}$, FeO/MnO = 31-34, N = 2), fayalite ($Fa_{84.5\text{-}85.6}$, FeO/MnO = 38, N = 2), plagioclase ($An_{78.7\text{-}82.9}Or_{1.3\text{-}0.6}$, N = 2).
Classification: Eucrite (melt-matrix polymict breccia).
Specimens: 25.8 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11702 (NWA 11702)
Mauritania
Purchased: 2017 Sep
Classification: Ordinary chondrite (LL6)
History: Purchased by Jason Bliss in September 2017 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of closely packed clasts with rare remnant chondrules in a dominant recrystallized, poikiloblastic matrix containing stained metal and chlorapatite.
Geochemistry: Olivine ($Fa_{29.7\text{-}30.0}$, N = 3), orthopyroxene ($Fs_{22.9\text{-}23.6}Wo_{2.7\text{-}3.9}$, N = 3), clinopyroxene ($Fs_{10.6\text{-}11.4}Wo_{42.5\text{-}42.2}$, N = 2).
Classification: Ordinary chondrite (LL6 breccia).
Specimens: 8.4 g including one polished thin section at *UWB*; remainder with Mr. J. Bliss.

Northwest Africa 11703 (NWA 11703)
(Northwest Africa)
Purchased: 2015 Apr
Classification: Lunar meteorite (gabbro)
History: Purchased by Darryl Pitt in April 2015 from a dealer in Erfoud, Morocco.
Physical characteristics: A single pale greenish stone (5309.1 g) with thin cross-cutting shock veinlets.
Petrography: (A. Irving and S. Kuehner, *UWS*) Medium grained (grainsize up to 1.4 mm) with cumulate texture. Major minerals are olivine, pigeonite, subcalcic augite and calcic plagioclase (predominantly converted to maskelynite with minor birefringent domains); accessory phases include ilmenite, taenite, troilite, Mg-merrillite and baddeleyite. Shock veinlets contain dark glass.
Geochemistry: Olivine ($Fa_{32.1\text{-}32.4}$, FeO/MnO = 91-97, N = 3), pigeonite ($Fs_{26.0}Wo_{9.7}$; $Fs_{27.7}Wo_{5.7}$; FeO/MnO = 47-60; N = 2), subcalcic augite ($Fs_{16.4\text{-}17.5}Wo_{34.9\text{-}32.3}$, FeO/MnO = 46-52, N = 2), plagioclase ($An_{89.7\text{-}91.2}Or_{0.8\text{-}1.1}$, N = 2).
Classification: Lunar (gabbro). This specimen is texturally and mineralogically identical to NWA 2977, NWA 6950, NWA 8127, and to the olivine gabbro clasts in NWA 773, NWA 2700, NWA 2727 and NWA 3333, and evidently is paired with those lithologies.
Specimens: 20.1 g including one polished thin section at *UWB*; remainder held by *DPitt*.

Northwest Africa 11704 (NWA 11704)
Mauritania
Purchased: 2018 Jan
Classification: HED achondrite (Eucrite, polymict)
History: A batch of about 50 stones with similar appearance found together in Mauritania was purchased by John Higgins in January 2018 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting predominantly of gabbroic eucrite clasts, some ophitic eucrite clasts and sparse clasts of feldspathic diogenite in a finer grained matrix. Minerals include exsolved pigeonite, calcic plagioclase (exhibiting undulose to polycrystalline microstructure), silica polymorph, ilmenite, Ti-chromite, Ti-poor chromite, troilite and minor barite. Feldspathic diogenite clasts consist mainly of relatively ferroan orthopyroxene with subordinate anorthite and minor clinopyroxene.
Geochemistry: Orthopyroxene host ($Fs_{58.5}Wo_{4.6}$, FeO/MnO = 35), clinopyroxene exsolution lamella ($Fs_{28.1}Wo_{41.0}$, FeO/MnO = 34), orthopyroxene host ($Fs_{44.5}Wo_{2.2}$, FeO/MnO = 30), clinopyroxene exsolution lamella ($Fs_{17.8}Wo_{43.8}$, FeO/MnO = 25), plagioclase ($An_{86.6}Or_{0.8}$). Minerals in feldspathic diogenite clast: orthopyroxene ($Fs_{33.2\text{-}33.8}Wo_{1.7\text{-}2.4}$, FeO/MnO = 29-32, N = 2), clinopyroxene ($Fs_{10.8}Wo_{45.8}$, FeO/MnO = 21), anorthite ($An_{95.4}Or_{0.2}$).

Classification: Eucrite (polymict breccia).
Specimens: 26.6 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

Northwest Africa 11705 (NWA 11705)
(Northwest Africa)
Purchased: 2017 Mar
Classification: Ordinary chondrite (H4/5)
History: Purchased by Bob Falls in March 2017 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen containing some well-formed, relatively small chondrules in a recrystallized matrix containing merrillite, troilite, kamacite and taenite.
Geochemistry: Olivine ($Fa_{15.6\text{-}15.7}$, N = 3), orthopyroxene ($Fs_{14.0\text{-}14.1}Wo_{0.6\text{-}0.7}$, N = 3), clinopyroxene ($Fs_{9.9}Wo_{33.9}$; $Fs_{7.9}Wo_{47.2}$; N = 2).
Classification: Ordinary chondrite (H4/5). The mafic silicates in this specimen are unusually magnesian in comparison to those in most H chondrites.
Specimens: 26.7 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11706 (NWA 11706)
Morocco
Purchased: Sept 2016
Classification: Carbonaceous chondrite (CK5)
History: A single stone weighing 116 g was purchased by Hichame Mimaghador at the Erfoud market, Morocco, in 2016.
Physical characteristics: A single stone, almost completely covered by a fusion crust with several contraction cracks.
Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The thin section displays a texture consisting of mm-sized granular olivine-rich chondrules containing magnetite blebs well integrated in a medium grained olivine-rich matrix. A fine grained olivine-augite-plagioclase aggregate 500 × 250 μm wide is visible. Main minerals are olivine, augite, intermediate plagioclase. Opaques are mainly pentlandite and Cr-rich magnetite, with minor altered kamacite.
Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Olivine ($Fa_{34.7\pm1.3}$, Fe/Mn = 142.0±8.1, N = 7), augite ($Fs_{13.5\pm0.4}Wo_{49.3\pm1.3}$, Al_2O_3 = 1.28 Wt.%, N = 6). Feldspar $An_{55.0}Ab_{43.9}Or_{1.1.}$ Magnetite contains 1.7±0.1 wt.% Cr_2O_3, 0.26 wt.% Al_2O_3, 0.23 wt.% NiO (N=3). Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}O$ = -5.76 ‰, $\delta^{18}O$ = -1.91 ‰, $\Delta^{17}O$ = -4.76 ‰.
Classification: Carbonaceous chondrite (CK5). Moderate weathering.
Specimens: A total of 19.6 g specimen, a block (0.4 g) and a thin section are on deposit at MSN-Fi. 96 g with Mimaghador.

Northwest Africa 11707 (NWA 11707)

Morocco

Purchased: Feb 2016

Classification: Carbonaceous chondrite (CK4)

History: A single stone weighing 470 g was purchased by Hichame Mimaghador at the Erfoud market, Morocco, in 2016.

Physical characteristics: A single stone covered by fusion crust with contraction cracks.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): A texture consisting of well-formed, mm-sized granular chondrules containing magnetite can be observed. Chondrules are surrounded by a medium grained, recrystallized matrix with disseminated opaque phases. Main minerals are olivine, orthopyroxene, augite, albitic plagioclase. Opaque phases are mainly represented by troilite and Cr-rich magnetite, with minor kamacite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): Olivine ($Fa_{28.0\pm1.2}$, Fe/Mn = 93.6±10.1, N = 8), orthopyroxene ($Fs_{23.7\pm1.0}Wo_{1.7\pm0.2}$, Al_2O_3 = 2.51 Wt.%, N = 4); augite ($Fs_{8.8\pm1.5}Wo_{44.1\pm1.8}$, Al_2O_3 = 0.51 Wt.%, N = 4). Feldspar $An_{17.2}Or_{5.3.}$ Magnetite contains 2.7±0.1 wt.% Cr_2O_3, 0.67 wt.% Al_2O_3, 0.55 wt.% NiO (N=3); Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}O$ = -3.58 ‰, $\delta^{18}O$ = 0.93 ‰, $\Delta^{17}O$ = -4.06 ‰

Classification: Carbonaceous chondrite (CK4). Moderate weathering.

Specimens: A total of 20.7 g specimen is on deposit at MSN-Fi. The main mass is with owner.

Northwest Africa 11708 (NWA 11708)

Morocco

Purchased: Feb 2016

Classification: Carbonaceous chondrite (CK3)

History: A stone weighing 1104 g was purchased by Hichame Mimaghador at the Erfoud market in 2016.

Physical characteristics: A single stone covered by fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The thin section displays separated, well-formed chondrules (ranging in diameter from 300 to 700 μm, mean value 350 μm) of different types, in a fine-grained matrix consisting of Fe-rich olivine and orthopyroxene, coarse grained Fe-rich olivine fragments and scattered opaque phases. Chondrule types are mainly PO, with minor POP and PP types. Main minerals are olivine, orthopyroxene, Ca-rich plagioclase and clinopyroxene. Opaques are mainly consisting of troilite and Cr-magnetite, with minor altered kamacite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Olivine in PO and POP chondrules ($Fa_{1.7\pm0.2}$, Fe/Mn = 11.4±1.1, N = 6); Olivine in mineral fragments ($Fa_{38.9\pm5.3}$, Fe/Mn = 101.7±10.1, N = 10), Orthopyroxene in POP chondrules ($Fs_{2.5\pm0.2}Wo_{2.1\pm0.1}$, Fe/Mn = 11.5±1.2, N = 15); Matrix orthopyroxene ($Fs_{43.5\pm3.5}Wo_{1.2\pm0.2}$, Fe/Mn = 105.1±1.2, N = 5); fassaite ($Fs_{4.4\pm0.4}En_{56.6\pm0.3}Wo_{39.0\pm0.9}$,

Al_2O_3 = 6.0 Wt.%, N = 5). Feldspar $An_{95.7}Or_{0.1.}$ Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}O$ = -4.75 ‰, $\delta^{18}O$ = -1.14 ‰, $\Delta^{17}O$ = -4.15 ‰.
Classification: Carbonaceous chondrite (CK3). Moderate weathering.
Specimens: A total of 24 g specimen is on deposit at *MSN-FI*. The main mass is with owner.

Northwest Africa 11709 (NWA 11709)
Morocco
Purchased: June 2016
Classification: HED achondrite (Eucrite)
History: A fragmented stone consisting of many pieces totally weighing 180 g was found by an anonymous person in Western Sahara and purchased 2016 by Enzo Compagnucci.
Physical characteristics: Few fragments are partly covered by fusion crust.
Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The thin section reveals a brecciated texture consisting of lithic clasts in a fine grained matrix. Lithic clasts consists of exsolved orthopyroxene crystals with fine pigeonite exsolution lamellae, 4-8 μm in width, augite, calcic plagioclase, ilmenite, chromite, troilite and FeNi metal.
Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Eucritic clasts: orthopyroxene host ($Fs_{36.6\pm1.1}En_{60.2\pm1.3}Wo_{3.3\pm0.2}$, FeO/MnO = 29.5?0.3, n=6); augite ($Fs_{22.6\pm1.1}En_{33.0\pm1.2}Wo_{44.4\pm1.4}$; n=6; Fe/Mn=28.3±0.3); pigeonite exsolution lamellae in orthopyroxene ($Fs_{52.6\pm1.2}$,$En_{44.4\pm1.1}Wo_{3.0\pm0.3}$; n=5; Fe/Mn = 31.2±0.3); Plagioclase $An_{91.7\pm1.3}Or_{0.3\pm0.1}$, n=4;
Classification: Eucrite with medium degree of shock and medium degree of weathering.
Specimens: A total of 20.2 g specimen and one thin section is on deposit at MSN-Fi. Cavaglià owns the main mass, now weighing 160 g.

Northwest Africa 11710 (NWA 11710)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a Morrocan meteorite dealer at the mineral fair in Munich, Germany.
Physical characteristics: Greyish individual partly covered with fusion crust.
Petrography: The meteorite is a medium-grained unbrecciated igneous rock predominantly composed of 100-600 μm sized exsolved pyroxene and calcic plagioclase. Minor phases include silica, ilmenite, troilite, and metallic iron.
Geochemistry: low-Ca pyroxene $Fs_{58.3\pm1.3}Wo_{3.9\pm1.6}$ ($Fs_{55.9\text{-}59.5}Wo_{2.1\text{-}6.2}$, n=11, FeO/MnO=29-30); Ca-pyroxene: $Fs_{29.6\pm3.1}Wo_{39.4\pm3.9}$ ($Fs_{27.1\text{-}38.8}Wo_{28.1\text{-}42.2}$, n=11, FeO/MnO=27-32); calcic plagioclase: $An_{89.8\pm0.5}$ ($An_{88.6\text{-}90.5}$, n=13)

Northwest Africa 11712 (NWA 11712)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Howardite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark-grayish individual lacking any fusion crust.
Petrography: The meteorite is a breccia composed of abundant up to 1.3 mm mineral and less abundant basaltic clasts set into a finer grained clastic matrix. Predominant minerals are exsolved pyroxene, diogenetic orthopyroxene (30-35%) and calcic plagioclase. Accessory phases include silica, chromite, and metallic Fe. The meteorite contains abundant shock melt veins and pockets.
Geochemistry: diogenetic low-Ca pyroxene $Fs_{33.6\pm0.5}Wo_{2.3\pm0.2}$ ($Fs_{33.2\text{-}34.6}Wo_{2.0\text{-}2.8}$, n=16, FeO/MnO=25-31); low-Ca pyroxene host to augite exsolution lamellae: $Fs_{58.6\pm0.7}Wo_{4.4\pm0.7}$ ($Fs_{57.5\text{-}59.7}Wo_{3.2\text{-}5.7}$, n=10, FeO/MnO=32-35); Ca-pyroxene: $Fs_{28.6\pm2.0}Wo_{40.4\pm1.9}$ ($Fs_{25.8\text{-}31.9}Wo_{37.4\text{-}42.7}$, n=6, FeO/MnO=31-38); calcic plagioclase: $An_{89.4\pm3.1}$ ($An_{82.6\text{-}92.9}$, n=17)

Northwest Africa 11720 (NWA 11720)
(Northwest Africa)
Purchased: 2017 Jan
Classification: Pallasite (Main group, anomalous)
History: A batch of small metal-bearing stones (230 g) purported to have been found at the same site as NWA 10023 and NWA 10252 was purchased by Mike Bandli in January 2017 from a Moroccan dealer at the Tucson Gem and Mineral Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Coarse grained aggregate of olivine and stained plessitic metal with rare accessory schreibersite.
Geochemistry: Olivine ($Fa_{13.3\text{-}13.7}$, FeO/MnO = 47-53, N = 3).
Classification: Pallasite PMG-an. Likely paired with NWA 10023 and NWA 10252. Anomalous designation based on the presence of the same plessitic metal observed in the larger specimens, plus the fact that these stones were found with the previous specimens and purchased from the same Moroccan dealer.
Specimens: 20.2 g including one polished endcut at *UWB*; remainder with Mr. M. Bandli.

Northwest Africa 11721 (NWA 11721)
(Northwest Africa)
Purchased: 2017 Dec
Classification: Rumuruti chondrite (R3)

History: A batch of about 10 stones with similar appearance (total 5345 g, the largest stone 2670 g) was purchased by Jason Phillips in December 2017 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular clasts in a matrix of related debris. Clasts contain well-formed, separated unequilibrated chondrules (apparent diameter 310±200 μm, N = 15) set in a finer grained metal-free matrix. Accessory minerals are sodic plagioclase, troilite, Ti-chromite and chlorapatite.
Geochemistry: Olivine ($Fa_{7.0\text{-}57.4}$, N = 5), orthopyroxene ($Fs_{0.7\text{-}8.1}Wo_{0.1}$, N = 2), pigeonite ($Fs_{32.7}Wo_{6.6}$), augite ($Fs_{11.7}Wo_{44.7}$). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.43.
Classification: R3 chondrite (breccia).
Specimens: 25.3 g including one polished thin section at *UWB*; remainder with Mr. J. Phillips.

Northwest Africa 11722 (NWA 11722)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter 510±370 μm, N = 15) are set in a finer grained matrix containing altered kamacite, merrillite and taenite.
Geochemistry: Olivine ($Fa_{6.3\text{-}43.5}$, Cr_2O_3 in ferroan examples 0.03-0.15 wt.%, mean 0.08±0.05 wt.%, N = 8), orthopyroxene ($Fs_{2.1\text{-}19.5}Wo_{0.3\text{-}0.4}$, N = 3), pigeonite ($Fs_{3.6}Wo_{17.1}$), augite ($Fs_{7.9}Wo_{44.7}$).
Classification: Ordinary chondrite (L3).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11723 (NWA 11723)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L5)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules occur in a recrystallized matrix containing altered metal.
Geochemistry: Olivine ($Fa_{25.5\text{-}25.9}$, N = 3), orthopyroxene ($Fs_{20.9\text{-}21.2}Wo_{1.8\text{-}1.5}$, N = 2), clinopyroxene ($Fs_{6.8\text{-}8.1}Wo_{46.2\text{-}44.3}$, N = 2).
Classification: Ordinary chondrite (L5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11724 (NWA 11724)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L6)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules; accessory chlorapatite and merrillite are present. Silicates are extensively stained by weathering products of primary metal and there are cross-cutting Fe hydroxide veinlets.
Geochemistry: Olivine ($Fa_{25.2-25.3}$, N = 3), orthopyroxene ($Fs_{21.6-21.8}Wo_{1.7-1.1}$, N = 2), clinopyroxene ($Fs_{8.5-12.7}Wo_{43.8-41.8}$, N = 2).
Classification: Ordinary chondrite (L6).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11725 (NWA 11725)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L4)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, closely packed chondrules are set in a finer grained matrix containing stained metal.
Geochemistry: Olivine ($Fa_{24.9-25.0}$, N = 3), orthopyroxene ($Fs_{20..5-20.6}Wo_{1.6-4.0}$, N = 2), clinopyroxene ($Fs_{8.6-9.3}Wo_{44.2-42.7}$, N = 2).
Classification: Ordinary chondrite (L4).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11726 (NWA 11726)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L4/5)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Some well-formed chondrules are present within a recrystallized matrix containing stained metal.
Geochemistry: Olivine ($Fa_{24.5-24.7}$, N = 3), orthopyroxene ($Fs_{20.5-21.8}Wo_{1.6-1.5}$, N = 2), clinopyroxene ($Fs_{7.9-8.1}Wo_{44.5-45.1}$, N = 2).
Classification: Ordinary chondrite (L4/5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11727 (NWA 11727)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L5)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules occur in a recrystallized matrix containing altered metal.
Geochemistry: Olivine ($Fa_{24.7\text{-}25.1}$, N = 3), orthopyroxene ($Fs_{20.9\text{-}21.0}Wo_{1.3\text{-}1.6}$, N = 2), clinopyroxene ($Fs_{7.2\text{-}7.9}Wo_{45.2\text{-}44.7}$, N = 2).
Classification: Ordinary chondrite (L5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11728 (NWA 11728)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L4)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, closely-packed chondrules are set in a finer grained matrix containing stained metal.
Geochemistry: Olivine ($Fa_{24.5\text{-}24.9}$, N = 3), orthopyroxene ($Fs_{19.4\text{-}20.5}Wo_{0.5\text{-}1.2}$, N = 2), subcalcic augite ($Fs_{21.6}Wo_{29.1}$), augite ($Fs_{9.6}Wo_{37.1}$).
Classification: Ordinary chondrite (L4).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11729 (NWA 11729)
Mauritania
Purchased: 2017 Dec
Classification: HED achondrite (Eucrite, anomalous)
History: Purchased by Rachid Chaoui in December 2017 from a Mauritanian dealer and subsequently acquired by Bob Falls.
Physical characteristics: A single brownish stone (345 g) mostly coated by black fusion crust. The interior exhibits a breccia texture with beige clasts stained light orange by terrestrial weathering.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of closely packed microgabbroic clasts plus some genomict breccia clasts within a sparse matrix of related debris. Minerals are exsolved ferroan pigeonite, calcic plagioclase, silica polymorph, ilmenite Ti-chromite, fayalitic olivine and minor zircon. Terrestrial weathering has resulted in extensive alteration of primary troilite to Fe hydroxides and some cross-cutting hydroxide veinlets.

Geochemistry: Orthopyroxene host ($Fs_{69.6}Wo_{1.7}$, FeO/MnO = 29), clinopyroxene exsolution lamella ($Fs_{33.2}Wo_{42.1}$, FeO/MnO = 30), clinopyroxene host ($Fs_{30.9}Wo_{43.5}$, FeO/MnO = 32), orthopyroxene exsolution lamella ($Fs_{69.5}Wo_{1.9}$, FeO/MnO = 36), fayalite ($Fa_{73.9\text{-}74.1}$, FeO/MnO = 47, N = 2), plagioclase ($An_{82.3\text{-}84.3}Or_{0.7\text{-}0.5}$, N = 2). Oxygen isotopes (K. Ziegler, UNM): analyses of acid-washed subsamples by laser fluorination gave, respectively, d17O 2.680,3.062, 2.301; d18O 5.540, 6.312, 4.934; D17O -0.245, -0.271, -0.304 per mil.
Classification: Eucrite (anomalous monomict breccia, microgabbroic, highly ferroan). The pyroxenes in this specimen are much more ferroan than in any other known eucrites: ferrosilite contents in orthopyroxene are almost 70 mol.%. The oxygen isotopic composition is also unusual with a higher d18O than other main group eucrites.
Specimens: 22.5 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11730 (NWA 11730)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL6, melt breccia)
History: Purchased by Larry Atkins from Morocco in 2017.
Physical characteristics: Single stone, no fusion crust. A saw cut reveals a gray-colored breccia with pervasive dark shock melt veins and pockets.
Petrography: (C. Agee, *UNM*) This meteorite is a breccia of LL6 chondrite clasts set in a network of shock melt veins. Faint chondrules were observed, most metal and sulfide is in the form of finely dispersed blebs.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{32.7\pm0.2}$, Fe/Mn=66±2, n=8; low Ca pyroxene $Fs_{26.3\pm0.2}Wo_{1.8\pm0.3}$, Fe/Mn=39±1, n=7.
Classification: LL6-melt breccia
Specimens: 34.8 g including a probe mount on deposit at *UNM*, Larry Atkins holds the main mass.

Northwest Africa 11731 (NWA 11731)
(Northwest Africa)
Purchased: 2017
Classification: Enstatite chondrite (EL6)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Brownish individual with some patches of black fusion crust.
Petrography: The meteorite displays a recrystallized texture dominated by up to 300 μm sized enstatite grains. Less abundant are albitic feldspar and typically intergrown daubreelite and troilite. No chondrules are visible. The meteorite is strongly altered, i.e., metal is completely converted into Fe-oxides and cracks are frequently filled with calcite and barite.

Geochemistry: feldspar: $An_{15.8}Ab_{79.8}Or_{4.4}$, n=5
Classification: Although metal is completely oxidized and the Si content could not be determined, the absence of niningerite and alkali sulfides points towards an EL6 classification.

Northwest Africa 11732 (NWA 11732)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM2.0)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Small black individual with some fusion crust.
Petrography: The meteorite is a brecciated carbonaceous chondrite composed of chondrule, mineral and CAI polymorphs set into a fine-grained matrix of phyllosilicates (as indicated by fibrous appearance), carbonates and sulfides including up to 400 μm long needles of Ni-bearing pyrrhotite. Carbonates are almost pure calcites and Mg-Mn-Fe-rich varieties. The hydrous and porous nature of the matrix is also proven by low analytical totals of defocused (10 μm beam diameter) electron microprobe analyses. Many components are surrounded by flaky phyllosilicates apparently replacing former dust rims. No anhydrous silicates have been found.
Geochemistry: Mean values of defocused (10 μm beam diameter) matrix analyses (all wt%; N=27): SiO_2: 27.0, TiO_2: 0.09; Na_2O: 0.11; Cr_2O_3: 0.41, MgO: 19.8, MnO: 0.18, CaO: 0.25, FeO: 21.7, Al_2O_3: 2.29, NiO: 0.79, P_2O_5: 0.03, S: 0.36, Total: 73.01
Classification: CM2.0. Subtype based on the absence of anhydrous silicates.

Northwest Africa 11733 (NWA 11733)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Small black individual without fusion crust.
Petrography: The meteorite is a brecciated chondrite consisting of small chondrules (mean apparent diameter about 0.3 mm), mineral fragments, and less abundant CAIs set into a fine-grained matrix. Chondrules and CAIs are sometimes surrounded by dust rims. Matrix minerals are phyllosilicates (as indicated by low analytical totals), carbonates, and pyrrhotite.

Northwest Africa 11734 (NWA 11734)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite, melt breccia)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Brownish individual with some patches of black fusion crust.
Petrography: The meteorite is a eucrite-melt breccia composed of up to 1 cm sized light colored basaltic clasts set into dark recrystallized shock melt matrix. Dominant minerals in the clasts are exolved pyroxene and calcic plagioclase. Minor phases include silica, ilmenite, troilite, chromite, and barite. No metallic Fe has been found.
Geochemistry: low-Ca pyroxene $Fs_{60.8\pm1.0}Wo_{2.8\pm0.5}$ ($Fs_{59.1\text{-}62.1}Wo_{2.1\text{-}3.3}$, n=16, FeO/MnO=30-35); Ca-pyroxene: $Fs_{27.6\pm1.5}Wo_{42.9\pm1.5}$ ($Fs_{25.8\text{-}32.2}Wo_{37.9\text{-}44.2}$, n=23, FeO/MnO=29-37); calcic plagioclase: $An_{88.2\pm2.4}$ ($An_{83.3\text{-}91.0}$, n=21)

Northwest Africa 11735 (NWA 11735)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a Moroccan meteorite dealer on the mineral fair in Munich, Germany.
Physical characteristics: Dark brownish individual with some fusion crust.
Petrography: The meteorite displays a chondritic texture with sometimes slightly flattened and well packed chondrules (mean diameter about 0.6 mm) in a more fine-grained matrix that contains sulfides and FeNi metal.

Northwest Africa 11736 (NWA 11736)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a local meteorite dealer in Algeria.
Physical characteristics: Light brownish individual without fusion crust.
Petrography: The meteorite shows a chondritic texture with clearly defined, sometimes deformed packed chondrules (mean diameter about 0.7 mm) in a fine-grained matrix of mineral and chondrule fragments, FeNi metal and sulfides.

Northwest Africa 11737 (NWA 11737)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Sixteen dark grayish individuals with some fusion crust.

Petrography: The meteorite displays a dark brownish interior and is composed of up to 1.5 mm sized chondrules (mean diameter about 0.9 mm), whitish CAIs, and olivine amoeboids set into a fine-grained almost opaque matrix. Chondrules frequently show brownish staining due to terrestrial weathering; type II chondrules are absent.

Northwest Africa 11738 (NWA 11738)
(Northwest Africa)
Purchased: 2012
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Dark brownish individual without fusion crust.
Petrography: The meteorite shows a cumulus texture of up to 1.5 mm sized Cr-rich olivine and pigeonite crystals. It is brecciated, contains some flaky graphite and olivine displays pronounced reduced rims.
Geochemistry: reduced rims in olivine: $Fa_{2.5\text{-}6.2}$; olivine contains 0.70±0.03 wt% Cr_2O_3 and 0.43±0.02 wt% CaO
Classification: Ureilite, brecciated

Northwest Africa 11739 (NWA 11739)
(Northwest Africa)
Purchased: 2017
Classification: Primitive achondrite
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Small light brownish individual without fusion crust. Sawn surface reveals mosaic of shiny, fine-grained crystals.
Petrography: The meteorite shows an equigranular equilibrium texture with abundant triple junctions between adjoining mineral grains. It is predominantly composed of 200-300 µm sized Fe-rich olivine (about 60 vol.%) with less abundant clinopyroxene (about 15 vol.%) and intermediate plagioclase (about 20 vol.%). Minor phases are FeNi metal and sulfides. No orthopyroxene has been detected.
Geochemistry: olivine: $Fa_{31.2\pm0.1}$, CaO=0.08±0.1, Cr_2O_3=0.01±0.1, FeO/MnO=74-96, n=12; Ca-pyroxene: $Fs_{11.2\pm0.5}Wo_{43.4\pm0.6}$, FeO/MnO=34-54, n=12; feldspar: $An_{34.0}Ab_{63.0}Or_{3.0}$, n=18
Classification: Olivine-rich primitve achondrite with mineral chemistry close to brachinites. However, small grain sizes and high abundance of plagioclase are contrary to brachinites.

Northwest Africa 11740 (NWA 11740)
(Northwest Africa)

Purchased: 2014
Classification: Carbonaceous chondrite (CV3)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Greyish individual with some fusion crust.

Petrography: Carbonaceous chondrite composed of up to 3 mm sized chondrules (mean diameter about 1 mm), CAIs and olivine amoeboids all set into a fine-grained almost black matrix. One CAI about 7 mm in diameter has been observed. Type II chondrules are absent.

Northwest Africa 11741 (NWA 11741)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Diogenite)

History: The meteorite was bought from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Light brownish to orange individual with some patches of fusion crust.

Petrography: The meteorite is a fragmental breccia predominantly composed of blocky up to 4 mm sized orthoproxene crystals. Minor phases include silica, chromite, troilite and metallic iron. Neither plagioclase nor olivine have been found in the section studied.

Geochemistry: low-Ca pyroxene: $Fs_{27.5\pm0.4}Wo_{4.0\pm0.4}$ ($Fs_{26.7\text{-}28.0}Wo_{3.2\text{-}6.8}$, n=22, FeO/MnO=27-32)

Northwest Africa 11742 (NWA 11742)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, melt breccia)

History: The meteorite was bought from a local meteorite dealer in Quarzazate, Morocco.

Physical characteristics: Brownish individual without fusion crust.

Petrography: The meteorite is a melt breccia composed of up to 5 mm sized basaltic clasts set into shock melted matrix. Basaltic clasts consist of exsolved pyroxenes and often lath shaped calcic plagioclase. The shock melt is mostly recrystallized to plagioclase and pyroxene; some regions show pronounced flow textures. Minor phases include silica, chromite, ilmenite and barite.

Geochemistry: low-Ca pyroxene: $Fs_{59.9\pm0.9}Wo_{4.0\pm1.3}$ ($Fs_{57.4\text{-}61.1}Wo_{2.2\text{-}7.6}$, n=14, FeO/MnO=33-37); Ca-pyroxene: $Fs_{27.8\pm1.2}Wo_{42.1\pm1.2}$ ($Fs_{26.2\text{-}30.1}Wo_{39.7\text{-}43.8}$, n=16, FeO/MnO=33-39); calcic plagioclase: $An_{90.6\pm0.8}$ ($An_{89.3\text{-}91.9}$, n=16)

Northwest Africa 11743 (NWA 11743)

Morocco
Purchased: May 2014
Classification: Ordinary chondrite (H4)

History: A small fragment of the studied meteorite weighting 5.0 g was purchased by I. Baziotis from a dealer in Marrakech, Morocco (May 2014). The stone was a broken fragment partly surrounded by fusion crust. A polished thin section was carefully prepared from the fragment and subsequently examined using optical microscopy to identify the texture and mineralogy.

Physical characteristics: 5.0 g. 1 piece. The color of the meteorite is pale brown. Black fusion crust partly covers the sample. Red-brown oxidation is visible on the exterior surface, around metal grains on cut surfaces and within the matrix.

Petrography (I. Baziotis, *AUA*; A. Bischoff, *IfP*): Textural observations of the thin section in reflected light showed a chondritic structure. It contains porphyritic and non-porphyritic chondrules, both Type I (Mg/(Mg+Fe)<90). ?he porphyritic olivine (PO) chondrules have a rounded to oval shape ranging from 300 to 350 ?m, and from 600 to 1200 ?m in size. The groundmass consists of olivine (30 vol.%), low Ca-pyroxene (20 vol.%), clinopyroxene (5 vol.%), plagioclase (5 vol.%) and rare phosphates (apatite). Also, metal-rich material has filled the cracks of the fragment (40 vol%). Shock veins were not observed. The rock matrix is brecciated.

Geochemistry: Mineral Composition and Geochemistry: Coarse grained rock with euhedral to subhedral olivine with narrow compositional range ($Fa_{18.6\text{-}19.2}$), embedded in a translucent feldspathic glassy mesostasis $Ab_{87.6\text{-}82.8.}$ Olivine $Fa_{18.9\pm0.3}$ (n=23); Low-Ca Pyroxene $Fs_{17.8\pm0.3}$ (n=24), $Wo_{0.8\pm0.1}$ (n=24).

Classification (I. Bazioti and A.Pantazidis, *AUA*): This meteorite is a H4 ordinary chondrite. Weathering stage: Minor to slighly moderate oxidation W2, with the major silicates being unaffected.

Specimens: 4.94 g at *NHMV*.

Northwest Africa 11744 (NWA 11744)
(Northwest Africa)
Purchased: 2004
Classification: Ordinary chondrite (L5)

History: sample was purchased from a meteorite collector by Dr Mahesh Anand (*OU*). In July 2016, thin sections of the sample were passed to Craig Walton (*UStA*) for classification work.

Physical characteristics: A single 1566 g stone. Sample mostly has a dark fusion crust, but in places a light coloured interior is exposed. Sample contains abundant complex shock features, mainly micro-fault shear textures, associated with melt pools.

Petrography: (Craig Walton, *UStA*) Overall, sample has a chondritic brecciated texture. Main phases are olivine and pyroxene with opaque metal + troilite. Porphyritic olivine, radial pyroxene, barred olivine and porphyritic olivine pyroxene chondrule types are all common, along with rare cryptocrystalline and glassy chondrules. Chondrule average diameter is 370±220 μm (N=27), up to 1

mm. Chondrules comprise ~70 % of the sample. Opaque phases are metal (Fe,Ni in exsolution as kamacite and taenite) and sulfide (troilite). Modal abundances of metal and sulfide are 5.8% and 4.4%, respectively. A recrystallized and shock-darkened matrix of fine-grained lithic fragments comprises ~ 20% of the sample area. Some isolated euhedral olivine grains (up to ~1 mm) occur embedded in this matrix. Olivine contains planar deformation features and has undulose extinction. Planes across which shear displacement has occurred (microfaults) crosscut chondrule and brecciated matrix textures. Fine-grained silicate melt-pools bearing globules of immiscible metal and sulfide are hosted within some sections of these microfaults. Microfault textures crosscut chondrules, matrix and metal, with individual faults running along the length of the slide. Offset on the faults is on the order of 500 μm. ~50 μm-wide shock-melt pools/veins occur within the faults.
Geochemistry: Mineral compositions and geochemistry: (Craig Walton, *UStA*; Mahesh Anand, Sam Hammond, Richard Greenwood, *OU*) Microprobe (Cameca SX100 EMPA) (all values given in wt %). Olivine (n=5): MgO = 38.8, CaO = 0.1, MnO = 0.5, FeO = 22.7, SiO = 38.1. TiO = 0.1 Pyroxene (n=2): Na_2O = 0.1, MgO = 28.5, K_2O = 0.2, CaO = 1.3, MnO = 0.4, FeO = 14.2, Al_2O_3 = 0.8, Cr_2O_3 = 0.4, SiO_2 = 55.1, TiO_2 = 0.1, P_2O_5 = 0.1. Oxygen Isotopes (Laser fluorination CO_2 laser, Thermo Scientific MAT 253 gas source mass spectrometer) $\delta^{18}O$=5.139, $\delta^{17}O$=3.778, $\Delta^{17}O$=1.105 (all in ‰).
Classification: L5 chondrite. Shock stage is S4/5 as evidenced by shear microfault textures, associated shock-melt veins, shock darkening of matrix and undulose extinction and planar deformation features in olivine. Oxygen isotopes are indiscriminate between L and LL, however Fs (Px) and Fa (Ol) data along with metal abundances indicate an L chondrite grouping. Potentially paired with NWA 11745.
Specimens: Main mass at *OU*

Northwest Africa 11745 (NWA 11745)
(Northwest Africa)
Purchased: 2004
Classification: Ordinary chondrite (L5)
History: sample was purchased in Morocco from a meteorite collector by Dr Mahesh Anand (*OU*) some years ago. In July 2016, thin sections of the sample were passed to Craig Walton (*UStA*) for preliminary classification work.
Physical characteristics: One large piece is present in the collection (554.16). Sample predominantly has a light color, but has a dark fusion crust on one side. Sample contains abundant complex shock features - mainly micro-fault shear textures, associated with melt pools.
Petrography: (Craig Walton, *UStA*) Overall, sample has a chondritic brecciated texture. Main phases are olivine and pyroxene with opaque metal + troilite. Porphyritic olivine, radial pyroxene, barred olivine and porphyritic olivine pyroxene chondrule types are all common, along with rare cryptocrystalline and glassy chondrules. Chondrule average diameter is 0.56 mm, ranging from 1.25 mm

to 0.25 mm. Chondrules comprise ~ 70% of the sample. Opaque phases are metal (Fe, Ni _ in exsolution as kamacite and taenite) and sulfide (troilite). A recrystallized and shock-darkened matrix of fine-grained lithic fragments comprises ~ 20 % of the sample area. Some isolated euhedral olivine grains (up to ~ 1mm) occur embedded in this matrix. Olivine contains planar deformation features and has undulose extinction. Planes across which shear displacement has occurred (microfaults) crosscut chondrule and brecciated matrix textures. Fine-grained silicate melt-pools bearing globules of immiscible metal and sulfide are hosted within some sections of these microfaults. Microfault textures crosscut chondrules, matrix and metal, with individual faults running along the length of the slide. Offset on the faults is on the order of 500 μm. ~50 μm-wide shock-melt pools/veins occur within the faults.
Geochemistry: Mineral compositions and geochemistry: (Craig Walton, *UStA*; Mahesh Anand, Sam Hammond, Richard Greenwood, *OU*) Microprobe (Cameca SX100 EMPA) Olivine (n=15): MgO = 38.4, MnO = 0.5, FeO = 23.4, SiO = 38.3 P_2O_5 = 0.1 Pyroxene (n=7): MgO = 28.7, CaO = 0.9, MnO = 0.5, FeO = 14.5, Al_2O_3 = 0.2, Cr_2O_3 = 0.1, SiO_2 = 55.7, TiO_2 = 0.2. Plagioclase: Na_2O = 10.7, K_2O = 1.1, CaO = 2.3, FeO = 0.8, Al_2O_3 = 22.1, SiO_2 = 65.8 ; Plagioclase $Ab_{76.1}Or_{7.71}An_{16.2}$ (N=11).. Oxygen Isotopes (Laser fluorination CO_2 laser, Thermo Scientific MAT 253 gas source mass spectrometer) $\delta^{18}O$ = 4.931, $\delta^{17}O$ = 3.693, $\Delta^{17}O$ = 1.129, $\Delta^{17}O$ linear = 1.105 (all ‰).
Classification: L5. Shock stage is S4/5 as evidenced by shear microfault textures, associated shock-melt veins, shock darkening of matrix and undulose extinction and planar deformation features in olivine. Oxygen isotopes are indiscriminate between L and LL, however Fs (PX) and Fa (Ol) data indicate an L chondrite. Potentially paired with NWA 11744.
Specimens: Main mass at *OU*

Northwest Africa 11746 (NWA 11746)
(Northwest Africa)
Purchased: 2015
Classification: Martian meteorite (Shergottite)
History: Purchased by Jay Piatek from Morocco, 2015.
Physical characteristics: Fusion crusted individual. A saw-cut surface reveals gray-green, fine-grained, basaltic texture.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows an ophitic texture with ~60% zoned pyroxene and ~30% maskelynite. Accessory phases include titanomagnetite, ilmenite, Fe-sulfide, and silica.
Geochemistry: (C. Agee, *UNM*) Pigeonite $Fs_{50.5\pm14.8}Wo_{16.9\pm6.8}$, Fe/Mn=37±3, n=8; augite $Fs_{29.3\pm10.4}Wo_{31.7\pm2.8}$, Fe/Mn=32±4, n=12; maskelynite $Or_{2.8\pm1.1}Ab_{49.8\pm3.9}An_{47.4\pm4.9}$, n=6.
Classification: Martian (shergottite), pyroxene-phyric. Possibly paired with NWA 10016.

Specimens: 1.9 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11747 (NWA 11747)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite)
Petrography: Highly brecciated, fine-medium grained sample. Fine grained matrix is composed of fragmented pyroxene and feldspar with three cohesive, coarse grained subophitic/gabbroic clasts. Dark grey to black melt glass pockets, often containting small fragmented clasts of pyroxene, are focused in a darker region of the sample which constitutes approximately 40% of the thin section. Accessory phases include apatite, merrillite, zircon, ilmenite and rare baddeleyite.
Geochemistry: Mineral compositions and geochemistry: Pyroxene yield bulk Fe/Mn ratios of 29.42 (N=46). Pyroxene ($En_{45}Fs_{46}Wo_{8}$; N=43) with exsolved augite lamella ($En_{35}Fs_{23}Wo_{42}$; N=3) occur throughout the sample. Feldspar composition averages An_{88} (N=25). Mineral chemistry measured by EMP.
Classification: Eucrite (monomict breccia)

Northwest Africa 11748 (NWA 11748)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite)
Petrography: Sample is brecciated, containing subophitic gabbroic clasts of pyroxene and plagioclase set in a finer grained matrix of the same assemblage. Accessory phases include apatite, merrillite, zircon, ilmenite and rare baddeleyite.
Geochemistry: Mineral compositions and geochemistry: Pyroxene yield bulk Fe/Mn ratios of 31.49 (N=34). Orthopyroxene ($En_{35}Fs_{58}Wo_{7}$; N=29) contain abundant exsolution lamella of augite composition ($En_{30}Fs_{29}Wo_{41}$; N=5). Feldspar yields highly anorthitic compositions averaging An_{91} (N=20). Mineral chemistry measured by EMP.
Classification: Eucrite (monomict breccia)

Northwest Africa 11749 (NWA 11749)
Morocco
Purchased: 2016 Oct
Classification: HED achondrite (Eucrite, unbrecciated)
History: Bought in Munich from a dealer from NWA.
Physical characteristics: Crusted stone. Cut surface reveals a rather orase-grained light grey rock.

Petrography: Unbrecciated igneous rock with subophitic texture and typical grain size 500 μm. Main minerals are pyroxene and plagioclase. Troilite (to 40 μm), chromite, ilmenite, silica polymorph, FeNi metal are present.
Geochemistry: Low-Ca pyroxene $Fs_{63.0\pm0.3}Wo_{2.2\pm0.4}$ (N=6), augite exsolution $Fs_{26.4}Wo_{45.0}$ (N=2), FeO/MnO 31.1±1.7 (N=8). Plagioclase $An_{88.6}Ab_{11.1}Or_{0.3}$ (N=3).
Classification: Eucrite-unbr
Specimens: Type specimen at *CEREGE*. Main mass with Andreas *Gren*.

Northwest Africa 11750 (NWA 11750)
Morocco
Purchased: 2016 May
Classification: C3.00-ung
History: The meteorite was reportedly found near Foum Zguid. It was bought by Pierre-Marie Pelé in Morocco in May 2016 and a subsample was sent to *CEREGE* for classification. In view of its scientific interest, the whole stone was eventually given to *CEREGE* by Pierre-Marie Pelé.
Physical characteristics: Black irregular stone. Cut surface reveals a dark homogeneous interior.
Petrography: (J. Gattacceca, B. Devouard, H. Pourkhorsandi, *CEREGE*; L. Bonal, *IPAG*) Chondrules and mineral fragments (26 vol%) set in a fine-grained iron-rich matrix (74 vol%, modal abundances by point counting N=204). Average chondrule apparent size 240±170 μm (N=28). Opaque are mostly FeNi metal (both in matrix and chondrules) and sulfides with typical grain size about 10 μm. In the matrix, FeNi metal and sulfides are finely intermixed. Saturation magnetization is Ms=2.39 Am2/kg indicating a bulk metal content of at least 1.1 wt%. Hysteresis properties show the significant presence of tetrataenite in the form of cloudy zone (Gattacceca et al., 2014). XRD over a ~1 cm2 area on a polished section (D. Borschnek, B. Devouard, *CEREGE*) does not reveal the presence of hydrous phases (serpentine, tochilinite) typically observed in type 2 chondrites using the same experimental setup. The absence of hydrous phases in the fine-grained matrix is confirmed by IR transmission spectra. Raman spectra of the fine-grained matrix reveal the presence of polyaromatic carbonaceous matter characterized by a structural order comparable to type 2 chondrites, thus reflecting a peak metamorphic temperature lower than in the least metamorphosed type 3 chondrites (e.g., Semarkona)
Geochemistry: Olivine $Fa_{11.9\pm17.1}$, range $Fa_{0.8\text{-}45.1}$, PMD 126% (N=7). Ferroan olivine has Cr_2O_3 0.24±0.16 wt% (N=3). Orthopyroxene $Fs_{3.2\pm2.2}Wo_{3.8\pm1.1}$ (N=3). Kamacite Fe 91.0, Ni 6.7, Co, 2.3 (N=1). Taenite Fe 67.2, Ni 29.6, Co 0.9 (atom%). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of a 1.5 mg aliquot of a powdered 40 mg bulk sample is $\delta^{17}O$=3.47, $\delta^{18}O$=14.3, $\Delta^{17}O$=-4.0, all per mil (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.03.

Classification: C3.00-ung. The type 3 derives from the unequilibrated nature, the absence of phyllosilicates and abundance of metal. The subtype 3.00 derives from Raman spectroscopy. The ungrouped designation derives from the oxygen isotopes and petrography.
Specimens: Main mass and type specimen at *CEREGE*.

Northwest Africa 11751 (NWA 11751)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CO3.05)
Physical characteristics: Dark brown stone. Cut surface reveals an almost featurless dark brown interior.
Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE* ; Lydie Bonal, *IPAG*) Small chondrules (average apparent diameter 230±100 μm, N=22) set in a fine-grained iron-rich matrix. Chondrules 65 vol%, matrix 35 vol% (point counting, N=213). Small CAI are present. Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy, this meteorite appears to be less metamorphosed than Colony (CO 3.1) and more metamorphosed than ALHA 77307 (CO 3.05). The Raman spectroscopy parameters of interest are FWHM-D (cm-1)=187.6±6.0, ID/IG=1.00±0.04 (see Bonal et al. 2016, GCA 189:312-337, figure 6).
Geochemistry: Olivine $Fa_{10.4\pm10.0}$, range $Fa_{0.7\text{-}25.4}$, PMD 91% (N=9), Cr_2O_3 in ferroan olivine 0.35±0.17 wt% (N=7). Orthopyroxene $Fs_{3.6\pm1.4}Wo_{3.8\pm2.0}$ (N=4). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg)=4.69
Classification: Carbonaceous chondrite (CO3.05). Subtype from Raman spectroscopy and Cr_2O_3 content in ferroan olivine.
Specimens: Type specimen at *CEREGE*. Main mass with Fabien *Kuntz*.

Northwest Africa 11752 (NWA 11752)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL3.05)
Physical characteristics: Dark brown stone. Cut surface reveals packed well-defined chondrules in a brown matrix.
Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*; Lydie Bonal, *IPAG*) Large and closely packed chondrules. Opaques are FeNi minerals and troilite. Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy, this meteorite appears to be as metamorphosed as ALHA 77307 (CO3.05). The Raman spectroscopy parameters of interest are FWHM-D (cm-1)=210.9±14.8, ID/IG=0.95±0.05 (see Bonal et al. 2016, GCA 189:312-337, figure 7).

Geochemistry: Olivine $Fa_{16.8\pm5.4}$, range $Fa_{8.6\text{-}24.9}$, PMD 27% (N=6), Cr_2O_3 in ferroan olivine 0.45±0.05 wt% (N=6). Orthopyroxene $Fs_{10.4\pm8.4}Wo_{1.6\pm1.3}$ (N=4). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.00.
Classification: LL3.05. Subtype from Raman spectroscopy and Cr_2O_3 content in ferroan olivine.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11753 (NWA 11753)
Morocco
Purchased: 2017 Jul
Classification: HED achondrite (Eucrite, polymict)
Petrography: (K. Metzler, *IfP*) Fine-grained polymict breccia consisting of mm-sized basalt clasts (subophitic and granulitic textures) and mineral fragments set in a fine-grained clastic matrix made of related debris. Breccia-in breccia textures occur. Most pyroxenes exhibit augite exsolution lamellae. Fragments of diogenitic low-Ca pyroxene are admixed (<10 vol%). Accessories are silica polymorph, ilmenite, chromite, troilite, and Cr-Al-spinel.
Geochemistry: Mineral compositions and geochemistry: Eucritic low-Ca pyroxene (host; n=9): $Fs_{47.8\pm5.8}$ (39-58); $Wo_{2.1\pm0.6}$ (1-3); mean Fe/Mn (at.): 33. Eucritic Ca-pyroxene (exsolution lamellae; n=3) $Fs_{20.2\pm4.2}$ (18-25); $Wo_{42.2\pm1.9}$ (40-44). Diogenitic pyroxene (n=4): $Fs_{29.5\pm1.9}Wo_{3.7\pm0.5}$ ($Fs_{28\text{-}31}Wo_{3\text{-}4}$); mean Fe/Mn (at.): 36.Plagioclase (n=10): $An_{90.6\pm2.6}$ (85-94).

Northwest Africa 11754 (NWA 11754)
Morocco
Purchased: 2017 Jul
Classification: Ureilite
Petrography: (K. Metzler, *IfP*) Coarse-grained ultramafic rock with metamorphic texture (~120° triple junctions), consisting of olivine, low-Ca pyroxene, and Ca-pyroxene grains with sizes up to ~3 mm. Reverse zoning of olivine with Mg-rich zones at the margins and along cracks can be observed. Metal is concentrated along grain boundaries and cracks and mostly oxidized by terrestrial weathering.
Geochemistry: Mineral compositions and geochemistry: Olivine cores (n=4): $Fa_{11.4\pm0.7}$; Olivine rims (n=3): $Fa_{6.6\pm0.3.}$ Low-Ca pyroxene grains (n=9): $Fs_{10.7\pm0.2}Wo_{4.9\pm0.2.}$ Ca-pyroxene grains (n=12): $Fs_{6.6\pm0.2}Wo_{36.2.\pm0.2.}$ The concentration of Cr_2O_3 in olivine and pyroxene is 0.5 wt% and 1.1 wt%, respectively.

Northwest Africa 11755 (NWA 11755)
Morocco
Purchased: 2017 Sep
Classification: Ureilite

Petrography: (K. Metzler, *IfP*) Coarse-grained ultramafic rock with metamorphic texture (~120° triple junctions), consisting of olivine and pyroxene grains up to ~5 mm. Reverse zoning of olivine grains with Mg-rich zones at the margins and along cracks. Graphite and partly oxidized metal are concentrated along grain boundaries.
Geochemistry: Mineral compositions and geochemistry: Olivine cores (n=12): $Fa_{21.3\pm0.3}$; Olivine rims (n=5): $Fa_{9.0\pm2.0.}$ Pyroxene grains (n=13): $Fs_{11.8\pm1.5}Wo_{6.1\pm1.8.}$ The Cr_2O_3 concentration in olivine and pyroxene is 0.7 wt% and 1.0 wt%, respectively.

Northwest Africa 11756 (NWA 11756)
Morocco
Purchased: 2017 Sep
Classification: Primitive achondrite (Brachinite)
Petrography: (K. Metzler, *IfP*) Olivine-dominated ultramafic rock with metamorphic texture (~120° triple junctions), consisting of olivine, low-Ca pyroxene, and Ca-pyroxene grains up to ~0.8 mm. Metal is replaced by weathering products which are also concentrated along grain boundaries. Accessories are Cr-Al-spinel (up to 700 µm) and weathered FeS. No plagioclase was found.
Geochemistry: Mineral compositions and geochemistry: Olivine grains (n=12): $Fa_{26.8\pm0.2}$, mean Fe/Mn (at.)= 58; Low-Ca pyroxene grains (n=12): $Fs_{22.1\pm0.4}Wo_{2.1\pm0.1.}$ Ca-pyroxene grains (n=5): $Fs_{9.1\pm0.2}Wo_{43.6\pm0.5.}$ The concentration of Cr_2O_3 in olivine and pyroxene is <0.1 wt% and 0.3 wt%, respectively. Composition of Cr-spinel (n=2; at.): Cr/(Cr+Al)=0.78; TiO_2 1.4-1.5 wt%. SEM analyses of large thin section areas reveal that this sample is nearly devoid of aluminum.
Classification: Brachinite, based on metamorphic texture, grain size, modal composition, absence of plagioclase, and mineral chemistry.

Northwest Africa 11757 (NWA 11757)
Morocco
Purchased: 2017 Sep
Classification: Ureilite
Petrography: (K. Metzler, *IfP*) Coarse-grained ultramafic rock with metamorphic texture (~120° triple junctions), consisting of olivine and pyroxene grains up to ~2 mm. Reverse zoning of olivine grains with Mg-rich zones at the margins and along cracks. Metal is concentrated along grain boundaries and partly oxidized by terrestrial weathering.
Geochemistry: Mineral compositions and geochemistry: Olivine cores (n=10): $Fa_{21.0\pm0.6}$; Olivine rims (n=5): $Fa_{1.4\pm0.1.}$ Pyroxene grains (n=10): $Fs_{18.0\pm0.3}Wo_{7.2\pm0.2.}$ The concentration of Cr_2O_3 in olivine and pyroxene is 0.5 wt% and 0.8 wt%, respectively.

Northwest Africa 11761 (NWA 11761)

(Northwest Africa)
Purchased: June 2016
Classification: Mesosiderite

History: The meteorite was purchased by an anonymous collector at St. Marie-aux-Mines, France, mineral show in June 2016 from an anonymous Moroccan dealer.

Physical characteristics: The stone of 2258 g total weight has irregular shape; the surface is reddish-brown; the fusion crust is not preserved.

Petrography: (C. A. Lorenz, *Vernad*) The meteorite has a brecciated texture; it is composed of lithic and mineral fragments (50 vol%) embedded into a troilite-metal-silicate melt matrix (13, 22, 15 vol% respectively). The mineral fragments are pyroxene, feldspar and silica; the rock fragments are fine-, medium- and coarse-grained pyroxene-feldspar rocks of equigranular, subophitic or gabbroic textures, fine-grained clastic and melt-matrix breccias and minor dunitic and peridothitic rocks. Coarse-grained pyroxenes contain the fine exsolution lamellae. The rock contains 11 vol% of fragments of >2 mm in size. The matrix has heterogeneous texture varying in troilite, metal and silicates composition. Matrix silicates forming intergrowths with troilite are fine-grained subhedral pyroxene, anhedral feldspar and glass. Metal-and sulfide-poor matrix surrounding large lithic fragments are fine-grained melt rock. Metal forms irregular and globular grains in the troilite matrix and is composed of kamacite with inclusions of taenite. Accessory minerals are silica and chromite.

Geochemistry: Mineral compositions and geochemistry: (Kononkova N. N., *Vernad*) Matrix pyroxene is $En_{21.5-56.2}Wo_{0.5-8.4}$ (Fe/Mn=16 - 30, at.), feldspar is $An_{84.7-90.2}Ab_{9.5-14.6}$; fragments pyroxene is $En_{20.4-31.0}Wo_{2.1-15.2}$ (Fe/Mn= 23 - 30, at.); feldspar is $An_{94.5}Ab_{5.5.}$

Classification: Mesosiderite of Type 4, anomalous; weathering is minimal. This mesosiderite is unusually troilite-rich and metal-poor.

Specimens: A piece and slices of 103 g total weight and thick section is on deposit in *Vernad*. Anonymous collector holds the main mass.

Northwest Africa 11762 (NWA 11762)
(Northwest Africa)
Purchased: 2014
Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Small dark greyish individual with some fusion crust.

Petrography: The meteorite is a fragmental breccia composed of up to 5 mm sized basaltic clasts and dark impact melt clasts set into a fine-grained clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and plagioclase grains of variable grain sizes ranging from about 20 to 600 μm. Several matrix pyroxenes display magmatic zoning. Minor phases include ilmenite, pyrrhotite, silica, apatite, and metallic iron.

Geochemistry: low-Ca pyroxene $Fs_{42.3\pm10.3}Wo_{3.9\pm1.2}$ ($Fs_{20.9\text{-}51.3}Wo_{2.0\text{-}5.7}$, n=15, FeO/MnO=31-47); Ca-pyroxene: $Fs_{25.2\pm1.0}Wo_{39.6\pm1.4}$ ($Fs_{23.2\text{-}27.6}Wo_{37.1\text{-}42.1}$, n=14, FeO/MnO=30-35); calcic plagioclase: $An_{90.2\pm1.5}$ ($An_{87.5\text{-}92.5}$, n=14)

Northwest Africa 11763 (NWA 11763)
(Northwest Africa)
Purchased: 2014
Classification: HED achondrite (Eucrite, brecciated)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Small individual almost completely covered with fusion crust.
Petrography: The meteorite displays a light greyish to whitish interior and is composed of up to 4 mm sized angular to subrounded basaltic clasts set into a fine-grained recrystallized matrix. Dominant minerals in clasts and matrix are exsolved pyroxene and calcic plagioclase. Grain sizes in the matrix are 10 to 40 μm; plagioclase laths in basaltic clasts are up to 300 μm in length. Minor phases are silica, chromite, ilmenite, and troilite. Metallic iron was not detected. Contains some thin shock melt veins.
Geochemistry: low-Ca pyroxene $Fs_{60.9\pm0.5}Wo_{2.4\pm0.3}$ ($Fs_{59.9\text{-}61.5}Wo_{1.9\text{-}3.0}$, n=14, FeO/MnO=31-35); Ca-pyroxene: $Fs_{26.7\pm1.3}Wo_{42.6\pm1.4}$ ($Fs_{25.6\text{-}31.0}Wo_{37.3\text{-}43.9}$, n=18, FeO/MnO=30-38); calcic plagioclase: $An_{89.4\pm0.5}$ ($An_{88.6\text{-}90.2}$, n=13)

Northwest Africa 11764 (NWA 11764)
(Northwest Africa)
Purchased: 2014
Classification: Carbonaceous chondrite (CK5)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Dark greyish to greenish individual with some fusion crust.
Petrography: The meteorite is composed of recrystallized matrix predominantly composed of Fe-rich olivine with several scattered and clearly defined chondrules (mean diameter about 0.8 mm). Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, and sulfides. Metal is virtually absent. Plagioclase grain size is about 100 μm.
Geochemistry: olivine: $Fa_{33.4\pm0.3}$, n=16, FeO/MnO=133±9; low-Ca pyroxene:$Fs_{26.8\pm0.2}Wo_{0.8\pm0.1}$, n=9; feldspar: $An_{54.9\pm3.1}Ab_{42.9\pm2.8}$, n=3

Northwest Africa 11765 (NWA 11765)
(Northwest Africa)
Purchased: 2014

Classification: Carbonaceous chondrite (CK6)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Small individual almost completely covered with fusion crust.

Petrography: The meteorite is largely composed of fine-grained recrystallized matrix mainly consisting of ferrous olivine. Chondrules are only rarely encountered; one CAI was found. Minor phases include plagioclase, low-Ca pyroxene, Ca-pyroxene and sulfides. Cr-rich magnetite is abundant, metal is virtually absent.

Geochemistry: olivine: $Fa_{31.3\pm0.3}$, n=14, FeO/MnO=128±13; low-Ca pyroxene:$Fs_{26.4\pm0.3}Wo_{1.6\pm1.4}$, n=10; feldspar: $An_{79.8\pm0.8}Ab_{19.9\pm0.8}$, n=5

Northwest Africa 11766 (NWA 11766)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Almost black individual without fusion crust.

Petrography: Carbonaceous chondrite composed of separated and clearly defined chondrules (mean apparent diameter about 1.1 mm), CAIs (up to 7 mm), and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent.

Northwest Africa 11767 (NWA 11767)

(Northwest Africa)

Purchased: 2012

Classification: Lunar meteorite

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Many small light greenish fragments lacking any fusion crust.

Petrography: Monomict olivine-rich gabbroic breccia predominantly composed of up to 4 mm sized Fe-rich olivine, pigeonite, augite and calcic plagioclase. Minor phases include chromite, troilite and K-feldspar. The meteorite contains abundant shock melt veins along which some olivine has been transformed into ringwoodite.

Geochemistry: olivine: $Fa_{31.6\pm0.2}$ ($Fa_{31.3\text{-}32.0}$, n=13, FeO/MnO=85-105); pigeonite: $Fs_{25.6\pm1.1}Wo_{10.7\pm2.8}$ ($Fs_{23.3\text{-}27.7}Wo_{5.9\text{-}16.4}$, n=12, FeO/MnO=46-63); augite: $Fs_{16.1\pm1.0}Wo_{35.7\pm2.1}$ ($Fs_{14.8\text{-}17.8}Wo_{32.1\text{-}39.0}$, n=12, FeO/MnO=41-52); calcic plagioclase: $An_{93.1\pm0.8}$ ($An_{91.1\text{-}93.9}$, n=10)

Classification: Lunar Olivine-Gabbros. The meteorite might be paired with NWA 773 and paired stones.

Northwest Africa 11768 (NWA 11768)
(Northwest Africa)
Purchased: 2013
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Five dark greyish fragments without fusion crust.
Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 6 mm sized), CAIs, and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are absent. Most chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11769 (NWA 11769)
(Northwest Africa)
Purchased: 2014
Classification: Rumuruti chondrite (R3)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Brownish individual without fusion crust.
Petrography: The meteorite shows an orange interior and is composed of 200 to 800 μm sized chondrules (mean about 400 μm) in abundant matrix dominated by Fe-rich olivine. Olivine and low-Ca pyroxene in chondrules are mostly unequilibrated. Minor phases include pentlandite, sodic plagioclase, and Ti-bearing chromite; no metal has been detected.

Northwest Africa 11770 (NWA 11770)
(Northwest Africa)
Purchased: 2014
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Dark greyish individual without fusion crust.
Petrography: Carbonaceous chondrite composed of up separated and partly flattened chondrules (mean diameter about 1.2 mm; up to 5 mm), CAIs (up to 6 mm), and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are absent. Most chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11771 (NWA 11771)
(Northwest Africa)

Purchased: 2014
Classification: HED achondrite (Diogenite)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Greyish individual partly covered with fusion crust

Petrography: Monomict breccia predominantly composed of blocky up to 2 mm sized orthoproxenes and more fine-grained cataclastic interstitial regions. Minor phases include feldspar, olivine, silica, chromite, and FeNi metal. No metallic iron has been detected.

Geochemistry: low-Ca pyroxene: $Fs_{29.2\pm0.3}Wo_{4.2\pm0.2}$ ($Fs_{28.7\text{-}29.5}Wo_{3.9\text{-}4.6}$, n=18, FeO/MnO=27-32); olivine: $Fa_{37.7}$, n=1, FeO/MnO=54; calcic plagioclase: $An_{92.7\pm0.4}$ ($An_{92.2\text{-}93.4}$, n=5)

Northwest Africa 11772 (NWA 11772)
(Northwest Africa)
Purchased: 2014
Classification: Rumuruti chondrite (R5)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Thirty eight small dark greyish fragments partly covered with fusion crust. Sawn surface shows a fresh greyish interior.

Petrography: The meteorite is a R-type breccia composed of up to 8 mm sized angular to subrounded clasts set into a more fine-grained clastic matrix. Chondrules are 100 μm to 1 mm with an average of about 350 μm. Fe-rich olivine is the most abundant mineral phase in all lithologies. More minor phases include low-Ca pyroxene, augite, pentlandite, and sodic plagioclase (mean grain size about 40 μm). No metal has been detected. All silicates are compositionally equilibrated.

Geochemistry: olivine: $Fa_{38.2\pm0.3}$ (n=13, FeO/MnO=74-87);low-Ca pyroxene: $Fs_{30.1\pm0.2}Wo_{1.3\pm0.1}$ (n=11, FeO/MnO=47-58); augite: $Fs_{12.0\pm0.3}Wo_{44.3\pm0.4}$ (n=10, FeO/MnO=37-55)

Classification: R5 according to mineral chemistry and plagioclase grain size.

Northwest Africa 11773 (NWA 11773)
(Northwest Africa)
Purchased: 2014
Classification: Carbonaceous chondrite (CK6)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Dark greyish individual without fusion crust.

Petrography: The meteorite displays a greyish to light greenish interior and is composed of abundant recrystallized matrix dominated by of Fe-rich olivine with only few scattered and poorly defined chondrules (mean diameter about 0.7 mm).

Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, Ca-pyroxene, and sulfides. No metal has been detected.
Geochemistry: olivine: $Fa_{33.2\pm0.2}$, n=16, FeO/MnO=118±9; Ca-pyroxene: $Fs_{9.7\pm1.2}Wo_{47.2\pm3.1}$, n=12; feldspar: $An_{64.2}Ab_{35.0}Or_{0.8}$, n=2

Northwest Africa 11774 (NWA 11774)
Mauritania
Purchased: 2018 Jan
Classification: Mesosiderite
History: Found near Ain Ben Tili, Mauritania, in December 2017 and purchased by Bob Falls in January 2018 from a Moroccan dealer.
Physical characteristics: A single metal-rich mass (439.2 g) with a weathered exterior. The fresh interior consists mainly of metal with ~10 vol.% interstitial silicate-rich material.
Petrography: (A. Irving and S. Kuehner, *UWS*) Composed predominantly of granular kamacite (containing small, irregularly-shaped grains of taenite and rare schreibersite) together with interstitial regions containing calcic plagioclase, orthopyroxene, silica polymorph, chromite, merrillite, ilmenite and troilite.
Geochemistry: Orthopyroxene ($Fs_{30.3\text{-}31.7}Wo_{2.9\text{-}3.8}$, FeO/MnO = 18-19, N = 3), plagioclase ($An_{85.3\text{-}86.9}Or_{0.5\text{-}0.2}$, N = 2).
Classification: Mesosiderite. This specimen has close textural and mineralogical similarities to the metal-rich nodules in Bondoc, and is unusual because of its very high metal/silicate ratio relative to typical examples.
Specimens: 24.1 g in the form of a polished slice at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11775 (NWA 11775)
Morocco
Purchased: 2018 Jan
Classification: Ureilite
History: The sample was bought in Malaga, Spain, from a Saharawi meteorite dealer
Petrography: (K. Metzler, *IfP*) Ultramafic rock with metamorphic texture (~120° triple junctions), consisting of olivine and pyroxene grains up to ~1.5 mm. Reverse zoning of olivine grains with Mg-rich zones at the margins and along cracks. Metal is concentrated along grain boundaries and cracks and partly oxidized by terrestrial weathering.
Geochemistry: Mineral compositions and geochemistry: Olivine cores (n=10): $Fa_{20.1\pm0.3}$; Olivine rims (n=5): $Fa_{7.7\pm2.3.}$ Pyroxene grains (n=10): $Fs_{17.3\pm0.3}Wo_{3.6\pm0.1.}$ The mean concentration of Cr_2O_3 in olivine and pyroxene is 0.5 wt% and 0.7 wt%, respectively.

Northwest Africa 11776 (NWA 11776)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL6, anomalous)
History: 1 stone weighing 100.7 g was found near Laayoune, Morocco, prior to 2017. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.
Physical characteristics: Sample is dark-orange-brown in color, irregularly shaped. The sample lacks fusion crust. The interior of the cut face shows a brecciated texture.
Petrography: Description and Classification (A. Lov, *App*): Sample is a breccia composed of up to 1 cm angular recrystallized clasts of chondritic rock with barely discernible chondrules. All FeNi has been oxidized. Sulfides are partly altered. Average diameter of relict chondrules 1314 μm. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.88 (measured with a SM30 instrument).
Geochemistry: (A. Love, *App*) Olivine ($Fa_{35.7\pm0.3}$, N=8, Fe/Mn=69.6±1.0), low Ca pyroxene ($Fs_{26.6\pm0.4}Wo_{1.9\pm0.3}$, N=8). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ = 4.321, 4.476, 4.508; $\delta^{18}O$ = 5.841, 6.144, 6.148; $\Delta^{17}O$ = 1.237, 1.232, 1.262 (all per mil).
Classification: Ordinary Chondrite (LL6-anomalous) S6 W3. The oxygen isotopes are in the LL range. Mean olivine and pyroxene compositions are outside the normal range for LL chondrites, hence the anomalous designation.
Specimens: *PARI* holds the main mass. One endcut weighing 20.02 g and a polished thin section are on deposit at *App*.

Northwest Africa 11777 (NWA 11777)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite)
History: One mostly crusted stone weighing 705 g was found in Morocco prior to 2017. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.
Physical characteristics: Sample is rounded to irregularly shaped and contains many narrow and broad, shallow regmaglypts on 1/3 of its surface. Sample is ~85% covered by orange brown to dark brown patina, some of which may be original fusion crust. Fractures within the patina show a light-colored interior with fine-grained basaltic texture.
Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of up to 1 cm, rounded to irregularly shaped, ophitic, cumulate textured clasts and subophitic basaltic textured clasts. Clasts are set within a matrix of granular eucritic debris. Pyroxenes are exsolved. Minerals: orthopyroxene, Ca-pyroxene, ilmenite, phosphates, SiO_2 polymorph, FeS.
Geochemistry: (A. Love, *App*) Eucrite: low-Ca pyroxene $Fs_{61.2\pm0.5}Wo_{2.5\pm0.4}$ ($Fs_{60.2\text{-}62.1}Wo_{2.0\text{-}3.2}$, FeO/MnO=29.4-31.1, N=14); high-Ca pyroxene exsolution lamellae

$Fs_{26.4\pm0.7}Wo_{44.2\pm0.6}$ ($Fs_{25.1\text{-}27.8}Wo_{42.9\text{-}44.9}$, FeO/MnO=29.6-32.0, N=14); plagioclase ($An_{88.0\pm2.0}Or_{0.0}$ ($An_{85.2\text{-}91.9}Or_{0.0}$, N=14);
Classification: HED (equilibrated basaltic eucrite) Original igneous textures within clasts are preserved while major element compositions of pyroxenes within sample are equilibrated. Plagioclase compositions are poorly equilibrated.
Specimens: *PARI* holds the main mass. One 20 g endcut and a polished thin section are on deposit at *App*.

Northwest Africa 11778 (NWA 11778)
(Northwest Africa)
Purchased: June 2013
Classification: Ordinary chondrite (H5)
History: Purchased by *WrocU*, Faculty of Geoengineering, Mining and Geology from Moroccan dealer in Zagora; 120 g was cut off and analyzed in thin section; 16.5 g of sample was powdered and for bulk chemistry.
Physical characteristics: Single stone (767.5 g) covered by black (with slight brown shade) fusion crust, 0.5 mm thick.
Petrography: (T.A. Przylibski, K. Luszczek, *UTWroc*) Chondrules (75 vol.%) include BO, PO, GO, RP, POP, and C types. Chondrules are mostly well defined and often have sharp edges. Chondrule diameters are from 0.2 to 1.2 mm, average 600±290um. One compound chondrule is 6.7 mm. Devitrified, partly crystallized mesostasis. Opaque minerals (20 vol.%) include troilite, kamacite and taenite, and rare chromite. Small feldspar grains discernible in electron images. Accessory apatite crystals. Matrix (5 vol.%) is fine-grained, crystalline and transparent, composed mostly of olivine crystals. Around 25% of low-Ca pyroxene crystals are twinned, some of them showing inclined extinction. Some olivine and pyroxene crystals show undulatory extinction. Irregular veins and cracks are filled with opaque iron oxides and hydroxides. Some grains of kamacite are weathered on edges.
Geochemistry: (R. Kryza, *WrocU*; T.A. Przylibski, K. Luszczek, *UTWroc*) Olivine $Fa_{18.0\pm0.0}$ (n=6); Pyroxene $Fs_{13.2\pm0.0}Wo_{1.1}$ (N=12); Chromite (Mg0.3 Fe2+0.38 Mn0.03 Zn0.01 Si0.19 Ti0.02 Ca0.01)(Al0.27 Fe3+0.38 Cr1.27)O4; kamacite (5.85 wt%), taenite (from 40.4 to 52.7 wt%). Bulk chemistry (in wt%): Si 15.69, Al 0.99, Fe 29.74, Mg 12.42, Ca 1.19, Na 0.55, K 0.07, Ti 0.05, P 0.12, Mn 0.22, Cr 0.34, Ni 1.81, C 0.07, S 2.04; (in ppm) Ba 8, Co 961.2, Ga 4.8, Hf 6, Nb 0.3, Rb 1.5, Sr 15.2, V 64, Mo 1.3, Cu 93.5, Pb 0.1, Zn 10, As 0.7, Se 9.1, Zr 253.4, Au 207.3, Y 15.7, La 0.6, Ce 0.8, Pr 0.13, Nd 0.6, Sm 0.19, Eu 0.04, Gd 0.25, Tb 0.05, Dy 0.26, Ho 0.07, Er 0.18, Tm 0.02, Yb 0.18, Lu 0.02
Classification: Ordinary chondrite, H5, S2, W1.

Northwest Africa 11779 (NWA 11779)
(Northwest Africa)
Purchased: 2012

Classification: Ordinary chondrite (L6)
History: Purchased by Tomasz Jakubowski from Moroccan dealer in 2012; 40 g was cut off and analyzed as one thin section on petrographic microscope in polarized and reflected light, other one thin section was analyzed on microprobe; 16.5 g of sample was powdered and bulk chemistry was analyzed by ICP MS
Physical characteristics: Single specimen with partly preserved fusion crust.
Petrography: (T.A. Przylibski, K. Luszczek *UTWroc*) Rare chondrules, most with gradual transition to matrix. Only a few chondrules have sharp edges. Chondrules are identified as: BO, RP, PO, GO, PP. Some of them have rims up to 0.2 mm thick. Chondrule diameters are from 0.5 to 1.9 mm, average 1.2 mm. Some chondrules are up to 2.7 mm in diameter. Mesostasis is crystallized and matrix is corse-grained with olivine crystals up to 0.5 mm in diameter. Also feldspar crystals are clearly visible and some of them are polysynthetically twinned. Feldspars are from 0.02 to 0.15 mm large. Opaque minerals (around 10 vol.%) include troilite, kamacite and taenite, and rare chromite.
Geochemistry: (R. Kryza *WrocU*; T.A. Przylibski, K. Luszczek, *UTWroc*) Olivine $Fa_{24.9}$; pyroxene $Fs_{19.4}Wo_{1.3}$; chromite $(Mg_{0.12}\ Fe^{2+}_{0.71}\ Mn_{0.03}\ Zn_{0.01}\ Ti_{0.07})(Al_{0.25}\ Fe^{3+}_{0.19}\ Cr_{1.56})O_4$; kamacite (5.7-6.7 wt%), taenite (up to 29.6 wt%), troilite without traces of Ni. Bulk chemistry (in wt%): Si 19.65, Al 1.19, Fe 18.45, Mg 15.51, Ca 1.52, Na 0.70, K 0.09, Ti 0.07, P 0.10, Mn 0.28, Cr 0.39, Ni 1.20, C 0.07, S 1.61; (in ppm) Ba 66, Co 306.7, Ga 4.6, Hf 13.9, Nb 0.8, Rb 2.1, Sn 18, Sr 24.7, V 74, Mo 0.8, Cu 82.1, Pb 0.2, Zn 20, Se 6.9, Zr 581.3, Au 126.5, Hg 0.11, Y 34.5, La 0.7, Ce 1.4, Pr 0.19, Nd 0.9, Sm 0.28, Eu 0.09, Gd 0.37, Tb 0.06, Dy 0.38, Ho 0.08, Er 0.22, Tm 0.03, Yb 0.2, Lu 0.03
Classification: Ordinary chondrite, L6, S1, W1

Northwest Africa 11781 (NWA 11781)
(Northwest Africa)
Purchased: 2017 Aug 09
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a meteorite dealer in Moscow, Russia.
Petrography: (S. V. Berzin and K. A. Dugushkina, *RAS-UB*) Chondrule ~20%, refractory inclusion (CAIs, AOAs, Forsterite rich objects) ~3-5% and fine-grained matrix. Most chondrules are porphyritic. Average chondrule size is 0.3 mm. Chondrule mesostasis is rare. The matrix contains phyllosilicates and calcite. CAIs are small (0.05-0.3 mm in size) and very fine grained. The dominant minerals of CAIs are spinel, Ca-pyroxene, hibonite, with accessory perovskite. Some CAIs have forsterite rims. AOAs mainly has spinel-diopside inclusion. Forsterite rich objects have low-Ca pyroxene rims. Refractory forsterite is zoned. Unshocked, low grade of terrestrial weathering (metal partially oxidized).
Geochemistry: Element composition by ICP-MS (ppm): Li 6.05, Sc 2.93, Ti 427, V 55.9, Cr 2307, Mn 1365, Co 236, Ni 2597, Cu 86.0, Zn 129, Ga 6.82, Ge 8.91, As 2.69, Se 4.82, Rb 0.952, Sr 190, Y 1.87, Zr 5.54, Nb 0.431, Mo 1.33, Ag 0.197, Cd 0.151, Sn 1.180, Sb 0.146, Te 0.949, Cs 0.038, Ba 283, La 0.545, Ce 1.33, Pr

0.194, Nd 0.963, Sm 0.281, Eu 0.104, Gd 0.458, Tb 0.061, Dy 0.409, Ho 0.088, Er 0.267, Tm 0.040, Yb 0.264, Lu 0.041, Hf 0.209, Ta 0.365, W 0.151, Tl 0.053, Pb 7.36, Bi 0.024, Th 0.100, U 0.481.
Classification: CM2 Carbonaceous chondrite

Northwest Africa 11782 (NWA 11782)
Mali
Purchased: 2018
Classification: Ordinary chondrite (L3)
History: Purchased by Abdelhadi Aithiba in Mali.
Physical characteristics: Broken surface reveals numerous, distinct, closely packed chondrules. A single large sulfide grain ~5 mm was also observed.
Petrography: (C. Agee, *UNM*) microprobe examination of a polished mount of this lithology shows numerous porphyritic chondrules, most with mesostasis or glass. Cl-rich apatite detected.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{24.7\pm5.5}$, Cr_2O_3=0.10±0.21 (wt%), n=21; low-Ca pyroxene $Fs_{19.8\pm5.6}Wo_{1.2\pm0.7}$, n=11.
Classification: Ordinary chondrite (L3), subtype approximately L3.7 based on Fa and Fa s.d.
Specimens: 39.4g including a probe mount on deposit at *UNM*, Abdelhadi Aithiba holds the main mass.

Northwest Africa 11783 (NWA 11783)
(Northwest Africa)
Purchased: 20 Sep 2014
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased by Jay Piatek from a Moroccan meteorite dealer.
Physical characteristics: Several visually identical appearing pieces. No fusion crust. A saw cut reveals a fragmental breccia with white feldspathic clasts set in a dark gray ground mass.
Petrography: (C. Agee, *UNM*) This meteorite is a breccia of fragmental pyroxene, olivine, plagioclase grains. There are many domains that are fine-grained and cataclastic with shock melt and vesicles. Fe-metal, chromite, ilmenite, silica, and a phosphate mineral were detected.
Geochemistry: (C. Agee, *UNM*) olivine Fa: 28.1±4.8, Fe/Mn=100±2, n=4; clinopyroxene $Fs_{19.0\pm4.4}Wo_{23.1\pm17.6}$, Fe/Mn=52±8, n=3; plagioclase $An_{94.6\pm1.3}$, n=3; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): SiO_2=46.0±0.4, TiO_2=0.51±0.02, Al_2O_3=28.0±0.5, Cr_2O_3=0.11±0.01, MgO=6.0±0.2, FeO=4.7±0.2, MnO=0.07±0.00, CaO=15.3±0.1, Na_2O=0.61±0.03, K_2O=0.16±0.01 (all wt%), n=7.
Classification: Lunar feldspathic breccia
Specimens: 13 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11784 (NWA 11784)
(Northwest Africa)
Purchased: 27 Jul 2015
Classification: Ureilite
History: Purchased by Jay Piatek from a Moroccan meteorite dealer.
Physical characteristics: Single stone. A saw cut reveals medium grained, gray, pyroxene crystals with a mildly aligned orientation. Very fine, scattered metal and graphite grains are visible throughout.
Petrography: (C. Agee, *UNM*) Microprobe examination shows olivine, pigeonite, and augite grains, many in the size range ~1-2 mm. Graphite blades are present up to ~500 μm in length. Fine metal blebs and oxidized iron are observed along olivine grain boundaries. Olivines have oxidation-reduction rims.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{12.0\pm3.5}$, Fe/Mn=25±8, Cr_2O_3=0.61±0.02 CaO=0.29±0.03 (wt%), n=6; olivine cores $Fa_{14.2\pm0.7}$, n=4; olivine rims $Fa_{7.7\pm0.4}$, n=2; pigeonite $Fs_{12.7\pm0.3}Wo_{4.9\pm0.0}$, Fe/Mn=20±0, n=6; augite $Fs_{8.1\pm0.1}Wo_{35.4\pm0.4}$, Fe/Mn=16±1, n=5.
Classification: Ureilite, augite-bearing.
Specimens: 20.2 g on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11785 (NWA 11785)
(Northwest Africa)
Purchased: 22 May 2015
Classification: HED achondrite (Eucrite, melt breccia)
History: Purchased by Jay Piatek from a Moroccan meteorite dealer.
Physical characteristics: Single stone, no fusion crust. Exterior shows numerous white clasts set in a dark matrix of shock melt.
Petrography: (C. Agee, *UNM*) Microprobe examination shows a cataclastic mix of fragmental pyroxene and feldspar grains engulfed in abundant shock melt veins and pools. Accessory chromite and ilmenite were detected.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{53.1}Wo_{1.9}$, Fe/Mn=32, n=1; high-Ca pyroxene $Fs_{22.6}Wo_{44.1}$, Fe/Mn=28, n=1; plagioclase $An_{90.5\pm1.3}$, n=2; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): SiO_2=46.1±1.9, TiO_2=0.8±0.02, Al_2O_3=25.1±9.9, Cr_2O_3=0.13±0.10, MgO=5.0±3.5, FeO=9.2±6.0, MnO=0.28±0.19, CaO=14.4±2.7, Na_2O=0.66±0.27, K_2O=0.05±0.01 (all wt%), n=5.
Classification: Eucrite-melt breccia, eucrite pyroxene compositions are consistent with cumulate eucrite.
Specimens: 20 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11786 (NWA 11786)

(Northwest Africa)
Purchased: 30 Aug 2015
Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Jay Piatek from a Moroccan meteorite dealer.
Physical characteristics: Single stone, no fusion crust. Exterior shows, dark gray, fine grained texture.
Petrography: (C. Agee, *UNM*) (C. Agee, *UNM*) Microprobe examination shows approximately 60% pyroxene and 35% plagioclase. Shock melt veins and mild brecciation are present. Accessory troilite, chromite, silica, and ilmenite were detected.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{59.0\pm2.1}Wo_{5.2\pm2.5}$, Fe/Mn=31±1, n=1; high-Ca pyroxene $Fs_{27.6\pm1.3}Wo_{42.4\pm1.5}$, Fe/Mn=31±3, n=4; plagioclase $An_{89.7\pm0.7}$, n=2.
Classification: Eucrite, monomict
Specimens: 22 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11787 (NWA 11787)
Mauritania
Purchased: 2017
Classification: Lunar meteorite (feldspathic breccia)

History: Purchased in Mauritania by Dustin Dickens from anonymous meteorite hunter.
Physical characteristics: Many visually identical appearing pieces, ranging from several kilograms to sub-gram fragments. Some pieces show a light-gray, remnant fusion crust on one or more faces, with most having no fusion crust. Saw cut reveals a fragmental breccia with white feldspathic clasts set in a dark-gray ground mass.
Petrography: (C. Agee, *UNM*) This meteorite is a polymict breccia of fragmental feldspathic, troctolitic and mafic lithologies, as well as fragmental pyroxene, olivine, plagioclase grains, and shock melt with vescicles.
Geochemistry: (C. Agee, *UNM*) olivine Fa: 25.6±8.9, Fe/Mn=95±18, n=13; low-Ca pyroxene $Fs_{26.2\pm8.8}Wo_{6.2\pm2.5}$, Fe/Mn=52±4, n=7; subcalcic augite $Fs_{35.9\pm5.8}Wo_{26.9\pm7.9}$, Fe/Mn=69±5, n=2; augite $Fs_{14.5\pm7.1}Wo_{41.0\pm2.0}$, Fe/Mn=45±15, n=3; plagioclase $An_{96.2\pm0.8}$, n=6; Shock melt (20 _m defocused electron beam, proxy for bulk meteorite composition): SiO_2=42.9±0.4, TiO_2=0.11±0.05, Al_2O_3=31.1±4.0, Cr_2O_3=0.10±0.05, MgO=5.1±3.3, FeO=3.3±2.0, MnO=0.05±0.05, CaO=16.6±1.6, Na_2O=0.37±0.06, K_2O=0.04±0.00 (all wt%), n=3.
Classification: Lunar feldspathic breccia
Specimens: 21.25 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11788 (NWA 11788)

Mali
Purchased: 2017
Classification: Lunar meteorite (feldspathic breccia)

History: Purchased in Mali by Dustin Dickens from anonymous meteorite hunter.
Physical characteristics: Many dark visually identical appearing pieces, with masses ranging from ~2 kg to many sub-g fragments, showing no fusion crust. Saw cut reveals a finely fragmental breccia with white feldspathic clasts set in a dark gray ground mass with metal flecks and minor vesiculation appearing throughout.
Petrography: (C. Agee, *UNM*) This meteorite is a breccia of fragmental pyroxene, olivine, plagioclase grains. There are domains that are fine-grained and cataclastic with shock melt and vesicles.
Geochemistry: (C. Agee, *UNM*) olivine Fa: 31.2±9.4, Fe/Mn=95±7, n=12; clinopyroxene $Fs_{36.0\pm10.0}Wo_{22.2\pm8.8}$, Fe/Mn=60±5, n=12; plagioclase $An_{93.0\pm1.8}$, n=7; Shock melt (20 _m defocused electron beam, proxy for bulk meteorite composition): SiO_2=43.2±1.7, TiO_2=0.46±0.20, Al_2O_3=24.2±3.6, Cr_2O_3=0.23±0.08, MgO=7.8±1.4, FeO=8.0±3.2, MnO=0.10±0.05, CaO=14.2±1.4, Na_2O=0.35±0.23, K_2O=0.08±0.05 (all wt%), n=4.
Classification: Lunar feldspathic breccia
Specimens: 28.9 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11789 (NWA 11789)
Mauritania
Purchased: 2017
Classification: Lunar meteorite (feldspathic breccia)

History: Purchased in Mauritania by Dustin Dickens from anonymous meteorite hunter.
Physical characteristics: Seven black visually identical appearing pieces that fit back together to form a single mass with the largest piece weighing over 2 kg and the smallest under 45 g. The larger pieces show a black-brown fusion crust and thumb printing. Saw cut reveals a fragmented breccia with white feldspathic clasts set in a black ground mass.
Petrography: (C. Agee, *UNM*) This meteorite is a polymict breccia of fragmental feldspathic and mafic lithologies, as well as fragmental pyroxene, olivine, plagioclase grains, and shock melt.
Geochemistry: (C. Agee, *UNM*) Olivine Fa: 31.7±6.3, Fe/Mn=92±9, n=10; clinopyroxene $Fs_{32.2\pm10.8}Wo_{12.9\pm8.2}$, Fe/Mn=54±8, n=12; plagioclase $An_{96.7\pm0.8}$, n=7; Shock melt (20 µm defocused electron beam, proxy for bulk meteorite composition): SiO_2=43.6±0.8, TiO_2=0.19±0.13, Al_2O_3=27.6±5.0, Cr_2O_3=0.12±0.08, MgO=6.7±4.4, FeO=4.3±2.9, MnO=0.06±0.04, CaO=15.7±2.3, Na_2O=0.34±0.13, K_2O=0.09±0.05 (all wt%), n=6.
Classification: Lunar feldspathic breccia
Specimens: 43.15 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11790 (NWA 11790)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CO3)
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Two black fragments partly covered with fusion crust.
Petrography: The meteorite displays a dark interior and is composed of small (mean diameter about 280 μm) chondrules, mineral fragments and CAIs set into an abundant fine-grained Fe-rich matrix. Opaques are mostly Fe,Ni metal. Several components are surrounded by fine-grained dust rims. Matrix constituents include phyllosilicates (low analytical totals), Ca-carbonates, and pyrrhotite.

Northwest Africa 11791 (NWA 11791)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Six black fragments partly covered with fusion crust.
Petrography: The meteorite is a breccia dominated by fine-grained almost opaque matrix composed of phyllosilicates, Fe-sulfides, Ca-carbonates and rare FeNi metal. Embedded in this matrix are chondrules (mean diameter about 300 μm), chondrule pseudomorphs, mineral fragments, and rare CAIs some of which are surrounded by fine-grained dust rims.

Northwest Africa 11792 (NWA 11792)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Many small dark-grayish to black fragments, some partly covered with fusion crust.
Petrography: Carbonaceous chondrite composed of small (about 0.1-0.6 mm in diameter, mean about 250 μm) chondrules, chondrule pseudomorphs, mineral fragments and rare CAIs many of which surrounded by fine-grained dust rims set into abundant matrix. Matrix is Fe-rich and contains abundant Fe-sulfides and less abundant phyllosilicates and Ca-carbonates. Most of the Fe-rich olivines are strongly corroded.

Northwest Africa 11793 (NWA 11793)
(Northwest Africa)

Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Twelve small almost black fragments lacking fusion crust.
Petrography: Brecciated matrix-dominated carbonaceous chondrite with chondrules (mean diameter about 350 μm), mineral fragments and few CAIs. Some of the components are dust-mantled. Matrix is highly porous and composed of abundant Ca-carbonates and less abundant phyllosilicates and Fe-sulfides. Some rare FeNi metal grains are present.

Northwest Africa 11794 (NWA 11794)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite)
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Eleven greyish fragments partly covered with fusion crust.
Petrography: Unbrecciated fine-grained basaltic rock predominantly composed of exsolved pyroxene and often lath-shaped plagioclase with average grains sizes of about 150 μm. Minor phases include silica, ilmenite, chromite, and troilite; no metallic iron has been detected. The meteorite contains several shock melt veins.
Geochemistry: low-Ca pyroxene: $Fs_{61.6\pm0.6}Wo_{2.4\pm0.5}$ ($Fs_{60.0-62.2}Wo_{1.8-3.7}$, n=14, FeO/MnO=31-36); Ca-pyroxene: $Fs_{26.8\pm0.8}Wo_{43.3\pm0.9}$ ($Fs_{26.0-29.5}Wo_{40.0-44.0}$, n=16, FeO/MnO=29-36); calcic plagioclase: $An_{89.4\pm0.6}$ ($An_{88.7-90.4}$, n=13)

Northwest Africa 11795 (NWA 11795)
(Northwest Africa)
Purchased: 2018
Classification: Primitive achondrite (Lodranite)
History: The meteorite was purchased in Tindouf, Algeria, from a Sahrawi dealer.
Physical characteristics: Brownish individual lacking any fusion crust.
Petrography: The meteorite is a breccia predominantly composed of up to 3 mm sized olivine and orthopyroxene grains (mean diameter about 0.6 mm) with related fine-grained mineral debris. More minor phases include Ca-pyroxene, chromite, kamacite, troilite and Ni-bearing pyrrhotite. Ca-pyroxene often ocurrs as fine exsolution lamellae in low-Ca pyroxene and kamacite is mostly altered to Fe-oxides/hydroxides. No feldspar was found in the section studied.
Geochemistry: olivine: $Fa_{10.7\pm0.1}$, ($Fa_{10.5-10.8}$, n=13, FeO/MnO=25±1); low-Ca pyroxene: $Fs_{10.3\pm0.1}Wo_{2.2\pm0.2}$ ($Fs_{10.1-10.5}Wo_{1.9-2.5}$, n=12, FeO/MnO=16±1); Ca-pyroxene: $Fs_{4.6\pm0.2}Wo_{43.6\pm0.5}$ ($Fs_{4.3-4.9}Wo_{42.8-44.9}$, n=12, FeO/MnO=11±1); Cr_2O_3 in Ca-pyroxene: 1.06±0.13 wt.%

Classification: Lodranite according to mineral chemistry, grain size, and absence of feldspar.

Northwest Africa 11796 (NWA 11796)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased in Tindouf, Algeria, from a Sahrawi dealer.
Petrography: The meteorite displays a chondritic texture with slightly flattened and well-packed chondrules (mean diameter about 0.6 mm) in a more fine-grained matrix that contains sulfides and FeNi metal.

Northwest Africa 11797 (NWA 11797)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L6)
History: The meteorite was purchased in Tindouf, Algeria from a Sahrawi dealer.
Physical characteristics: Brownish individual lacking any fusion crust.
Petrography: Plagioclase grain size about 70 μm

Northwest Africa 11801 (NWA 11801)
Algeria
Purchased: 2016 May 1
Classification: Lunar meteorite
History: Purchased by Miao Bing-an in 2016 from Morocco.
Physical characteristics: This meteorite is in irregular and brecciated, partially covered with black fusion crust. A saw cut reveals an abundance of fragments set in dark-colored matrix.
Petrography: The section is composed of abundant mineral fragments and a few lithic clasts and glass set in a fine-grained matrix. The mineral fragments, lithic clasts, and glass areas show irregular shapes and variable textures with different sizes (from ~10 μm to ~4.1 mm across). The matrix is made up of fine-grained minerals bound by glassy cement.Mineral fragments include plagioclase, pyroxene, olivine, and minor ilmenite, chromite, silica, Ni-Fe metal, troilite, armalcolite, k-feldspar. The section contains various types of lithic clasts (anorthosite, gabbro, troctolite, and crystalline impact melt breccia). Several glassy spheres and veins were found in the thin section. One anomalously large glassy vein (up to 2.7 mm thick) that crosscut the section was observed.
Geochemistry: Plagioclase $An_{91-96}Or<0.4$; pyroxene $Wo_{4-36}En_{7-69}$; olivine Fo_{10-83}. The Fe/Mn ratios of pyroxene and olivine in this meteorite lie approximately along the lunar line, although the range of values is very large (44-79 for pyroxene and 72-127 for olivine).

Classification: Lunar (breccia)
Specimens: specimen and a polished thin section are deposited in *GUT*

Northwest Africa 11802 (NWA 11802)
(Northwest Africa)
Purchased: 2017 Jun
Classification: Ordinary chondrite (L3)
History: Purchased by Gary Fujihara in June 2017 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed unequilibrated chondrules (apparent diameter 620 ± 410 μm, N = 18) are set in a sparse fine grained matrix containing stained metal.
Geochemistry: Olivine ($Fa_{0.6\text{-}81.6}$, Cr_2O_3 in ferroan examples 0.06-0.28 wt.%, mean 0.12±0.06 wt.%, N = 9), orthopyroxene ($Fs_{1.5\text{-}23.3}Wo_{0.2\text{-}3.4}$, N = 3), subcalcic augite ($Fs_{14.6}Wo_{26.6}$), augite ($Fs_{5.4}Wo_{45.4}$). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.76.
Classification: Ordinary chondrite (L3). The ranges of Fa content in olivine and of Cr_2O_3 content in ferroan olivine indicate a relatively low petrologic subtype between 3.3 and 3.5.
Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. G. Fujihara.

Northwest Africa 11803 (NWA 11803)
Algeria
Purchased: 2017 Aug
Classification: HED achondrite (Eucrite, brecciated)
History: Purportedly found in Algeria and purchased by Gary Fujihara in August 2017 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of large gabbroic eucrite clasts in a very fine grained, vesicular quenched melt matrix containing angular mineral debris. Eucrite clasts (grainsize up to 2 mm) consist of exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, troilite and Ni-free metal. Pyroxenes in the matrix include both pigeonite and ferropigeonite.
Geochemistry: Gabbroic eucrite clasts: orthopyroxene host ($Fs_{61.1}Wo_{2.1}$, FeO/MnO = 33), clinopyroxene exsolution lamella ($Fs_{27.3}Wo_{42.4}$, FeO/MnO = 33), orthopyroxene host ($Fs_{51.7}Wo_{2.0}$, FeO/MnO = 35), clinopyroxene exsolution lamella ($Fs_{20.3}Wo_{44.5}$, FeO/MnO = 26), plagioclase ($An_{91.3}Or_{0.2}$). Matrix: pigeonite ($Fs_{44.2}Wo_{11.6}$, FeO/MnO = 32), ferropigeonite ($Fs_{70.3}Wo_{23.1}$, FeO/MnO = 38), plagioclase ($An_{89.7}Or_{0.2}$).
Classification: Eucrite (gabbroic, melt matrix breccia).
Specimens: 22 g including one polished thin section at *UWB*; remainder with Mr. G. Fujihara.

Northwest Africa 11804 (NWA 11804)
(Northwest Africa)
Purchased: 2018 Jan
Classification: Martian meteorite (Shergottite)
History: Purportedly found in the Tanezrouft region of Algeria and purchased by John Higgins in January 2018 from a Mauritanian dealer.
Physical characteristics: A single disaggregated brownish stone (34 grams). Several of the desert-ablated fragments fit together and some retain partial black fusion crust.
Petrography: (A. Irving and S. Kuehner, *UWS*) Diabasic assemblage of mainly zoned clinopyroxene and maskelynite with accessory ilmenite, titanomagnetite, fayalite and pyrrhotite. Inclusions of K-rich glass and silica polymorph are present within pyroxenes.
Geochemistry: Subcalcic augite ($Fs_{26.1\text{-}45.0}Wo_{28.6\text{-}30.8}$, FeO/MnO = 31-38, N = 3), pigeonite ($Fs_{47.8\text{-}59.8}Wo_{12.7\text{-}15.4}$, FeO/MnO = 35-37, N = 3), fayalite ($Fa_{76.3}$, FeO/MnO =54), maskelynite ($An_{53.1\text{-}53.3}Or_{0.9\text{-}1.0}$, N = 2).
Classification: Shergottite (diabasic). Paired with NWA 2975 and many other stones found in the Tanezrouft area.
Specimens: 6.88 g including one polished thick section at *UWB*; remainder with Mr. J. Higgins.

Northwest Africa 11805 (NWA 11805)
(Northwest Africa)
Purchased: 2018 Jan
Classification: HED achondrite (Diogenite, polymict)
History: Purchased by Christopher Colvin in January 2018 from a dealer in Arizona, who had obtained the specimen from a Moroccan source.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of angular mineral debris plus sparse lithic clasts of diogenite and microgabbroic eucrite. The majority (>90 vol.%) of the mineral debris is diogenitic (orthopyroxene, olivine, chromite) with minor eucritic exsolved pigeonite, calcic plagioclase, silica polymorph, Ti-chromite and troilite.
Geochemistry: Diogenitic orthopyroxene ($Fs_{23.4\text{-}24.5}Wo_{2.3\text{-}2.0}$; $Fs_{17.1}Wo_{0.9}$; FeO/MnO = 27-32; N = 3), olivine ($Fa_{28.9}$; $Fa_{52.0}$; FeO/MnO = 44-49; N = 2), orthopyroxene host ($Fs_{44.7}Wo_{3.5}$, FeO/MnO = 33), clinopyroxene exsolution lamella ($Fs_{23.0}Wo_{39.4}$, FeO/MnO = 26), plagioclase ($An_{88.6\text{-}90.3}Or_{0.5\text{-}0.4}$, N = 2).
Classification: Diogenite (polymict breccia).
Specimens: 21.1 g including one polished thin section at *UWB*; remainder with Mr. C. Colvin.

Northwest Africa 11806 (NWA 11806)
(Northwest Africa)
Purchased: 2005

Classification: Ordinary chondrite (H3)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and donated to the Planetary Studies Foundation.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed chondrules (apparent diameter 350±240 μm, N = 24) are set in a sparse fine grained matrix containing altered metal.
Geochemistry: Olivine ($Fa_{0.8-23.1}$, Cr_2O_3 in ferroan examples 0.02-0.28 wt.%, mean 0.07±0.10 wt.%, N = 7), orthopyroxene ($Fs_{1.4-28.6}Wo_{0.7-1.8}$, N = 3), subcalcic augite ($Fs_{9.2-30.1}Wo_{30.9-32.7}$, N = 2), diopside ($Fs_{1.1}Wo_{41.7}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.86.
Classification: Ordinary chondrite (H3).
Specimens: The entire specimen including a polished endcut is at *PSF*.

Northwest Africa 11807 (NWA 11807)
(Northwest Africa)
Purchased: 2018 Jan
Classification: Primitive achondrite (Winonaite)
History: Purchased by Darryl Pitt in January 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Metamorphic aggregate (mean grainsize 320 μm, with triple grain junctions) composed of forsterite, diopside and enstatite with accessory troilite and stained kamacite.
Geochemistry: Olivine ($Fa_{2.9-3.0}$, FeO/MnO = 12-13, N = 3), orthopyroxene ($Fs_{2.7-3.0}Wo_{1.1-1.0}$, FeO/MnO = 8, N = 2), clinopyroxene ($Fs_{1.1-1.2}Wo_{46.4-46.3}$, FeO/MnO = 5, N = 2). Oxygen isotopes (K. Ziegler, UNM): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ 2.395, 2.477, 2.360; $\delta^{18}O$ 5.567, 5.758, 5.487; $\Delta^{17}O$ -0.544, -0.563, -0.537 per mil.
Classification: Winonaite.
Specimens: 20.2 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11808 (NWA 11808)
(Northwest Africa)
Purchased: 2017 Nov
Classification: Carbonaceous chondrite (CK4)
History: Found by a camel herder in November 2017 near Tarfaya El Hagounia, Morocco and purchased by Mbark Arjdal.
Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, well-formed. magnetite-bearing granular chondrules (apparent diameter 770±380 μm, N = 20) and sparse very fine grained CAI are set in a fine grained matrix containing orange-stained Cr-magnetite.

Geochemistry: Olivine ($Fa_{34.3-34.3}$, N = 3), clinopyroxene ($Fs_{9.3-9.8}Wo_{46.5-46.0}$, N = 2), orthopyroxene ($Fs_{27.0}Wo_{3.9}$).
Classification: Carbonaceous chondrite (CK4).
Specimens: 20.2 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

Northwest Africa 11809 (NWA 11809)
(Northwest Africa)
Purchased: 2017 Sep
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased by Fabien *Kuntz* in September 2017 from a dealer in Erfoud, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular mineral clasts of anorthite, olivine, orthopyroxene, pigeonite, subcalcic augite and Ti-chromite in a finer grained matrix containing minor barite.
Geochemistry: Olivine ($Fa_{30.0-41.3}$, FeO/MnO = 87-97, N = 3), orthopyroxene ($Fs_{35.7}Wo_{4.2}$, FeO/MnO = 56), pigeonite ($Fs_{25.2-29.8}Wo_{7.9-10.1}$, FeO/MnO = 52-63, N = 2), subcalcic augite ($Fs_{15.8}Wo_{30.1}$, FeO/MnO = 56), anorthite ($An_{92.0-95.0}Or_{0.2-0.1}$, N = 2).
Classification: Lunar (feldspathic breccia).
Specimens: 14.11 g including a polished slice at *UWB*; main mass with *Kuntz*.

Northwest Africa 11810 (NWA 11810)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H3)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and donated to the Planetary Studies Foundation.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed chondrules (apparent diameter 400±160 μm, N = 20) are set in a sparse fine grained matrix containing merrillite, chlorapatite and stained metal. A single crystal clast of forsterite was observed.
Geochemistry: Olivine in chondrules ($Fa_{2.0-37.0}$ Cr_2O_3 in ferroan examples 0.03-0.21 wt.%, mean 0.08±0.07 wt.%, N = 7), fosterite crystal ($Fa_{0.7}$), orthopyroxene ($Fs_{2.1-31.3}Wo_{0.6-1.7}$ N = 3), pigeonite ($Fs_{0.4}Wo_{6.3}$), augite ($Fs_{3.2}Wo_{35.0}$; $Fs_{6.2}Wo_{45.5}$; N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 5.14.
Classification: Ordinary chondrite (H3).
Specimens: The entire specimen including a polished endcut is at *PSF*.

Northwest Africa 11811 (NWA 11811)
(Northwest Africa)

Purchased: 2017
Classification: LL5-an

Physical characteristics: Dark stone. Cut surface reveals a gray interior with chondritic texture.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*) Chondrite with recrystallized texture. Main minerals are olivine, pyroxene, and interstitial plagioclase with typical size about 25 μm. Presence of merrilite. Opaque minerals are sulfides (including pentlandite), chromite, and rare FeNi metal.

Geochemistry: Olivine $Fa_{33.5\pm0.9}$, PMD=3%, NiO 0.17 wt% (N=8). Orthopyroxene $Fs_{26.4\pm0.2}Ws1.6\pm0.1$ (N=5). Ca-pyroxene $Fs_{25.1}Wo_{17.4}$ (N=1). Plagioclase $An_{11.9}Ab_{80.2}Or_{7.9}$ (N=2). Chromite Cr# = 0.91, TiO_2 3.6 wt% (N=1). FeNi metal Fe32.3±0.3Ni66.2±0.3Co1.35±0.06 (N=7). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.42. Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 475 mg bulk sample is $\delta^{17}O$=4.38‰, $\delta^{18}O$=5.85‰ , $\Delta^{17}O$=1.31‰ (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively).

Classification: LL5-anomalous. The anomalous designation comes from the high Fa content of olivine compared to other equilibrated LL chondrites, and the presence of metal in the form of FeNi2 exclusively.

Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 11812 (NWA 11812)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL3)

Physical characteristics: Greyish stone. Cut surface reveals a dark-gray interior with closely packed well-defined chondrules.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*) Packed mm-sized chondrules.

Geochemistry: Olivine $Fa_{23.5\pm6.7}$, range 11.9-30.6, PMD 23% (N=5). Orthopyroxene $Fs_{17.5\pm5.3}Wo_{1.1\pm1.0}$, Fs PMD 25% (N=5).

Classification: LL3. LL than L classification from magnetic susceptibility.

Specimens: Type specimen at *CEREGE*. Main mass with Fabien *Kuntz*.

Northwest Africa 11813 (NWA 11813)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL3)

Physical characteristics: Greyish stone. Cut surface reveals a dark grey interior with closely packed well-defined chondrules.

Petrography: (J. Gattacceca, H. Pourkhorsandi, *CEREGE*) Packed chondrules with average apparent diameter 920 μm (N=36).

Geochemistry: Olivine $Fa_{18.2\pm8.1}$, range 1.1-33.8, PMD 33% (N=13), Cr_2O_3 in ferroan olivine 0.17±0.12 wt% (N=11). Orthopyroxene $Fs_{8.0\pm4.1}Wo_{2.3\pm1.8}$ (N=4).
Classification: LL3. LL than L classification from magnetic susceptibility.
Specimens: Type specimen at *CEREGE*. Main mass with Fabien *Kuntz*.

Northwest Africa 11814 (NWA 11814)
(Northwest Africa)
Purchased: 2016
Classification: Ordinary chondrite (H5)
Petrography: Chondrite with plagioclase to 40 μm in the matrix. Porosity under the form of pores of with typical size 150 μm (maximum 300 μm) amouts to 9 vol% (point couting, N=185) is unusual for an equilibrated ordinary chondrite.

Northwest Africa 11815 (NWA 11815)
(Northwest Africa)
Purchased: 2017 Dec
Classification: Ureilite
History: Purchased from an Algerian mineral dealer.
Petrography: (K. Metzler, *IfP*) Coarse-grained ultramafic rock with aligned texture, consisting of olivine and pyroxene grains with sizes up to ~2.5 mm. Reverse zoning of olivine grains with Mg-rich zones at the margins and along cracks. Metal is concentrated along grain boundaries and mostly oxidized by terrestrial weathering.
Geochemistry: Mineral compositions and geochemistry: Olivine cores (n=9): $Fa_{18.3\pm0.2}$; Olivine rims (n=6): $Fa_{3.6\pm1.1}$; Pyroxene grains (n=14): $Fs_{15.3\pm0.3}Wo_{8.1\pm0.3}$. The mean concentration of Cr_2O_3 in olivine and pyroxene is 0.7 wt% and 1.2 wt%, respectively.

Northwest Africa 11828 (NWA 11828)
(Northwest Africa)
Find: 2017
Classification: Lunar meteorite (feldspathic breccia)
History: Stones were acquired from a Moroccan dealer in 2017.
Physical characteristics: A group of dark- and light-gray stones with no fusion crust.
Petrography: (S. Demidova and D. Badyukov, *Vernad*): The meteorites are polymict breccias containing numerous mineral fragments and large rounded lithic clasts occuring within a brownish cryptocrystalline to glassy impact-melt matrix; the lithic clast population comprises impact-melt breccias, as well as cataclastic granulitic rocks of anorthositic, noritic, gabbro-noritic and troctolitic compositions; clasts of impact-melt breccias typically show breccia-in-breccia textures; glass fragments and rare spherules are present.

Geochemistry: feldspar, An_{92-98}; orthopyroxene, $Wo_{2-5}En_{60-81}$; clinopyroxene; $Wo_{5-43}En_{33-69}$, olivine, Fo_{22-93} (FeO/MnO = 85); accessory minerals include: ilmenite (2.6-6.2 wt % MgO), Cr-rich ulvöspinel, Ti,Al-rich chromite, silica, Ca-phosphate, armalcolite, baddeleyite, troilite, and abundant FeNi metal; the stones are moderately weathered; carbonate veins and Fe hydroxides are present.
Classification: Lunar, feldspathic regolith breccia
Specimens: 23 type specimens of 662.5 g, and a thin section, *Vernad*, the main mass with an anonymous keeper

Northwest Africa 11829 (NWA 11829)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark-grayish individual lacking any fusion crust.
Petrography: The meteorite displays a chondritic texture with slightly flattened and well packed chondrules (mean apparent diameter about 0.6 mm) in a more fine-grained dark matrix that contains sulfides and FeNi metal.

Northwest Africa 11830 (NWA 11830)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H4)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish individual without fusion crust.
Petrography: The meteorite displays a chondritic texture with well defined chondrules (mean diameter about 0.3 mm) and fine-grained matrix containing sulfides and abundant FeNi metal. Low-Ca pyroxene is compositionally highly unequilibrated; olivine is equilibrated.

Northwest Africa 11831 (NWA 11831)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL3-6)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark greyish individual with some fusion crust.
Petrography: The meteorite is a chondritic breccia consisting of clastic LL3 type matrix with embedded up to 2 mm sized LL6 clasts. Plagioclase grain size in type 6 clasts is about 60 µm. Chondrules have a mean diameter of about 0.8 mm.
Geochemistry: type 3 lithology: olivine: $Fa_{14.9\pm8.5}$ ($Fa_{5.0-31.9}$, n = 11); pyroxene: $Fs_{11.9\pm7.6}Wo_{0.8\pm0.9}$ ($Fs_{2.0-24.7}Wo_{0.3-4.6}$, n = 21); type 6 lithology: olivine: $Fa_{30.7\pm0.1}$, n=12; pyroxene: $Fs_{25.0\pm0.2}Wo_{2.1\pm0.6}$, n=13

Northwest Africa 11832 (NWA 11832)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L, melt rock)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Almost black individual partly covered with fusion crust.
Petrography: The meteorite displays an almost black interior and consists of abundant and partly recrystallized shock melt regions with characteristic FeNi metal and sufide spherules. Few relict chondrules and mineral fragments are present; no metal or sulfide veins are observed.

Northwest Africa 11833 (NWA 11833)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Diogenite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Light-grayish individual with patches of fusion crust.
Petrography: The meteorite is a breccia mainly composed of up to 2 mm sized blocky orthopyroxene grains (mean diameter about 0.8 mm) and related fine-grained mineral debris. Minor phases include calcic plagioclase, chromite, kamacite, and troilite; no nickel free metal has been detected.
Geochemistry: low-Ca pyroxene: $Fs_{28.8\pm0.3}Wo_{4.1\pm0.1}$ ($Fs_{28.3\text{-}29.4}Wo_{3.9\text{-}4.3}$, n=14, FeO/MnO=27-31); calcic plagioclase: $An_{93.0\pm0.7}$ ($An_{91.9\text{-}93.8}$, n=9)

Northwest Africa 11834 (NWA 11834)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Howardite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark greyish individual without fusion crust.
Petrography: The meteorite is a polymict breccia composed of mineral and lithic clasts (basaltic and impact melt clasts) set into a finer grained clastic matrix. Main minerals are exsolved pyroxene, up to 3 mm sized diogenetic orthopyroxene (about 15%) and calcic plagioclase. Minor phases include silica, chromite, ilmenite, barite, FeS, and metallic Fe. It contains abundant shock melt veins.
Geochemistry: pyroxene host to augite lamellae: $Fs_{59.2\pm0.9}Wo_{3.9\pm1.2}$ ($Fs_{58.0\text{-}60.5}Wo_{2.1\text{-}6.6}$, n=15, FeO/MnO=31-35); Ca-pyroxene: $Fs_{15.8\pm6.2}Wo_{43.4\pm1.2}$ ($Fs_{11.7\text{-}29.0}Wo_{40.2\text{-}44.5}$, n=14, FeO/MnO=21-38); diogenitic pyroxene: $Fs_{32.4\pm0.2}Wo_{2.2\pm0.1}$ ($Fs_{31.8\text{-}32.6}Wo_{2.2\text{-}2.5}$, n=12, FeO/MnO=29-34); calcic plagioclase: $An_{87.4\pm2.5}$ ($An_{82.7\text{-}90.2}$, n=16)

Northwest Africa 11835 (NWA 11835)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Brownish individual with some fusion crust.
Petrography: The meteorite shows a chondritic texture with mostly rounded and well-packed chondrules (mean apparent diameter about 0.7 mm) in a fine-grained matrix, that contains sulfides and FeNi metal.

Northwest Africa 11836 (NWA 11836)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CK5)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Several greyish to light greenish fragments without fusion crust.
Petrography: The meteorite displays a greyish interior and is predominantly composed of recrystallized olivine-rich matrix with scattered chondrules still being discernable. Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, Ca-pyroxene and troilite; metal was not detected.
Geochemistry: olivine: $Fa_{31.1\pm0.2}$, n=15, FeO/MnO=121.5±7.2; low-Ca pyroxene: $Fs_{25.8\pm0.2}Wo_{1.0\pm0.2}$, n=13; Ca-pyroxene: $Fs_{11.3\pm0.7}Wo_{48.2\pm0.3}$, n=6

Northwest Africa 11837 (NWA 11837)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Brownish individual with some fusion crust.
Petrography: Unbrecciated medium-grained basaltic rock predominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase with average grains sizes of about 600 μm. Minor phases include silica, ilmenite, chromite, troilite, and metallic iron.
Geochemistry: low-Ca pyroxene: $Fs_{62.6\pm0.6}Wo_{6.6\pm0.7}$ ($Fs_{61.4\text{-}63.2}Wo_{5.5\text{-}8.0}$, n=13, FeO/MnO=25-29); Ca-pyroxene: $Fs_{34.4\pm0.2}Wo_{39.6\pm0.3}$ ($Fs_{34.1\text{-}34.8}Wo_{39.1\text{-}40.1}$, n=14, FeO/MnO=26-30); calcic plagioclase: $An_{88.1\pm0.5}$ ($An_{87.2\text{-}88.9}$, n=13)

Northwest Africa 11838 (NWA 11838)
(Northwest Africa)
Find: 2017

Classification: Ordinary chondrite (LL6)
History: Purchased by Daniel Sheikh in 2018
Petrography: (F. Sheikh, *UFla*) Chondrules almost absent (800±50 μm, N=3). Fine-grained matrix containing low amounts of metal. Scattered shock melt veins containing FeS and FeO.
Geochemistry: Olivine, $Fa_{25.2\text{-}47.6}$, mean $Fa_{31.1\pm0.7}$, N=54; orthopyroxene, $Fs_{22.5\text{-}38.6}Wo_{2.4\text{-}6.6}$, mean $Fs_{27.7\pm0.6}Wo_{3.2\pm0.8}$, N=51.
Classification: Ordinary Chondrite (LL6).
Specimens: 455.88 g at *UCLA*; main mass with Daniel Sheikh.

Northwest Africa 11839 (NWA 11839)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Several small dark grayish to black fragments some of which partly covered with fusion crust.
Petrography: The meteorite is a brecciated carbonaceous chondrite composed of small chondrules (mean diameter about 250 μm), CAIs, and mineral fragments often surrounded by fine-grained dust rims. The ferroan matrix contains abundant sulfides, almost pure calcite and fibrous phyllosilicates.

Northwest Africa 11840 (NWA 11840)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Many small almost black fragments partially covered with fusion crust.
Petrography: Brecciated carbonaceous chondrite with abundant Fe-rich matrix, chondrules (mean diameter 280 μm), chondrule pseudomorphs, CAIs, and mineral fragments. Many components are surrounded by fine-grained dust rims. Matrix consists of abundant carbonates, sulfides and phyllosilicates. No pyroxene has been detected in the thin section studied. Absence of pyroxene and presence of Fe-Mg-rich carbonates attest to a high degree of alteration.
Geochemistry: Carbonates contain up to 1.3 wt% MgO and 1.0 wt% FeO

Northwest Africa 11841 (NWA 11841)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Several small black fragments without fusion crust.
Petrography: Carbonaceous chondrite consisting of chondrule and CAI pseudomorphs and mostly corroded mineral grains set into abundant fine-grained matrix. Some components are surrounded by dust rims. Ferroan olivine and all pyroxene have been aqueously altered; only few forsteric olivines are unaltered. Matrix contains sulfides, phyllosilicates and some carbonates.
Geochemistry: Carbonates too small to be analyzed

Northwest Africa 11844 (NWA 11844)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CO3)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Small dark-brownish individual with some fusion crust.
Petrography: The meteorite shows a dark-brownish interior and is composed of abundant small chondrules, CAIs, and mineral fragments some of which surrounded by fine-grained dust rims set into a fine-grained matrix. Chondrules have a mean diameter of about 0.2 mm; few regions show brownish staining due to terrestrial weathering.

Northwest Africa 11845 (NWA 11845)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark greyish individual with patches of fusion crust.
Petrography: Carbonaceous chondrite composed of separated well-defined chondrules (mean diameter about 1.0 mm), CAIs (up to 4 mm), and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent. Some chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11846 (NWA 11846)
(Northwest Africa)
Purchased: 2018 Jan
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased in New York City by Darryl Pitt in January 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Ophitic texture. Aggregate of exsolved pigeonite and calcic plagioclase with accessory silica polymorph, Ti-chromite, ilmenite and troilite.

Geochemistry: Orthopyroxene host ($Fs_{62.2-62.3}Wo_{2.2-1.9}$,FeO/MnO = 31-32, N = 2), clinopyroxene exsolution lamellae ($Fs_{27.3-27.4}Wo_{43.5-43.3}$,FeO/MnO = 28-31, N = 2), plagioclase ($An_{88.4-89.7}Or_{0.5-0.6}$, N = 2).
Classification: Eucrite (unbrecciated).
Specimens: 20.6 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11847 (NWA 11847)
(Northwest Africa)
Purchased: 2018 Jan
Classification: Ordinary chondrite (L5)
History: Purchased in New York City by Darryl Pitt in January 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules occur in a dark, recrystallized matrix containing stained metal. The specimen is cross-cut by shock melt veins with very fine grained quench texture.
Geochemistry: Olivine ($Fa_{24.4-25.2}$, N = 3), orthopyroxene ($Fs_{20.5-20.6}Wo_{2.1-2.0}$, N = 3), clinopyroxene ($Fs_{8.1-8.5}Wo_{44.8-43.8}$, N = 2).
Classification: Ordinary chondrite (L5, highly shocked).
Specimens: 20.1 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 11848 (NWA 11848)
(Northwest Africa)
Purchased: 2018 Jan
Classification: Primitive achondrite (Lodranite)
History: Purchased by Rachid Chaoui in January 2018 from a dealer in Nouadhibou, Mauritania.
Petrography: (A. Irving and S. Kuehner, *UWS*) Orthopyroxene-rich breccia composed of large grains (up to 6 mm) of low-Ca pyroxene (some exhibiting irregular exsolution lamellae) and orthopyroxenite lithic clasts in a relatively coarse grained matrix of orthopyroxene with accessory clinopyroxene, olivine, chromite, troilite and altered kamacite. Some secondary goethite veinlets are present.
Geochemistry: Orthopyroxene ($Fs_{9.9-10.5}Wo_{1.5-2.7}$, FeO/MnO = 15-16, N = 3), clinopyroxene ($Fs_{4.2-4.8}Wo_{44.4-41.4}$, FeO/MnO = 10-12, N = 2), olivine ($Fa_{10.7-10.8}$, FeO/MnO = 25-26, N = 2).
Classification: Lodranite (pyroxenitic breccia).
Specimens: 28.8 g including one polished thin section at *UWB*; remainder with Mr. R. Chaoui.

Northwest Africa 11849 (NWA 11849)
(Northwest Africa)

Purchased: 2018 Jan
Classification: L6-an

History: Purchased by Greg *Hupe* in January 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Vesicular, metal-poor specimen consisting predominantly of finely recrystallized mafic silicates together with accessory sodic plagioclase, chromite, troilite and stained kamacite. Very sparse remnant chondrules are present, as well as poikiloblastic regions (presumably former chondrules). Small, spherical vesicles are present throughout.

Geochemistry: Olivine ($Fa_{24.4-25.0}$, N = 3), orthopyroxene ($Fs_{18.9-20.5}Wo_{4.0-4.4}$, N = 3), clinopyroxene ($Fs_{10.9-11.6}Wo_{38.6-35.9}$, N = 2).

Classification: Ordinary chondrite (L6, anomalous, metal-poor, vesicular). The presence of abundant vesicles and the paucity of metal are anomalous features in comparison with typical L6 chondrites. Although this specimen contains rare remnant chondrules, in most other respects it closely resembles NWA 11253, and may be related to or even paired with that heterogeneous meteorite.

Specimens: 20.4 g including one polished thin section at *UWB*; remainder with GHupé.

Northwest Africa 11850 (NWA 11850)
(Northwest Africa)
Purchased: 2017 Sep
Classification: Carbonaceous chondrite (CV3)

History: Purchased by Fabien *Kuntz* in September 2017 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Irreglarly shaped to rounded chondrules (mostly granular, some BO; apparent diameter 890±350 μm, N = 18) and very fine grained, amoeboid CAI are set in a fine grained matrix (~40 vol.%, black in thin section).

Geochemistry: Olivine ($Fa_{0.6-58.7}$, N = 3), orthopyroxene ($Fs_{2.5-15.1}Wo_{0.4-1.5}$, N = 3), clinopyroxene ($Fs_{9.3-12.5}Wo_{39.6-37.4}$, N = 2).

Classification: Carbonaceous chondrite (CV3).

Specimens: 21.62 g including one polished thin section at *UWB*; remainder with *Kuntz*.

Northwest Africa 11851 (NWA 11851)
Mali
Purchased: 2018 Mar
Classification: Lunar meteorite (feldspathic breccia)

History: Found in the Azawad region of northern Mali and purchased by Habib Naji in March 2018.

Physical characteristics: A fine grained, medium gray stone (227 g) with macroscopically indistinct clasts; partly coated by light brown weathering products.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Polymict breccia consisting of small mineral clasts (anorthite, olivine, pigeonite, augite, orthopyroxene, ilmenite, Ti-Cr-Mg-Al spinel, troilite, merrillite, kamacite) and small lithic clasts (including gabbroic lithologies and quench-textured melt rocks) in a finer grained matrix.
Geochemistry: Olivine ($Fa_{17.8-23.5}$, FeO/MnO = 90-127, N = 3), orthopyroxene ($Fs_{16.1}Wo_{3.8}$, FeO/MnO = 53), pigeonite ($Fs_{25.4-37.2}Wo_{8.1-13.0}$, FeO/MnO = 54-60, N = 3), augite ($Fs_{44.1}Wo_{35.6}$, FeO/MnO = 62), plagioclase ($An_{95.5-95.7}Or_{0.5-0.3}$, N = 2).
Classification: Lunar (feldspathic breccia).
Specimens: 22 g including one polished thin section at *UWB*; remainder with Mr. H. Naji.

Northwest Africa 11852 (NWA 11852)
(Northwest Africa)
Purchased: 2018 Feb
Classification: Ordinary chondrite (LL7)
History: Purchased by Fred *Olsen* in February 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Triple grain junction texture with no chondrules or chondrule remnants. Relatively fine grained aggregate (mean grainsize ~150 µm) of olivine, orthopyroxene, clinopyroxene, sodic plagioclase, chromite, chlorapatite, taenite and troilite.
Geochemistry: Olivine ($Fa_{29.6-29.8}$, N = 3), orthopyroxene ($Fs_{23.7-23.8}Wo_{1.7-2.0}$, N = 3), clinopyroxene ($Fs_{10.0-10.4}Wo_{43.2-42.1}$, N = 2).
Classification: Ordinary chondrite (LL7).
Specimens: 9.2 g including one polished thin section at *UWB*; remainder with Mr. F. *Olsen*.

Northwest Africa 11853 (NWA 11853)
(Northwest Africa)
Purchased: 2011 Apr
Classification: Mesosiderite
History: Purchased by Alexandre Debienne in April 2011 from a dealer in Agadir, Morocco.
Physical characteristics: A batch of identical brownish stones (total weight 270 g).
Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively coarse-grained aggregate of compositionally zoned orthopyroxene, calcic plagioclase, troilite and abundant altered kamacite.
Geochemistry: Orthopyroxene ($Fs_{15.8}Wo_{1.1}$, FeO/MnO = 33; $Fs_{24.7}Wo_{2.7}$, FeO/MnO = 27; $Fs_{46.6}Wo_{2.8}$, FeO/MnO = 31, N = 3).
Classification: Mesosiderite.

Specimens: A 21 g stone polished on one side is at *PSF*. The remaining material is held by Mr. A. Debienne.

Northwest Africa 11854 (NWA 11854)
(Northwest Africa)
Purchased: 2005
Classification: Carbonaceous chondrite (CV3)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Granular chondrules (apparent diameter 960±360 µm, N = 20) and irregularly shaped, very fine grained CAI are set in a fine grained matrix (40 vol.%, red-brown in thin section).
Geochemistry: Olivine ($Fa_{0.2\text{-}41.0}$, N = 3), orthopyroxene ($Fs_{0.9\text{-}1.2}Wo_{3.8\text{-}0.7}$, N = 3), clinopyroxene ($Fs_{0.9\text{-}1.2}Wo_{39.4\text{-}35.3}$; $Fs_{45.1}Wo_{50.3}$; N = 3).
Classification: Carbonaceous chondrite (CV3).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11855 (NWA 11855)
(Northwest Africa)
Purchased: 2017 Oct
Classification: Ordinary chondrite (H6)
History: Purchased by Stefan *Ralew* in October 2017 from a Moroccan dealer at the Munich Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Shock-darkened breccia. Very sparse remnant chondrules occur in a recrystallized matrix containing merrillite, altered kamacite and taenite. Some secondary goethite veinlets are present.
Geochemistry: Olivine ($Fa_{19.9\text{-}20.0}$, N = 3), orthopyroxene ($Fs_{16.9\text{-}17.6}Wo_{1.2\text{-}1.1}$, N = 3), clinopyroxene ($Fs_{6.4\text{-}9.3}Wo_{45.9\text{-}44.7}$, N = 2).
Classification: Ordinary chondrite (H6 breccia, shock-darkened).
Specimens: 20.8 g including one polished slice and one polished thin section at *UWB*; remainder with Mr. S. *Ralew*.

Northwest Africa 11856 (NWA 11856)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite)
History: A single stone weighing 137 g was found in Morocco prior to 2017. J. Donald Cline and John Sinclair purchased the sample from a meteorite dealer during the 2017 Tucson Gem and Mineral Show.
Physical characteristics: Sample is coated with a patchy, glossy, black, flow-lined fusion crust that covers ~75% of the irregularly shaped stone. Sample contains a

number of broad regmaglypts. Areas where fusion crust is absent show a light-colored, fine-grained granular texture.
Petrography: Description and Classification (A. Love, *App*): Sample is a matrix-supported breccia composed of dominantly of granular mineral fragments and sparse (~8 vol%) small (avg. dia. 1150 μm) angular-subrounded lithic clasts of intergranular to subophitic textured eucrite. Minerals are: birefringent clouded, plagioclase; exsolved pyroxenes; ilmenite; chromite; Fe metal; FeS.
Geochemistry: (A. Love, *App*) Low-Ca pyroxene host $Fs_{59.4\pm0.6}Wo_{2.0\pm0.2}$ ($Fs_{58.9-61.3}Wo_{1.7-2.3}$, FeO/MnO=30.2-34.5, N=12); high-Ca pyroxene exsolution lamellae $Fs_{25.8\pm0.4}Wo_{43.4\pm0.4}$ ($Fs_{25.1-26.5}Wo_{42.8-44.0}$, N=12); plagioclase $An_{82.3\pm1.4}Or_{0.6\pm0.2}$ ($An_{80.7-84.0}Or_{0.4-1.0}$ N=8).
Classification: HED (eucrite) FeO/MnO and Fs compositions of pyroxenes indicate this sample is a basaltic eucrite. Original igneous textures within clasts are preserved while major element compositions of pyroxenes within sample are equilibrated. Minor element compositions of pyroxenes (Al, Ti, Cr) are less equilibrated. Plagioclase compositions are unequilibrated.
Specimens: *PARI* holds the main mass. One endcut weighing 20 g and a polished thin section are on deposit at *App*.

Northwest Africa 11857 (NWA 11857)
Northwest Africa
Purchased: 2018
Classification: HED achondrite (Diogenite)
History: One stone weighing 580 g was found in Morocco prior to 2018. Steve Arnold purchased the sample from a meteorite dealer while at the 2018 Tucson Gem and Mineral Show.
Physical characteristics: The uncrusted sample has a weathered orangish-yellow exterior and yellowish-orange interior that is brecciated and friable. The cut face shows angular-subrounded clasts up to 5 mm in the long dimension.
Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of diogenitic lithic fragments (with average grainsize of 681 μm) and coarser grained (~1287 μm) cataclastic clasts mixed within a comminuted host of similar materials. Lithic clasts are composed of interlocking, orthopyroxenes, which share 120º grain boundaries. Orthopyroxenes contain CPX inclusions and exsolution lamellae (up to 0.5mm) within crystals. Additional minerals are Si polymorphs, chromite, FeS and rare Ni-free iron metal.
Geochemistry: (A. Love, *App*) Low-Ca pyroxene host $Fs_{26.2\pm0.6}Wo_{2.8\pm0.7}$ ($Fs_{26.2-28.0}Wo_{1.8-3.6}$, FeO/MnO=26.3-27.6 , N=12); high-Ca pyroxene inclusions and exsolution lamellae $Fs_{10.6\pm0.5}Wo_{44.0\pm1.2}$ ($Fs_{9.9-11.6}Wo_{41.9-45.7}$, FeO/MnO=20.1-21.2 N=6)
Classification: HED (monomict diogenite breccia). Textures, FeO/MnO and Fs compositions of pyroxenes indicate this sample is a diogenite.
Specimens: Steve Arnold holds the main mass. One 20 g endcut, several fragments and a polished thin section are on deposit at *App*.

Northwest Africa 11858 (NWA 11858)
Morocco
Purchased: 2008
Classification: HED achondrite (Howardite)
History: The meteorite was purchased at the Munich show in 2008 from a Moroccan meteorite dealer from Rissani.
Physical characteristics: The main mass is approximately 4 × 4 × 10 cm, and is almost completely covered in fusion crust, some of which is dark brown and glassy with flow lines. Minor evidence of terrestrial weathering is present as red-brown straining and adhered dust. Cut surfaces reveal numerous, mostly gray clasts set in a fine-grained, light-gray matrix.
Petrography: (C. Herd and J. Hamilton, *UAb*) Well-consolidated breccia of clasts up to 5 mm in longest dimension of diogenite (~25 vol%), unequilibrated eucrite (~10 vol%), equilibrated eucrite (~10 vol%), cumulate gabbroic eucrite (~10 vol%), and impact melt, as well as grains of anorthitic plagioclase, olivine, chromite, sulfide, and FeNi metal. All plagioclase has been transformed to maskelynite, and strong mosaicism is common. Fine-grained recrystallized areas of some gabbroic eucrite clasts indicate shock melting.
Geochemistry: (C. Herd, *UAb*) Diogenite orthopyroxene $Fs_{27\pm3}Wo_{2.6\pm0.8}$, Fe/Mn=32±2, n=23, eucrite pigeonite average $Fs_{48\pm10}Wo_{6\pm3}$, Fe/Mn=32±2, range $Fs_{32\text{-}63}$, n=32, eucrite augite $Fs_{40\pm10}Wo_{28\pm10}$, Fe/Mn=32±1, n=10; plagioclase $An_{88\pm3}Ab_{11\pm3}Or_{0.5\pm0.3}$, n=21; high-Ti (15 wt% TiO_2) and low-Ti (0.8 wt% TiO_2) chromite.
Classification: Achondrite (howardite)
Specimens: Type specimen of 21.3 g, including one thin section, is at *UAb*. Main mass at *JTESM*.

Northwest Africa 11859 (NWA 11859)
(Northwest Africa)
Purchased: 2017
Classification: Iron meteorite (IAB-MG)
History: Purportedly found in the NWA area. Presented to *UCLA* by A. *Aaronson* in 2017.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 69.1, Co = 4.54 (both mg/g), Ga = 94.9, As = 11.8, W = 1.27, Ir = 3.75, Au = 1.485 (all µg/g).
Classification: Iron, IAB main group. Probably paired with Campo del Cielo.
Specimens: Type specimen at *UCLA*.

Northwest Africa 11860 (NWA 11860)
(Northwest Africa)
Purchased: 2017

Classification: Rumuruti chondrite (R3-5)

History: A single stone weighing 520 g was found in Morocco prior to 2017. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February of 2017.

Physical characteristics: Sample is black in color, lacks fusion crust, has a rounded flattened shape with shallow broad regmaglypts. A small cut face shows brecciated texture composed of clasts set within abundant small chondrules, which, are visible through the patina. Sample is non-magnetic and only sulfides appear to reflect light on the surface of the cut face.

Petrography: Description and Classification (A. Love, *App*) Sample is a breccia composed of up to 3 cm irregularly shaped, light-orangish to brown-black unequilibrated and equilibrated clasts set within a recrystallized host containing chondrules (avg. dia. 432 μm), fragments and abundant Ni-bearing sulfides and pentlandite. Host contains 40 vol% well-defined, unequilibrated chondrules set within a recrystallized matrix. Unequilibrated clasts contain chemically-zoned, unequilibrated chondrules set within a fine-grained, opaque matrix. Equilibrated clasts contain olivine, low-Ca pyroxene within a recrystallized matrix containing isolated intergrowths of plagioclase with average size 30 μm (Berlin and Stoeffler, 2004).

Geochemistry: (A. Love, *App*) Host: Olivine $Fa_{25.0\pm14.7}$ ($Fa_{2.1\text{-}48.5}$), Cr_2O_3 in ferroan olivine=0.1±0.1, Fe/Mn=74.5 n=22, Low Ca Pyroxene: $Fs_{13.8\pm9.2}Wo_{1.1\pm1.0}$ ($Fs_{2.1\text{-}28.1}Wo_{0.3\text{-}3.1}$), N=9. Clast: Olivine $Fa_{41.8\pm0.3}$, Fe/Mn=94.5±2.2, n=5, low Ca Pyroxene: $Fs_{36.0\pm0.2}Wo_{2.2\pm0.3}$, N=3.

Classification: Rumuruti chondrite (R3-5, S2, wi-2). Based on Fa and Fe/Mn compositions of olivines, chondrule diameter and texture this sample is a Rumuruti chondrite breccia. Based on the coefficient of variation of olivine within unequilibrated clast, the petrologic subtype is estimated at 3.4 (Bischoff, 2000). Based on presence of low-Ca pyroxene and isolated plagioclase intergrowths within equilibrated clasts, these represent type 5 material.

Specimens: *PARI* holds the main mass. One endcut weighing 20.02 g and a polished thin section are on deposit at *App*.

Northwest Africa 11861 (NWA 11861)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite, polymict)

History: A single 538 g stone was found in Morocco prior to 2018. Steve Arnold purchased the stone from a meteorite dealer during the 2018 Tucson Gem and Mineral Show.

Physical characteristics: Stone is irregularly shaped and ~20% is covered by a weathered fusion crust. The weathered exterior is light orangish-gray in color and light gray on the cut face. Numerous mineral and rock clasts can be seen on the cut face.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of up to 5 mm angular basaltic and cumulate textured eucritic (~13 vol%) and diogenitic (~8 vol%) lithic clasts and related mineral fragments hosted within a fine-grained comminuted matrix. Eucrite clasts have ophitic to subophitic textures and exsolved pyroxenes. Minerals: Chromite, Ilmenite, FeS, Si Polymorph, phosphate.
Geochemistry: (A. Love, *App*) Eucrite: Low-Ca pyroxene host $Fs_{49.7\pm7.6}Wo_{2.5\pm0.7}$ ($Fs_{40.7\text{-}65.8}Wo_{1.7\text{-}4.5}$, FeO/MnO=27.5-32.3, N=16); pigeonite ($Fs_{42.0\pm4.4}Wo_{12.2\pm6.7}$ ($Fs_{35.9\text{-}48.4}Wo_{8.5\text{-}25.7}$, FeO/MnO=29.0-31.2, N=5); high-Ca pyroxene exsolution lamellae $Fs_{23.73\pm6.1}Wo_{42.5\pm1.8}$ ($Fs_{16.1\text{-}33.5}Wo_{39.5\text{-}44.2}$, N=9); plagioclase $An_{85.8\pm7.4}Or_{0.6\pm0.7}$ ($An_{71.5\text{-}94.7}$, $Or_{0.0\text{-}1.6}$ N=10). Diogenite: Low-Ca pyroxene $Fs_{26.4\pm3.8}Wo_{2.4\pm0.5}$ ($Fs_{21.1\text{-}31.8}Wo_{1.7\text{-}3.4}$, FeO/MnO=27.8-34.7, N=10)
Classification: HED (polymict eucrite breccia). FeO/MnO and Fs compositions of pyroxenes indicate this sample is a HED meteorite composed of a mixture of eucrite and diogenite components.
Specimens: Steve Arnold holds the main mass. Three slices and an endcut totaling 20g and a polished thin section are on deposit at *App*.

Northwest Africa 11862 (NWA 11862)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H4/5)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Some well-formed chondrules are set in a recrystallized matrix containing relatively abundant altered metal.
Geochemistry: Olivine ($Fa_{18.9\text{-}19.1}$, N = 3), orthopyroxene ($Fs_{16.3\text{-}17.2}Wo_{1.0\text{-}0.7}$, N = 3), clinopyroxene ($Fs_{6.0\text{-}6.2}Wo_{45.0\text{-}47.3}$, N = 2).
Classification: Ordinary chondrite (H4/5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11863 (NWA 11863)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L6)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules.
Geochemistry: Olivine ($Fa_{25.0\text{-}25.8}$, N = 3), orthopyroxene ($Fs_{20.6\text{-}21.2}Wo_{2.0\text{-}2.5}$, N = 3), clinopyroxene ($Fs_{9.4\text{-}9.9}Wo_{42.8\text{-}42.7}$, N = 2).
Classification: Ordinary chondrite (L6).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11864 (NWA 11864)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L4)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules are set in relatively coarse grained matrix.
Geochemistry: Olivine ($Fa_{24.8-25.1}$, N = 3), orthopyroxene ($Fs_{18.9-20.6}Wo_{1.1-0.5}$, N = 3), subcalcic augite ($Fs_{18.1}Wo_{26.7}$), augite ($Fs_{10.6}Wo_{36.3}$).
Classification: Ordinary chondrite (L4).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11865 (NWA 11865)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L6)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules.
Geochemistry: Olivine ($Fa_{24.5-25.0}$, N = 3), orthopyroxene ($Fs_{21.6-21.7}Wo_{1.6-1.9}$, N = 3), clinopyroxene ($Fs_{8.1-8.9}Wo_{44.4-43.7}$, N = 2).
Classification: Ordinary chondrite (L6).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11866 (NWA 11866)
(Northwest Africa)
Purchased: 2018 May
Classification: Martian meteorite (Shergottite)
History: Purchased by Ben Hoefnagels in May 2018 from a dealer in Zagora, Morocco.
Physical characteristics: A group of broken fragments with exterior coatings of black fusion crust (23.3 g) from an unknown larger stone. The pieces are very fresh and contain gray pyroxene and obvious glassy maskelynite.
Petrography: (A. Irving and S. Kuehner, *UWS*) Diabasic texture. Igneous assemblage of predominantly zoned clinopyroxene and maskelynite with accessory titanomagnetite, ilmenite, pyrrhotite and rare Fe-merrillite. Low-Ca pyroxene compositions do not extend to very magnesian compositions.

Geochemistry: Pigeonite ($Fs_{41.8-58.8}Wo_{11.1-14.4}$, FeO/MnO = 33-36, N = 4), subcalcic augite ($Fs_{24.5-47.2}Wo_{33.9-28.8}$, FeO/MnO = 30-38, N = 3), maskelynite ($An_{53.8-54.4}Or_{0.9}$, N = 2).
Classification: Martian (shergottite, diabasic). Although the pyroxene compositions are somewhat like those in Shergotty, the trend for low-Ca pyroxenes does not extend to as magnesian values.
Specimens: 4.8 g in the form of a polished endcut at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11868 (NWA 11868)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L6)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules.
Geochemistry: Olivine ($Fa_{24.8-24.9}$, N = 3), orthopyroxene ($Fs_{20.8-21.8}Wo_{1.0-0.9}$, N = 3), clinopyroxene ($Fs_{7.2-12.2}Wo_{45.7-43.1}$, N = 2).
Classification: Ordinary chondrite (L6).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11869 (NWA 11869)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L4)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules are set in relatively coarse grained, shock-darkened matrix.
Geochemistry: Olivine ($Fa_{23.5-23.7}$, N = 3), orthopyroxene ($Fs_{20.0-20.2}Wo_{3.4-1.5}$, N = 3), subcalcic augite ($Fs_{11.3}Wo_{27.4}$), augite ($Fs_{12.6}Wo_{35.6}$).
Classification: Ordinary chondrite (L4, shock-darkened).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11870 (NWA 11870)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L5)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with sparse remnant chondrules.
Geochemistry: Olivine ($Fa_{24.7-24.8}$, N = 3), orthopyroxene ($Fs_{21.4-21.5}Wo_{1.3-1.2}$, N = 3), subcalcic augite ($Fs_{12.0}Wo_{29.1}$), augite ($Fs_{11.1}Wo_{43.8}$).
Classification: Ordinary chondrite (L5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11871 (NWA 11871)
Algeria
Purchased: 2018 May
Classification: Lunar meteorite (feldspathic breccia)
History: Purportedly found near Tindouf, Algeria and purchased by Joseph Hum in May 2018 from a dealer in Gladstone, Oregon, who obtained it from a Mauritanian source.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of mineral clasts of anorthite, olivine, exsolved pigeonite, unexsolved pigeonite,orthopyroxene, aluminous subcalcic augite, chromite, ilmenite, troilite and kamacite in a fine grained, partly vesicular matrix.
Geochemistry: Olivine ($Fa_{19.7-51.6}$, FeO/MnO = 92-105, N = 3), orthopyroxene host ($Fs_{45.7}Wo_{3.6}$, FeO/MnO = 55), clinopyroxene exsolution lamella ($Fs_{24.2}Wo_{34.6}$, FeO/MnO = 54), orthopyroxene ($Fs_{47.9}Wo_{3.6}$, FeO/MnO = 59), pigeonite ($Fs_{24.8}Wo_{10.0}$, FeO/MnO = 68), aluminous subcalcic augite ($Fs_{18.5}Wo_{23.9}$, FeO/MnO = 56, Al_2O_3 = 15.4 wt.%, Na_2O = 0.4 wt.%), plagioclase ($An_{94.1-96.4}Or_{0.3-0.1}$).
Classification: Lunar (feldspathic regolithic breccia).
Specimens: 4.73 g including a polished endcut at *UWB*; remainder with Mr. J. Hum.

Northwest Africa 11872 (NWA 11872)
(Northwest Africa)
Purchased: 2007 June
Classification: Ordinary chondrite (L4)
History: Purchased from a moroccan mineral dealer at the meteorite show in Ensisheim, France.
Physical characteristics: Individual with about 50% fusion crust and deep, well-developed regmaglypts. The fusion crust and old fracture planes appear light brown, in contrast to the shock-darkened interior which is exposed on younger fracture planes.
Petrography: Brecciated shock-darkened ordinary chondrite with well-preserved chondrules. Silicates with tiny metal and sulfide veins along cracks and grain boundaries. Shock-deformed apatite with enclosed silicate clasts. One large sulfide grain (1.2 cm) was found.

Northwest Africa 11873 (NWA 11873)
(Northwest Africa)
Purchased: 2008 June
Classification: Ordinary chondrite (LL3-6)
History: Purchased from a Moroccan mineral dealer at the mineral show in Sainte-Marie-aux-Mines, France
Physical characteristics: Individual without fusion crust. Brecciation texture with differently colored clasts is visible. One fine-grained, gray, melt-rock clast of about 4 cm stands out.
Petrography: Genomict LL chondritic breccia, consisting of type 3 and type 6 clasts, embedded in a clastic matrix. The matrix also contains intact chondrules. One large melt rock clast occurs, consisting of euhedral igneously zoned olivine grains, embedded in a glassy mesostasis.
Geochemistry: Type 3 clast: Olivine $Fa_{28.2\pm4.1}$ ($Fa_{12.9\text{-}32.7}$; n=20). Pyroxene $Fs_{17.2\pm6.0}Wo_{0.8\pm0.5}$ ($Fs_{8.0\text{-}24.4}Wo_{0.1\text{-}1.7}$; n=15). Type 6 clast: Olivine $Fa_{29.3\pm0.4}$ ($Fa_{28.5\text{-}30.0}$; n=12). Pyroxene $Fs_{23.6\pm0.4}Wo_{1.5\pm0.2}$ ($Fs_{23.1\text{-}24.2}Wo_{1.3\text{-}1.9}$; n=9). Olivine in melt rock clast: $Fa_{11.6\text{-}42.2}$ (n=2).

Northwest Africa 11880 (NWA 11880)
Northwest Africa
Purchased: 2018 Jan
Classification: Rumuruti chondrite (R3.5-4)
Petrography: The sample is a breccia, consisting of light and dark clasts. The light clasts display well-defined chondrules surrounded by a fine-grained matrix. The dark clasts show very well-defined chondrules in a dark and glassy matrix. Mean apparent chondrule size is 550±377 μm in the dark clasts, and 694±316 μm in the light clasts. Maximum chondrule size is 2.65 mm. Undulatory extinction is visible in olivine grains. No oxidation rims are seen on sulphides or metal grains.
Geochemistry: As determined by EPMA, Dark Clast olivine compositions are: Fa=31.3±27.6 (n=35), coefficient of variation CV%=43.7, Cr_2O_3 (wt%) = 0.14. Dark clast pyroxene compositions are: High Ca Pyroxene - $Fs_{18.2\pm5.5}En_{52.5\pm7.3}Wo_{29.2\pm12}$ (n=4), Low Ca Pyroxene - $Fs_{29.6\pm5.6}En_{66.2\pm1.2}Wo_{4.2\pm5.1}$, (n=5). Light Clast olivine compositions are: $Fa_{40.9\pm0.6}$ (n=10), CV%=1.1, Cr_2O_3 (wt%) = 0.08. Light clast pyroxene compositions are: $Fs_{13.7\pm3.4}En_{43.9\pm0.7}Wo_{42.4\pm4.0}$ (n=6) (V. Di Cecco, *ROM*)
Classification: Pyroxenes: Dark/Unequilibrated Clast - High and low Ca pyroxenes occur in roughly equal proportions. Light/Equilibrated Clast - Ca pyroxene is dominant. This follows the summary of Bischoff et al. (2011) for R chondrites. $Fa_{40.9\pm0.6}$ is consistent with reported composition of equilibrated R chondrites. CV% of 43.7 suggests petrologic type 3.5.

Northwest Africa 11881 (NWA 11881)
(Northwest Africa)

Purchased: 2018
Classification: Ordinary chondrite (L3)
History: Bought from Mohamed Elguirah in Zagora in 2018.
Petrography: (J. Gattacceca, *CEREGE*) Packed chondrules with average size about 700 μm.
Geochemistry: Olivine $Fa_{7.3\text{-}29.1}$, Fa PMD=32%. Cr_2O_3 in ferroan olivine 0.07±0.07 wt% (n=7).
Classification: L3. L group based on magnetic susceptibility and chondrule size.

Northwest Africa 11886 (NWA 11886)
(Northwest Africa)
Purchased: 2018 March
Classification: Lunar meteorite
History: Bought in Erfoud, Morocco, in March 2018
Physical characteristics: Cut surface reveals a gray interior with light grey and white clasts.
Petrography: (J. Gattacceca, *CEREGE*) Igneous fragmental breccia. Main minerals are pyroxene and plagioclase with typical grain size of 300 μm. Other minerals include olivine, chromite, troilite, silica polymorph (to 200 μm), ilmenite, rare metal.
Geochemistry: Pyroxene $Fs_{44.4\pm6.0}Wo_{22.9\pm9.0}$, FeO/MnO=67.3±12.4 (N=5). Plagioclase $An_{92.7}Ab_{7.2}Or_{0.1}$ (N=2). Olivine $Fa_{87.8}$, FeO/MnO=109 (N=1).
Classification: Lunar, fragmental breccia
Specimens: 7.5 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 11887 (NWA 11887)
(Northwest Africa)
Purchased: 2015
Classification: Mesosiderite
Physical characteristics: Cut surface reveals abundant metal, up to cm size.
Petrography: (J. Gattacceca, *CEREGE*) Main minerals are pyroxene (to 200 μm), interstitial plagioclase (to 150 μm), kamacite (to cm). Other minerals: troilite, silica polymorph, merrillite. Silicate show triple junctions.
Geochemistry: Orthopyroxene $Fs_{15.9}Wo_{0.6}$, FeO/MnO=34.7 (N=1). Plagioclase $An_{89.9}Ab_{9.6}Or_{0.5}$ (N=3).
Classification: Mesosiderite
Specimens: 16 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 11888 (NWA 11888)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Diogenite)

Physical characteristics: Dark stone. Cut surface reveals a dark gray interior with a variety of clasts up to cm.
Petrography: (J. Gattacceca, *CEREGE*) Brecciated igneous rock with fractured lithic and mineral clasts set in a clastic matrix. The dominant mineral is pyroxene (to 500 um) and plagioclase (to 400 μm). Other minerals: troilite, chromite, silica polymorph, FeNi metal.
Geochemistry: Low-Ca pyroxene shows a wide range of composition from $Fs_{12.9}$ to $Fs_{47.4}$, and average $Fa_{26.6\pm10.0}Wo_{2.8\pm1.7}$, FeO/MnO=30.0±1.8 (n=15). Augite exsolution $Fs_{25.2}Wo_{39.2}$ (n=1). Plagioclase $An_{86.6}Ab_{12.9}Or_{0.5}$ (N=2)
Classification: Diogenite
Specimens: 30.9 g and a polished section at *CEREGE*. Main mass with R. Lenssen.

Northwest Africa 11889 (NWA 11889)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
Physical characteristics: Dark stone. Cut surface reveals homogeneous dark interior.
Petrography: (J. Gattacceca, *CEREGE*) Chondrules, some with fine grained dust rim, with average size 180±70 μm (N=20) set in a abundant fine grained iron rich matrix (61 vol% by point counting). Opaques are magnetite and troilite. No metal was observed. Low microprobe analyses totals in the matrix indicate the presence of phyllosilicates.
Geochemistry: Olivine $Fa_{1.0\text{-}46.6}$, Cr_2O_3 0.25±0.14 wt% (n=10). Defocalized (10 μm) electron microprobe analyses in the matrix yield totals of 75 wt%.
Classification: CM2
Specimens: 23.5 g and a polished section at *CEREGE*. Main mass with R. Lenssen.

Northwest Africa 11890 (NWA 11890)
(Northwest Africa)
Purchased: Nov 2016
Classification: Ureilite
Petrography: coarse-grained olivine with reduced rims (90%), pyroxene (<5%), Fe-rich metal, and carbon phases. Graphite, metal, and sulfide occur in veins around the olivines and pyroxenes. Olivines are up to 2 mm. Si glass, graphite, and diamonds were also identified.
Geochemistry: Mineral Compositions and Geochemistry: Olivine cores, $Fa_{21.7\pm0.1}$; rims $Fa_{8.2\pm4.0.}$ Pyroxenes contain a varied texture with lighter and darker spots, which display differing compositions: brighter $Fs_{9.3\pm1.8}Wo_{30.4\pm4.6}$; darker, $Fs_{12.6\pm2.5}Wo_{9.3\pm1.7}$).
Classification: Ureilite
Specimens: 20.0 g including a thin section and polished mount at *UWO*.

Northwest Africa 11891 (NWA 11891)
(Northwest Africa)
Purchased: Nov 2016
Classification: Ureilite
Petrography: olivine (90%) with reduced rims, pyroxene (5%), metals, and carbon phases. Olivine grains are up to 1.5 mm. Graphite and diamonds were found.
Geochemistry: Mineral Compositions and Geochemistry: Olivine cores, $Fa_{19.7\pm0.1}$; rims, $Fa_{10.2\pm2.0.}$ Pyroxene, $Fs_{16.7\pm0.2}Wo_{7.6\pm0.1.}$
Classification: Ureilite
Specimens: 20.1g including a thin section and polished mount at *UWO*.

Northwest Africa 11892 (NWA 11892)
(Northwest Africa)
Purchased: Nov 2016
Classification: Ureilite
Petrography: olivine (80%) with reduced rims, pyroxenes (15%), metal, sulfides, and carbon phases. Metal grains are present in veins and at the edges of olivine, pyroxene, and carbon grains. Olivines are up to 2.5 mm. Graphite and diamond were found.
Geochemistry: Mineral Compositions and Geochemistry: Olivine cores, $Fa_{21.6\pm0.1}$; rims $Fa_{8.9\pm3.0.}$ Pyroxenes contain a varied texture with lighter and darker spots, which display differing compositions: brighter $Fs_{8.0\pm1.8}Wo_{31.9\pm6.8}$; darker $Fs_{11.5\pm2.4}Wo_{7.9\pm1.6}$).
Classification: Ureilite
Specimens: 37.8g including a thin section and polished mount at *UWO*.

Northwest Africa 11893 (NWA 11893)
(Northwest Africa)
Purchased: Feb 2017
Classification: Ureilite
Petrography: The sample has a fine grained brecciated texture. It contains olivine (~65%) with reduced rims, pyroxene (pigeonite) (~25%), Metals in veins around grain boundaries, and graphite. Olivines are up to 3 mm. Graphite was found.
Geochemistry: Mineral Compositions and Geochemistry: Olivine core and rim compositions vary, with reduced rims. Cores $Fa_{16.0\pm0.1}$ ($Fa_{15.9\text{-}16.1}$, N=10); rims $Fa_{4.5\pm2.3}$ ($Fa_{1.9\ 8.4}$, N=10). All pyroxenes are clinopyroxene, $Fs_{13.7\pm0.1}Wo_{7.4\pm0.1}$ ($Fs_{13.4\text{-}13.8}Wo_{7.3\text{-}7.5}$, N=10).
Classification: Ureilite
Specimens: 21.0 g including a thin section and polished mount at *UWO*.

Northwest Africa 11894 (NWA 11894)
(Northwest Africa)
Purchased: 2016
Classification: Ureilite
History: Specimen was purchased from a dealer in Dakhla, Western Moroccan Sahara.
Petrography: olivine (~80%) with reduced rims, pyroxene (pigeonite) (~15%), metals, and carbon phases. Olivines are up to 1 mm in size. Graphite and diamonds were found.
Geochemistry: Mineral Compositions and Geochemistry: Olivine cores, $Fa_{19.2\pm0.0}$; rims $Fa_{12.6\pm0.0}$). Pyroxenes, $Fs_{13.7\pm0.1}Wo_{7.4\pm0.1}$).
Classification: Ureilite
Specimens: 15.3 g including a thin section at *UWO*.

Northwest Africa 11895 (NWA 11895)
Sahara
Find: 1998
Classification: Ordinary chondrite (H3-5)
History: Sample was found 1998 by the *Labenne* group. The coordinates are unknown.
Petrography: The sample is a breccia and contains fragments of different petrologic type, most fragments are recrystallized (type 5) and some are unequilibrated.
Geochemistry: Olivine compositions are $Fa_{14.2\text{-}21.0}$ (mean $Fa_{17.6\pm2.5}$, n=9), pyroxene compositions are $Fs_{8.2\text{-}20.4}Wo_{0.8\text{-}2.6}$ (mean $Fs_{15.7\pm3.4}Wo_{1.4\pm0.5}$, n=11). The equilibrated clasts have olivine compositions of $Fa_{19.2\pm0.2}$ (n=3) and pyroxene compositions of $Fs_{16.9\pm0.3}Wo_{1.3\pm0.2}$ (n=3).
Classification: Brecciated H chondrite (H3-5) based on mineral compositions and chondrule size. Very weakly shocked (S2), weathering degree: W2

Northwest Africa 11896 (NWA 11896)
(Northwest Africa)
Purchased: 2017
Classification: Martian meteorite
History: The Smithsonian specimen was purchased from Mendy Ouzillou, who had purchased it from Stefan *Ralew* in Ensisheim in 2017.
Physical characteristics: The type specimen has black exterior except for its saw-cut face. The saw cut exposes a gray interior that includes black spherules with sharp boundaries along the contact with the matrix and white, gray, and black clasts.
Petrography: Petrographic and microprobe examination of the polished sections show this breccia contains clasts, spherical inclusions, and mineral fragments with a wide range of textures and compositions. The fragmental minerals include

orthopyroxene, pigeonite, augite, plagioclase, albitic feldspar, potassium feldspar, phosphates, and opaque oxides. The clasts include basaltic (pyroxene-plagioclase) lithic clasts, with varying mineral compositions. This meteorite is texturally similar to Northwest Africa 7034 and 7475.
Geochemistry: Mineral compositions were determined by EPMA at *SI*. Low-Ca pyroxene are $Fs_{34\pm8}Wo_{5\pm4}$, Fe/Mn = 35±2, n = 144. Augite are $Fs_{24\pm7}Wo_{40\pm4}$, Fe/Mn = 32±3, n = 53. Collectively, the pyroxenes in Fe-Mn composition space have linear regression slope equal to 0.0289, using the method of Papike et al. (2003) American Mineralogist 88: 469. Plagioclase $Ab_{55\pm10}An_{43\pm10}Or_{2.4\pm0.7}$, n = 71, albitic feldspar $Ab_{81\pm11}An_{13\pm11}Or_{5.4\pm3.2}$, n = 19, and potassium feldspar $Ab_{20\pm13}An_{2.0\pm1.5}Or_{78\pm14}$, n = 18 are all present.
Classification: Martian, basaltic breccia

Northwest Africa 11897 (NWA 11897)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased in March 2018 by Craig Zlimen and Dustin Dickens from a Moroccan meteorite dealer.
Physical characteristics: Fusion crusted exterior; sawcut reveals a fine-grained, gray interior.
Petrography: (C. Agee, *UNM*) This meteorite is a porphyritic basalt with pigeonite phenocrysts set in a groundmass of fine-grained quench crystals of pyroxene, plagioclase, silica, chromite, and Fe-sulfide. Pigeonite phenocrysts show igneous zoning.
Geochemistry: (C. Agee, *UNM*) pigeonite $Fs_{45.5\pm8.4}Wo_{5.2\pm2.0}$, Fe/Mn=36±2, n=16.
Classification: Unequilibrated, porphyritic eucrite; unbrecciated
Specimens: 8.9 g including a probe mount on deposit at *UNM*, Craig Zlimen and Dustin Dickens hold the main mass.

Northwest Africa 11898 (NWA 11898)
Mali
Purchased: 2018
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased in March 2018 by Dustin Dickens from a meteorite dealer in Mali.
Physical characteristics: Several identical appearing dark stones covered partially with a milky-green fusion crust. Broken surface reveals a fragmental breccia with numerous white feldspathic clasts set in a dark colored ground mass.
Petrography: (C. Agee, *UNM*) This meteorite is a breccia of primarily feldspathic clasts, with lesser amounts of olivine and pyroxene fragments. The shock melt composition has a very high alumina content, vesicles occur throughout.

Geochemistry: (C. Agee, *UNM*) olivine $Fa_{25.0\pm6.4}$, Fe/Mn=90±5, n=8; pigeonite $Fs_{31.0\pm3.6}Wo_{8.1\pm3.6}$, Fe/Mn=58±4, n=6; high-Ca pyroxene $Fs_{22.3\pm3.7}Wo_{35.0\pm4.7}$, Fe/Mn=52±5, n=4; plagioclase $An_{96.3\pm0.7}Ab_{3.5\pm0.7}Or_{0.2\pm0.0}$, n=6; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): SiO_2=43.1±0.6, TiO_2=0.12±0.03, Al_2O_3=31.3±1.2, Cr_2O_3=0.03±0.01, MgO=2.0±0.5, FeO=2.5±0.5, MnO=0.03±0.01, CaO=18.0±0.4, Na_2O=0.36±0.01, K_2O=0.04±0.00 (all wt%), n=4.
Classification: Lunar feldspathic breccia
Specimens: 21.6 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11899 (NWA 11899)
Mali
Purchased: 2017
Classification: HED achondrite (Howardite)
History: Purchased by Dustin Dickens from Nomad in Mali.
Physical characteristics: Many identically appearing pieces. Fusion crusted exterior. A saw cut reveals a breccia with light and dark clasts set in light-brown matrix.
Petrography: (C. Agee, *UNM*) This meteorite is a polymict breccia consisting of approximately 60% diogenite and 40% eucrite clasts. Accessory Fe-Ni metal, Fe-sulfide, and silica observed.
Geochemistry: (C. Agee, *UNM*) diogenite low-Ca pyroxene $Fs_{25.1\pm2.5}Wo_{3.6\pm2.2}$, Fe/Mn=30±2, n=10; eucrite low-Ca pyroxene $Fs_{49.7\pm5.2}Wo_{4.8\pm2.8}$, Fe/Mn=29±2, n=7;.plagioclase AN93.1±1.2, n=7.
Classification: Howardite
Specimens: 22.8 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11900 (NWA 11900)
Western Sahara
Purchased: 2017
Classification: Ureilite
History: Purchased by Dustin Dickens from nomad near Dahkla in Western Sahara.
Physical characteristics: Weathered exteri; saw cut reveals an interior mosaic of green and brown crystals.
Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and augite. Ubiquitous fine-grained Fe-metal is present along grain boundaries. Elongate (100-200 μm) grains of graphite are scattered throughout.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{22.2\pm0.1}$, Fe/Mn=49±1, Cr_2O_3=0.36±0.02 (wt%), n=7; pigeonite $Fs_{18.6\pm0.3}Wo_{4.2\pm0.1}$, Fe/Mn=29±1, n=4; augite $Fs_{11.7\pm0.1}Wo_{34.9\pm0.1}$, Fe/Mn=22±1, n=3.

Classification: Augite-bearing ureilite
Specimens: 20.7 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11901 (NWA 11901)
Western Sahara
Purchased: 2017
Classification: Primitive achondrite (Lodranite)
History: Purchased by Dustin Dickens from nomad near Dahkla in Western Sahara.
Physical characteristics: Many identically appearing pieces. Weathered exterior. A saw cut reveals an interior of coarse green and brown crystals. Opaque grains are scattered throughout.
Petrography: (C. Agee, *UNM*) This meteorite consists primarily of olivine and Cr-diopside; low-Ca pyroxene and plagioclase are absent. Most grains are in the 1-3 mm size range.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{11.0\pm0.1}$, Fe/Mn=38±5, Cr_2O_3=0.03±0.01 (wt%), n=4; diopside $Fs_{5.0\pm0.6}Wo_{41.4\pm2.9}$, Fe/Mn=14±1, Cr_2O_3=1.09±0.06 (wt%)n=7.
Classification: Lodranite, opx-absent
Specimens: 22.9 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11903 (NWA 11903)
(Northwest Africa)
Purchased: 2016
Classification: Ordinary chondrite (H6)
History: Purchased by Dustin Dickens from Fyssal Mesgouri in Agadir, Morocco.
Physical characteristics: Weathered exterior. Saw cut reveals an interior with many small opaque grains and a few faint chondrules set in a dark, reddish-brown groundmass.
Petrography: (C. Agee, *UNM*) Faint, texturally equilibrated chondrules present, abundant Fe-Ni metal and sulfide throughout, plagioclase up to 150 μm.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{19.2\pm0.1}$, Fe/Mn=38±1, n=7; low-Ca pyroxene $Fs_{17.0\pm0.2}Wo_{1.3\pm0.3}$, Fe/Mn=22±1, n=7.
Classification: Ordinary chondrite, H6
Specimens: 25 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 11904 (NWA 11904)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)

History: Purchased by Abdelhadi Aithiba in Morocco in 2018.
Physical characteristics: Single stone, dark, weathered, irregular exterior, distinct chondrules up to ~3 mm and scattered CAIs are visible on the surface; the matrix is dark gray in color.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount many irregular shaped porphryritic chondrules, some AOAs observed, fine-grained matrix makes up about ~50% of this meteorite.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{2.8\pm2.7}$, range $Fa_{0.5\text{-}11.9}$, Cr_2O_3=0.25±0.14 (wt%), CaO=0.27±0.13 (wt%), n=22; low-Ca pyroxene $Fs_{4.5\pm7.7}Wo_{1.2\pm0.5}$, n=6. Oxygen isotopes (K. Ziegler, *UNM*): 3 analyses, with $\delta^{17}O$ = -2.359, -2.108, -0.349 and $\delta^{18}O$ = 2.317, 2.000, 4.233 (linearized values).
Classification: Carbonaceous chondrite (CV3)
Specimens: 20.66 g including a probe mount on deposit at *UNM*, Abdelhadi Aithiba holds the main mass.

Northwest Africa 11905 (NWA 11905)
(Northwest Africa)
Purchased: 2017
Classification: LL3.10-5
History: Purchased by Matthew Martin, February 2017, in Tucson from a Moroccan meteorite dealer.
Physical characteristics: Single stone. Saw cuts show a breccia of visually different chondrite clasts set in a host chondrite groundmass. Some of the clasts appear to be texturally equilibrated with less distinct chondrules, whereas others resemble type-3 lithologies with densely packed chondrules. The host groundmass contains numerous large, distinct, well-formed chondrules.
Petrography: (C. Agee, *UNM*) Microprobe examination of several polished mounts shows three group LL lithologies present: Lithology 1 is LL3.10; Lithology 2 is LL5; and Lithology 3 makes up the host groundmass and is LL3. Lithology 1 has numerous porphyritic chondrules, most with mesostasis or glass and abundant opaque matrix. The apparent mean chondrule diameter in Lithology 1 is 900±400 μm, n=31. Lithology 2 has texturally equilibrated chondrules and plagioclase grains up to 25 μm. Lithology 3 (host) has numerous porphyritic chondrules, many with mesostasis, fine-grained plagioclase also detected.
Geochemistry: (C. Agee, *UNM*) Lithology 1: all olivine $Fa_{14.0\pm11.0}$, Fe/Mn=41±15, n=44; ferroan chondrule olivine $Fa_{17.3\pm9.9}$, Fe/Mn=45±13, Cr_2O_3=0.32±0.20 (wt%), n=35; low-Ca pyroxene $Fs_{11.1\pm10.0}Wo_{1.1\pm0.8}$, n=12. Lithology 2: olivine $Fa_{30.7\pm0.6}$, Fe/Mn=60±2, n=19; low-Ca pyroxene $Fs_{24.9\pm0.3}Wo_{1.3\pm0.9}$, n=12. Lithology 3: olivine $Fa_{27.9\pm3.0}$, Fe/Mn=57±15, n=8; low-Ca pyroxene $Fs_{24.3\pm1.8}Wo_{2.1\pm3.5}$, n=4.
Classification: Ordinary chondrite (LL3.10-LL3-LL5), LL-group genomict breccia. Type 3.10 for Lithology 1 is based on the mean value of Cr_2O_3 in ferroan chondrule olivine and the 1-sigma standard deviation, (Grossman and Brearley, 2005), a similar petrologic type to NWA 1756 (LL3.10), NWA 3127 (LL3.10), RC

075 (H3.10), and MET 96503 (L3.10). Estimated type for Lithology 3 is 3.8/3.9 based on the scatter in olivine composition.
Specimens: 48.5 g on deposit at *UNM*, Matthew Martin holds the main mass.

Northwest Africa 11906 (NWA 11906)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CO3.0)
History: Purchased by Matthew Stream from Tindouf, Algeria, April 2018.
Physical characteristics: Single stone, partially covered in dark fusion crust with polygonal cracks. Broken surface reveals gray, fined-grained interior, with many small chondrules visible, scattered small CAIs were observed.
Petrography: (C. Agee, *UNM*) This meteorite consists of numerous small chondrules set in a fine-grained matrix. The matrix makes up approximately 40% of this meteorite. Mean apparent chondrule size 200±175 μm, n=50.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{14.0\pm14.6}$, Cr_2O_3=0.37±0.15 (wt%), n=18; low-Ca pyroxene $Fs_{2.3\pm1.2}Wo_{3.4\pm0.5}$, n=4.
Classification: Carbonaceous chondrite (CO3.0), 3.0 based on the Cr_2O_3 content and 1-sigma in olivine (Grossman and Brearley, 2005).
Specimens: 17.3 g including a probe mount on deposit at *UNM*, Matthew Stream holds the main mass.

Northwest Africa 11907 (NWA 11907)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL3)
History: Darryl Pitt purchased from Said Haddany at the Tucson Gem and Mineral Show in January 2018
Physical characteristics: Single stone with fusion crust. Saw cut reveals two distinct lithologies, one lighter and one darker in color. Numerous well formed, closely packed chondrules, some up to 2 mm in diameter. Average apparent chondrule diameter is 750±450 μm (n=16). Scattered metal/sulfide grains observed.
Petrography: (C. Agee, *UNM*) Microprobe examination shows many porphyritic chondrules in both lithologies, most with mesostasis and glass.
Geochemistry: (C. Agee,*UNM*) All olivine $Fa_{27.2\pm10.5}$, n=42; all low-Ca pyroxene $Fs_{23.6\pm8.3}Wo_{0.9\pm0.5}$, n=12. Dark lithology: olivine $Fa_{22.1\pm11.4}$, Cr_2O_3=0.11±0.16, Fe/Mn=51±17, n=21; low-Ca pyroxene $Fs_{18.2\pm0.2}Wo_{1.1\pm0.8}$, Fe/Mn=21±1, n=6. Light lithology: olivine $Fa_{32.4\pm6.3}$, Cr_2O_3=0.05±0.08, Fe/Mn=66±13, n=21; low-Ca pyroxene $Fs_{29.2\pm3.2}Wo_{1.1\pm0.5}$, Fe/Mn=46±11, n=6.
Classification: Ordinary chondrite (LL3), estimated sub-type LL3.2-3.3 based on mean Fa content of olivine and the 1-sigma Fa content of olivine, and on mean Cr_2O_3 content of ferroan olivine and the 1-sigma Cr_2O_3 content of ferroan

olivine (Grossman and Brearley, 2005). Similar to St. Marys County (LL3.3), GRO 95502 (L3.2) and GRO 95544 (L3.2).
Specimens: 22.7 g on deposit at *UNM*, *MMGM* holds the main mass.

Northwest Africa 11908 (NWA 11908)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL3)
History: Darryl Pitt purchased from Said Haddany at the Tucson Gem and Mineral Show in January 2018
Physical characteristics: Single stone. A saw cut reveals numerous distinct, closely packed chondrules, a few up to 4mm in diameter, set in a dark brown matrix.
Petrography: (C. Agee, *UNM*) Microprobe examination reveals many porphyritic chondrules with mesostasis and glass, abundant opaque matrix. Apparent mean chondrule diameter 800±625 μm, n=47.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{16.8\pm8.3}$, Cr_2O_3=0.09±0.05, Fe/Mn=52±21, n=31; low-Ca pyroxene $Fs_{12.5\pm9.4}Wo_{1.2\pm1.1}$, Fe/Mn=24±15, n=10.
Classification: Ordinary chondrite (LL3), estimated sub-type LL3.2-3.3 based on mean Fa content of olivine and the 1-sigma Fa content of olivine, and on mean Cr_2O_3 content of ferroan olivine and the 1-sigma Cr_2O_3 content of ferroan olivine (Grossman and Brearley, 2005). Similar to St. Mary's County (LL3.3), GRO 95502 (L3.2) and GRO 95544 (L3.2).
Specimens: 24.4 g on deposit at *UNM*, *MMGM* holds the main mass.

Northwest Africa 11909 (NWA 11909)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Diogenite)
History: Darryl Pitt purchased from Said Haddany at the Tucson Gem and Mineral Show in January 2018
Physical characteristics: Single stone, weathered exterior, coarse grained, green crystals with some iron staining.
Petrography: (C. Agee, *UNM*) Microprobe examination reveals an orthopyroxenite with minor amounts of chromite and sulfide; plagioclase and olivine are absent. Highly equilibrated and relatively low shock.
Geochemistry: (C. Agee, *UNM*) low-Ca pyroxene, $Fs_{23.2\pm0.3}Wo_{1.8\pm0.1}$, Fe/Mn=25±1, n=10.
Classification: Diogenite
Specimens: 20.1 g on deposit at *UNM*, *MMGM* holds the main mass.

Northwest Africa 11912 (NWA 11912)

(Northwest Africa)
Purchased: February 2014
Classification: Ordinary chondrite (H5)
History: Purchased by Fred *Olsen* in 2014
Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (500±80 μm, N=12). Recrystallized matrix with typical plagioclase size about 10 μm.
Geochemistry: Although the vast majority of olivine and orthopyroxene analyses are clustered, a few grains are unequilibrated. Olivine range $Fa_{14.1\text{-}24.0}$, mean $Fa_{18.4\pm0.3}$ (N=50); orthopyroxene, range $Fs_{15.74\text{-}30.36}Wo_{0.95\text{-}3.34}$, mean $Fs_{19.5\pm0.3}Wo_{1.7\pm0.1}$ (N=60).
Classification: Ordinary Chondrite (H5)
Specimens: 24.30 g at *UCLA*; main mass with Fred *Olsen*.

Northwest Africa 11913 (NWA 11913)
(Northwest Africa)
Purchased: 2013
Classification: Ordinary chondrite (H5)
History: Purchased by John A. Shea in 2013 via E-bay from an IMCA member who acquired it in a lot of northwest African meteorites.
Physical characteristics: Dark brown weathering patina with patches of rust covers all exterior surfaces
Petrography: In thin section, chondrules and fragments are delineated by a complex veining of weathering products (oxides and carbonate). Individual grains within chondrules are readily distinguished from mesostasis. Chondrule mesostases are devitrified and generally fine-grained, with feldspar grains typically small (< 10 microns in diameter), but up to ~40 μm across.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Olivine ($Fa_{19.8\pm0.2}$, N=16), low-Ca pyroxene ($Fs_{17.4\pm0.2}Wo_{1.5\pm0.1}$, N= 16).
Classification: H5 chondrite based on chemistry and texture.
Specimens: *Cascadia* holds 11.4 g in two pieces, in addition to one polished thin section and a mounted butt.

Northwest Africa 11914 (NWA 11914)
(Northwest Africa)
Purchased: 2013
Classification: Ordinary chondrite (H5)
History: Purchased by John A. Shea in 2013 via E-bay from Steve Witt who acquired it in a lot of northwest African meteorites
Physical characteristics: Dark reddish brown weathering patina covers all exterior surfaces
Petrography: In thin section, chondrules are readily delineated; mesostases are devitrified.

Geochemistry: (M. Hutson, A. Cairns, A. Maroni, J. Longfellow, and A. Ruzicka, *Cascadia*) Olivine ($Fa_{19.2\pm0.6}$, N=33), low-Ca pyroxene ($Fs_{17.1\pm0.8}Wo_{1.2\pm0.3}$, N= 17).
Classification: H5 chondrite based on chemistry and texture
Specimens: *Cascadia* holds 17.1 g in three pieces, in addition to one polished thin section and a mounted butt.

Northwest Africa 11915 (NWA 11915)
(Northwest Africa)
Purchased: 2013
Classification: Ordinary chondrite (LL4-6)
History: Purchased by John A. Shea in 2013 via E-bay from Mirko Graul who acquired it in a lot of northwest African meteorites.
Physical characteristics: Exterior surface covered by reddish brown weathering patina and patches of black fusion crust. Cut faces show angular dark bluish-gray clasts amid a beige host lithology, along with a few metal and sulfide grains and patches of rust.
Petrography: Three lithologies are readily distinguished in thin section. A lighter colored coarse-grain clast (clast B), approximately 400 × 600 μm, with a highly integrated texture is encompassed within a larger clast (clast A) which has a well integrated texture with barely distinguishable chondrules. Clast A is truncated along the edge of the section, but is approximately 1.2 cm long. The two clasts are set in a host which has readily delineated chondrules, smaller clasts, and fragments. Approximately 85% of the opaque grains have been replaced by Fe-hydroxide weathering product. In BSE imaging, host olivine grains appear equilibrated, but many larger host pyroxene grains are zoned. The host is brecciated on a fine scale: a single large (150 micron long) plagioclase feldspar grain, is located adjacent to a chondrule fragment with strongly-zoned low-calcium pyroxene grains with a mesostasis of devitrified glass. A rectangular clast (approximately 1.1 × 0.8 mm) consists of zoned low-calcium clinopyroxene enclosing a large patch of mostly replaced troilite containing silica polymorph rimmed by high-Ca pyroxene. Chondrules, clasts and larger mineral grains in the host are surrounded by a finer-grained (typically 5-20 μm across grains) of olivine, low-calcium pyroxene, and plagioclase feldspar grains.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Both host olivine ($Fa_{30.2\pm0.4}$, N=17) and clast B olivine ($Fa_{30.3\pm0.1}$) are equilibrated. Clast B low-Ca pyroxene ($Fs_{25.6\pm0.3}Wo_{2.0\pm0.2}$, N=9) is also equilibrated; however host low-Ca pyroxene ($Fs_{19.9\pm4.0}Wo_{1.0\pm0.8}$, N=28) is variable. Clast B plagioclase feldspar is albitic ($Ab_{84.5\pm1.1}An_{11.3\pm0.6}Or_{4.2\pm0.5}$, N=3).
Classification: LL4-6 based on chemistry and texture.
Specimens: *Cascadia* holds 83.5 g in two pieces, in addition to one polished thin section and a mounted butt

Northwest Africa 11916 (NWA 11916)
(Northwest Africa)
Purchased: 2014
Classification: Ungrouped achondrite
History: Bought by Luc *Labenne* in Agadir in 2014
Physical characteristics: A single brown weathered stone
Petrography: J. Gattacecca, B. Devouard, P. Rochette, *CEREGE*) Main minerals are finely exsolved, blocky pigeonite crystals, to 1.5 mm, set in plagioclase. Low-Ca pyroxene is found as small inclusions in pigeonite. Pigeonite shows reduction at grain rims and along cracks. Accessory silica, merrilite, troilite, FeNi metal. Metal and sulfides are finely dispersed in the silicates and finely interspersed.
Geochemistry: Pigeonite $Fs_{38.7\pm3.8}Wo_{6.9\pm2.0}$ ($Fs_{30.6\text{-}42.7}Wo_{5.0\text{-}10.2}$, N=8), FeO/MnO=23.0±3.4 (range 17.0 - 28.5). Plagioclase $An_{95.9\pm0.1}Ab_{4.0\pm0.1}Or_{0.1\pm0.1}$ (N=4). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of two acid-washed 1.5 mg aliquots of a powdered 55 mg bulk sample is $\delta^{17}O$=1.47‰, $\delta^{18}O$=3.68‰ , $\Delta^{17}O$=-0.46‰, and $\delta^{17}O$=1.71‰, $\delta^{18}O$=4.09‰ , $\Delta^{17}O$=-0.44‰ (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.91.
Classification: Ungrouped achondrite. Oxygen isotopes and Ca-pyroxene composition set this achondrite apart from HED achondrites.
Specimens: 2.2 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 11917 (NWA 11917)
(Northwest Africa)
Purchased: 2012
Classification: Primitive achondrite (Winonaite)
Petrography: No chondrules are present, but there are irregularly shaped silicate clusters (50-700 µm in size) that may have been derived from recrystallized chondrule fragments. There is no clear igneous texture. Olivine exhibits mildy undulose extinction. Plagioclase also occurs. The rock contains ~20 vol.% metal plus sulfide. Opaque phases include kamacite, martensite, taenite, schreibersite, ferroan alabandite, and magnesiochromite. Metal and sulfide grains average ~100 µm in size. There are some grains of polycrystalline troilite and polycrystalline kamacite. There are rare 8x12-µm-size patches of daubreelite at the ede of some troilite grains. There are also rare ~40-µm-size metal grains with martensitic structure, rimmed by cloudy taenite. There is a single thick, elongated band of troilite at the edge of one thin section (~300 × 3000 µm).
Geochemistry: Also present are plagioclase ($Ab_{84.7\pm0.2}Or_{2.7\pm0.2}$; n=5); kamacite (in wt.%): 92.5 Fe, 0.48 Co, 0.06 P, 6.8 Ni, <0.03 Si; taenite: 73.5 Fe, 0.17 Co, <0.03 P, 23.5 Ni, <0.03 Si; troilite: 62.6 Fe, 37.0 S, 0.35 Cr; magnesiochromite: 67.3 Cr_2O_3, 5.8 MnO, 12.0 MgO, 6.2 FeO. The O-isotopic composition of replicate samples was analyzed by R. Greenwood (*OU*): $\delta^{17}O$ = 1.876±0.006, $\delta^{18}O$ = 4.541±0.011, $\Delta^{17}O$ = -0.486±0.012 (per mil); this is in the winonaite range.

Classification: This is one of the most reduced winonaites, with very little FeO in the mafic silicates. The presence of some grains of polymict troilite and kamacite indicates moderately high shock, but the mildly undulose extinction in the olivine (characteristic of S2) suggests that the rock was shocked and then annealed, and perhaps (mildly) shocked again.

Northwest Africa 11919 (NWA 11919)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Eleven dark fragments some of which partly covered with fusion crust.
Petrography: The meteorite is a brecciated carbonaceous chondrite composed of chondrules (mean diameter about 300 μm), chondrule pseudomorphs, CAIs, and mineral fragments set into abundant Fe-rich matrix. Many of the components are heavily corroded and often surrounded by fine-grained dust rims. Compositionally zoned olivine is the only anhydrous silicate present; former pyroxenes are completely altered. The meteorite matrix consists of abundant carbonates, sulfides and phyllosilicates. Carbonates are particularly rich in Fe and Mg attesting to a high degree of alteration.
Geochemistry: carbonates contain up to 16.5 wt% MgO and 15.6 wt% FeO

Northwest Africa 11920 (NWA 11920)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H5, melt breccia)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Two small black individuals lacking any fusion crust.
Petrography: The meteorite is strongly brecciated and composed of recrystallized shock melt regions, relict mineral fragments and some preserved clasts (type 5). No pyroxene has been found in the thin section studied.

Northwest Africa 11921 (NWA 11921)
(Northwest Africa)
Purchased: 2018
Classification: Martian meteorite
History: Reportedly recovered in 2017 at the find site of NWA 7034 and purchased by Said Yousfi in 2018 from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Six black fragments with shiny crust.

Petrography: The meteorite is a polymict breccia composed of lithic and mineral clasts set into a very fine-grained clastic matrix. Lithic clasts include basaltic and impact melt types; most abundant mineral phases in clasts and matrix are pyroxene and feldspar, both of highly variable composition. Minor phases are ilmenite, magnetite, Ti,Cr-magnetite, and Cl-apatite. The meteorite's high magnetic susceptibility reflects the high content of Fe-oxides and is in good agreement with data in Gattacceca et al. 2014.
Geochemistry: low-Ca pyroxene: $Fs_{25.1\pm5.5}Wo_{3.6\pm1.1}$ ($Fs_{19.5\text{-}33.5}Wo_{2.0\text{-}5.0}$, n=15, FeO/MnO=30-38); pigeonite: $Fs_{39.9\pm12.0}Wo_{8.0\pm2.7}$ ($Fs_{25.6\text{-}52.3}Wo_{5.6\text{-}12.4}$, n=10, FeO/MnO=30-40); Ca-pyroxene: $Fs_{25.8\pm10.2}Wo_{36.7\pm6.5}$ ($Fs_{17.4\text{-}44.3}Wo_{26.1\text{-}43.3}$, n=15, FeO/MnO=26-41); feldspar: $An_{40.4\pm9.2}Ab_{56.5\pm8.2}Or_{3.1\pm1.9}$ ($An_{29.0\text{-}49.3}Ab_{48.3\text{-}66.7}Or_{2.0\text{-}4.4}$, n=13)
Classification: Martian meteorite (basaltic breccia). Likely paired with NWA 7034 and respective clan members.

Northwest Africa 11922 (NWA 11922)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L3-6)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Two dark-grayish individuals partly covered with fusion crust.
Petrography: The meteorite is a chondritic breccia consisting of angular to subrounded L3 and L6 clasts set into type 3 clastic matrix. Plagioclase grain size in L6 clasts is about 60 µm. Chondrules are mostly flattened and well packed and have a mean diameter of about 0.6 mm.
Geochemistry: type 3 lithology: olivine: $Fa_{14.9\pm9.3}$ ($Fa_{2.5\text{-}26.9}$, n=20); pyroxene: $Fs_{12.5\pm7.4}Wo_{0.5\pm0.1}$ ($Fs_{4.5\text{-}21.7}Wo_{0.3\text{-}0.8}$, n=17); type 6 lithology: olivine: 25.2±0.3, n=11; pyroxene: $Fs_{20.0\pm0.3}Wo_{1.9\pm0.2}$, n=12

Northwest Africa 11923 (NWA 11923)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish individual lacking any fusion crust.
Petrography: The meteorite displays a chondritic texture with well defined and slightly flattened chondrules (mean diameter about 0.4 mm) and fine-grained matrix containing sulfides and abundant FeNi metal.

Northwest Africa 11924 (NWA 11924)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish individual lacking any fusion crust.
Petrography: The meteorite displays a chondritic texture with small and well separated chondrules (mean diameter about 0.3 mm) and fine-grained matrix containing sulfides and abundant FeNi metal.

Northwest Africa 11925 (NWA 11925)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark greyish individual with some fusion crust.
Petrography: The meteorite displays a chondritic texture with slightly flattened and well packed chondrules (mean diameter about 0.6 mm) in a more fine-grained dark matrix that contains sulfides and FeNi metal.

Northwest Africa 11927 (NWA 11927)
(Northwest Africa)
Purchased: 2018
Classification: Rumuruti chondrite (R3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Light brownish individual lacking any fusion crust.
Petrography: The meteorite displays a light brownish to orange interior and is composed of up to 5 mm sized angular type 3 clasts and matrix. Olivine and low-Ca pyroxene are compositionally unequilibrated in clasts and matrix; Fe-rich olivine is the most dominant mineral phase in the matrix. Chondrules have an average diameter of about 400 μm. More minor phases include low-Ca pyroxene, Ca-pyroxene, sodic plagioclase, sulfides, and Ti-bearing chromite; no metal has been detected.
Geochemistry: Olivine: $Fa_{26.3\pm13.8}$ ($Fa_{1.6\text{-}44.9}$, n=26); low-Ca pyroxene: $Fs_{18.7\pm8.8}Wo_{1.5\pm0.6}$ ($Fs_{8.1\text{-}30.5}Wo_{0.4\text{-}2.8}$, n=17); Ca-pyroxene: $Fs_{10.3\pm3.0}Wo_{42.1\pm5.4}$ ($Fs_{5.2\text{-}16.1}Wo_{31.7\text{-}47.3}$, n=12)

Northwest Africa 11928 (NWA 11928)
(Northwest Africa)

Purchased: 2018
Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Grayish individual partly covered with fusion crust.

Petrography: The meteorite is a fine-grained polymict breccia with basaltic and black melt clasts set into a clastic mineral matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase with average grain sizes of about 200 μm. Minor phases include silica, chromite, FeS, fayalite, and ilmenite. No metallic Fe has been found.

Geochemistry: low-Ca pyroxene: $Fs_{35.6\pm2.1}Wo_{6.3\pm0.8}$ ($Fs_{32.6\text{-}38.8}Wo_{5.5\text{-}8.6}$, n=15, FeO/MnO=28-33); Ca-pyroxene: $Fs_{45.0\pm5.7}Wo_{31.5\pm4.8}$ ($Fs_{43.7\text{-}46.1}Wo_{25.4\text{-}36.6}$, n=11, FeO/MnO=29-35); calcic plagioclase: $An_{93.1\pm3.3}$ ($An_{86.4\text{-}96.4}$, n=12)

Northwest Africa 11933 (NWA 11933)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)

History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.

Physical characteristics: Greyish individual with some patches of fusion crust.

Petrography: The meteorite is an unbrecciated medium-grained basalt predominantly composed of exsolved pyroxene and calcic plagioclase with average grain sizes of about 500 μm. Pyroxene appears brownish in plane polarized light. Minor phases include silica, ilmenite, chromite, troilite, and metallic iron.

Geochemistry: low-Ca pyroxene: $Fs_{58.5\pm0.6}Wo_{2.8\pm0.7}$ ($Fs_{56.9\text{-}59.2}Wo_{2.3\text{-}4.5}$, n=11, FeO/MnO=28-31); Ca-pyroxene: $Fs_{29.1\pm1.7}Wo_{40.5\pm1.9}$ ($Fs_{27.7\text{-}33.5}Wo_{36.0\text{-}41.9}$, n=10, FeO/MnO=27-31); calcic plagioclase: $An_{89.9\pm0.8}$ ($An_{89.5\text{-}90.7}$, n=13)

Northwest Africa 11934 (NWA 11934)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite, polymict)

History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.

Physical characteristics: Three fragments lacking any fusion crust.

Petrography: The meteorite is a polymict breccia composed of mineral and lithic clasts (basaltic and dark impact melt clasts) set into a fine-grained clastic matrix. Main minerals in clasts and matrix are exsolved pyroxene and calcic plagioclase. Minor phases include up to 2 mm sized diogenetic orthopyroxene, silica, chromite, ilmenite, and FeS. No metallic Fe has been detected.

Geochemistry: pyroxene host to augite lamellae: $Fs_{37.6\pm9.5}Wo_{5.3\pm1.9}$ ($Fs_{23.0\text{-}55.4}Wo_{3.1\text{-}9.1}$, n=21, FeO/MnO=27-37); Ca-pyroxene: $Fs_{34.4\pm10.8}Wo_{36.3\pm3.2}$ ($Fs_{25.0\text{-}57.8}Wo_{29.3\text{-}41.8}$,

n=19, FeO/MnO=27-38); diogenitic pyroxene: $Fs_{29.1\pm0.2}Wo_{3.3\pm0.2}$ ($Fs_{28.8\text{-}29.4}Wo_{2.9\text{-}3.7}$, n=11, FeO/MnO=28-35); calcic plagioclase: $An_{91.2\pm1.4}$ ($An_{88.6\text{-}94.3}$, n=13)

Northwest Africa 11935 (NWA 11935)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H4)
History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.
Physical characteristics: Brownish individual without fusion crust.
Petrography: The meteorite displays a chondritic texture with slightly flattened chondrules (mean diameter about 0.3 mm) in a more fine-grained brownish matrix that contains sulfides and FeNi metal.

Northwest Africa 11936 (NWA 11936)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H3)
History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.
Physical characteristics: Five dark brownish individuals with some fusion crust.
Petrography: The meteorite displays a chondritic texture with slightly flattened and well separated chondrules (mean diameter about 0.4 mm) in a more fine-grained dark matrix that contains sulfides and FeNi metal.

Northwest Africa 11937 (NWA 11937)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Ensisheim, France.
Physical characteristics: Seventeen small dark brownish individuals without fusion crust.
Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 0.8 mm; up to 4 mm sized), CAIs, and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are absent. Few chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11940 (NWA 11940)
(Northwest Africa)
Purchased: 2018

Classification: Ordinary chondrite (L3)
History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Sainte Marie aux Mines, France.
Physical characteristics: Dark brownish individual lacking any fusion crust.
Petrography: The meteorite shows a chondritic texture with well separated and partly flattened chondrules (apparent mean diameter about 0.6 mm).

Northwest Africa 11941 (NWA 11941)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H4)
History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Sainte Marie aux Mines, France.
Physical characteristics: Dark brownish individual lacking any fusion crust.
Petrography: The meteorite shows a chondritic texture with small (apparent mean diameter about 0.3 mm) well separated chondrules.

Northwest Africa 11944 (NWA 11944)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL4)
History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Sainte Marie aux Mines, France.
Physical characteristics: Dark grayish individual lacking any fusion crust.
Petrography: The meteorite shows a chondritic texture with densely packed and partly flattened chondrules (apparent mean diameter about 0.9 mm).

Northwest Africa 11945 (NWA 11945)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Diogenite)
History: The meteorite was bought from a Moroccan meteorite dealer at a mineral fair in Sainte Marie aux Mines, France.
Physical characteristics: Light brownish individual lacking any fusion crust.
Petrography: The meteorite displays a light orange interior and is a monomict breccia predominantly composed of blocky up to 1.5 mm sized orthoproxenes grains and more fine-grained cataclastic regions. Minor phases include silica, chromite, and FeS. Neither plagioclase, olivine nor metallic iron have been found in the section studied.
Geochemistry: low-Ca pyroxene: $Fs_{25.5\pm0.4}Wo_{2.7\pm0.7}$ ($Fs_{25.0\text{-}26.3}Wo_{1.8\text{-}4.0}$, n=15, FeO/MnO=25-31)

Northwest Africa 11946 (NWA 11946)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Almost black individual without fusion crust.
Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 3 mm sized), CAIs, and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent. Several chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 11947 (NWA 11947)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark greyish individual with some fusion crust.
Petrography: The meteorite is a coarse-grained breccia composed of up to 1 cm sized basaltic clasts set into a clastic matrix. Mineral phases are predominantly up to 1 mm sized pyroxene and lath shaped calcic plagioclase. Pyroxene is compositionally zoned with rims being more Fe- and Ca-rich than cores indicating a low degree of thermal metamorphism. Minor phases include silica, ilmenite, chromite, troilite, zircon and fayalite. No metallic iron has been detected.
Geochemistry: pyroxene cores: $Fs_{34.2\pm4.4}Wo_{9.3\pm3.1}$ ($Fs_{30.0\text{-}40.1}Wo_{6.7\text{-}14.3}$, n=12, FeO/MnO=26-30); pyroxene rims: $Fs_{60.7\pm6.7}Wo_{24.5\pm3.2}$ ($Fs_{42.0\text{-}66.2}Wo_{20.5\text{-}30.4}$, n=12, FeO/MnO=29-41); calcic plagioclase: $An_{85.5\pm2.5}$ ($An_{81.0\text{-}88.7}$, n=13)

Northwest Africa 11948 (NWA 11948)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL4-6)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Brownish individual with some patches of fusion crust.
Petrography: The meteorite is a chondritic breccia consisting of clastic LL4 type matrix and embedded LL6 clasts. Plagioclase grain size in LL6 clasts is about 60 µm.

Geochemistry: type 4 lithology: olivine: $Fa_{27.3\pm0.2}$, n=12; pyroxene: $Fs_{20.6\pm3.8}Wo_{1.2\pm0.7}$ ($Fs_{14.1\text{-}23.7}Wo_{0.5\text{-}2.0}$, n = 20); type 6 lithology: olivine: $Fa_{27.2\pm0.2}$, n=11; pyroxene: $Fs_{22.6\pm0.3}Wo_{3.5\pm0.7}$, n=10

Northwest Africa 11949 (NWA 11949)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Laâyoune, Western Sahara.
Physical characteristics: Greyish individual partly covered with fusion crust.
Petrography: The meteorite is an unbrecciated basalt predominantly composed of exsolved pyroxene and mostly lath-shaped calcic plagioclase with average grain sizes of about 300 μm. Several regions of the rock have a pronounced spherulitic appearance due to sprays of pyroxene and plagioclase. Minor phases include silica, ilmenite, chromite, and troilite. No metallic iron has been detected.
Geochemistry: low-Ca pyroxene: $Fs_{57.7\pm0.3}Wo_{1.9\pm0.3}$ ($Fs_{57.1\text{-}58.1}Wo_{1.6\text{-}2.9}$, n=14, FeO/MnO=33-35); Ca-pyroxene: $Fs_{23.7\pm0.3}Wo_{44.6\pm0.5}$ ($Fs_{23.3\text{-}24.6}Wo_{43.2\text{-}45.1}$, n=14, FeO/MnO=29-35); calcic plagioclase: $An_{81.8\pm2.5}$ ($An_{76.9\text{-}84.7}$, n=10)

Northwest Africa 11950 (NWA 11950)
(Northwest Africa)
Purchased: 2007 Jan
Classification: Ureilite
History: Purchased by D. *Gregory* in Tucson, Arizona. Type specimen is under the museum number M53446
Petrography: (B. C. Hyde, *ROM*, *UWO*) The meterorite is predominantly olivine and pigeonite with grain size generally ranging from 0.5 to 3 mm. Olivine grains have reduced rims and minor reduction is seen along pigeonite rims. All olivine grains contain Ca,Cr-rich inclusions likely composed of multiple phases. Metal is abundant along grain boundaries and within reduction rims. Both graphite and diamond are present (as determined by Raman spectroscopy).
Geochemistry: Mineral Compositions and Geochemistry: SEM based quantitative EDS and WDS (B. C. Hyde, *UWO*, *ROM*): Olivine cores: $Fa_{21.1\pm0.2}$ (n=15), 0.58±0.04 wt% Cr_2O_3, 0.28±0.03 wt% CaO. Pyroxene cores: $Fs_{17.9\pm0.1}Wo_{7.5\pm0.1}$ (n=15). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave $\delta^{17}O$ = 3.909, 3.733; $\delta^{18}O$ = 9.183, 8.885; $\Delta^{17}O$ = -0.940, -0.958 per mil.
Classification: Ureilite
Specimens: Currently includes the main mass, type material, two thin sections and one thick section.

Northwest Africa 11951 (NWA 11951)
(Northwest Africa)
Purchased: 2014 Jan
Classification: Ureilite
History: Purchased by D. *Gregory* in Tucson, Arizona. Designated as DGR-001-14. Type specimen is under the museum number M58189
Petrography: (B. C. Hyde, *ROM*, *UWO*) The meteorite is predominantly olivine and pigeonite. Grains can be as large as 3 mm, but regions of small grains (10s to 100s of μm) are also common. Olivine grains have reduced rims. The smallest olivine grains often show reduction throughout the entire grain. Minor reduction is also seen along pigeonite rims. Metal is abundant along grain boundaries and within reduction rims. The meteorite has a high abundance of diamond. Graphite is also present (as determined by Raman spectroscopy). Minor phases include chromite (10s of microns).
Geochemistry: Mineral Compositions and Geochemistry: SEM based quantitative EDS and WDS (B. C. Hyde, *UWO, ROM*): Olivine cores: $Fa_{19.6\pm0.2}$ (n=14), 0.72±0.02 wt% Cr_2O_3, 0.30±0.01 wt% CaO. Pyroxene cores: $Fs_{17.1\pm0.1}Wo_{5.4\pm0.1}$ (n=17). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave $\delta^{17}O$ = 3.861, 3.832; $\delta^{18}O$ = 8.834,8.670; $\Delta^{17}O$ = -0.803, -0.746 per mil.
Classification: Ureilite
Specimens: Currently includes the main mass, type material, one thin section and one thick section.

Northwest Africa 11953 (NWA 11953)
(Northwest Africa)
Purchased: 2018 Feb
Classification: HED achondrite (Eucrite, monomict)
History: Purchased by Jason Phillips in February 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Highly shocked and partially melted breccia. Gabbroic-textured clasts (some up to 3 cm across) and related disaggregated debris consist mainly of extremely fine scale polycrystalline aggregates after primary pigeonite (with some exsolution lamellae still preserved) and polycrystalline, microvesicular calcic plagioclase (exhibiting "swirly" microtexture indicative of being previously molten). Accessory minerals are silica polymorph, ilmenite, Ti-chromite, Ti-poor chromite, troilite and minor secondary barite and calcite.
Geochemistry: Orthopyroxene host ($Fs_{57.9\text{-}60.6}Wo_{4.0\text{-}2.1}$, FeO/MnO = 31-34, N = 3), clinopyroxene exsolution lamellae ($Fs_{26.9\text{-}27.3}Wo_{41.8\text{-}42.6}$, FeO/MnO = 30-31, N = 2), plagioclase ($An_{89.2\text{-}90.4}Or_{0.9\text{-}0.4}$, N = 2).
Classification: Eucrite (monomict breccia, gabbroic, shock melted).
Specimens: 46.5 g including one polished thin section at *UWB*; remainder with Mr. J. Phillips.

Northwest Africa 11954 (NWA 11954)
(Northwest Africa)
Purchased: 2017 Nov
Classification: Ordinary chondrite (LL3)
History: Purchased by Fabien *Kuntz* in November 2017 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter 690±450 μm) are set in relatively fine grained matrix containing stained metal, merrillite and chlorapatite.
Geochemistry: Olivine ($Fa_{1.3-44.0}$, Cr_2O_3 in ferroan examples 0.06-0.36 wt.%, mean 0.12±0.12 wt.%, N = 7), orthopyroxene ($Fs_{2.5-15.1}Wo_{0.4-1.5}$, N = 3), clinopyroxene ($Fs_{9.3-12.5}Wo_{39.6-37.4}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.80.
Classification: Ordinary chondrite (LL3). LL classification from magnetic susceptibility.
Specimens: 22.41 g including one polished thin section at *UWB*; remainder with FKuntz.

Northwest Africa 11955 (NWA 11955)
(Northwest Africa)
Purchased: 2018 May
Classification: Martian meteorite (Shergottite)
History: Purchased by Ben Hoefnagels in May 2018 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Inequigranular gabbroic texture (pyroxene up to 3.1 mm, olivine up to 2.3 mm in length). Composed of homogeneous olivine, zoned pigeonite (prismatically twinned) and maskelynite with accessory Ti-chromite, ilmenite, merrillite, chlorapatite, pyrrhotite and minor baddeleyite.
Geochemistry: Olivine ($Fa_{49.3-49.4}$, FeO/MnO = 51-56, N = 3), pigeonite ($Fs_{29.2-45.7}Wo_{10.4-8.1}$, FeO/MnO = 30-33, N = 4), maskleynite ($An_{50.9-55.0}Or_{2.0-1.9}$, N = 2).
Classification: Shergottite (gabbroic).
Specimens: 23.4 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11956 (NWA 11956)
(Northwest Africa)
Purchased: 2015 Oct
Classification: Ureilite
History: Purchased by Marc Jost in October 2015 from a Moroccan dealer at the Munich Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively coarse grained protogranular aggregate composed of subequal amounts of olivine (exhibiting reduced magnesian rims containing fine Fe metal) and polysynthetically twinned clinopyroxene (both pigeonite and augite). No evidence of microdiamond was found.
Geochemistry: Olivine (cores $Fa_{10.8\text{-}11.0}$; rims $Fa_{0.9\text{-}5.3}$; N = 4), low-Ca pyroxene ($Fs_{11.0\text{-}11.1}Wo_{4.6\text{-}4.7}$, N = 2), high-Ca pyroxene ($Fs_{5.8\text{-}6.8}Wo_{37.2\text{-}37.1}$, N = 2).
Classification: Ureilite.
Specimens: 27.8 g including one polished thin section at *UWB*; remainder with Space Jewels Switzerland.

Northwest Africa 11957 (NWA 11957)
(Northwest Africa)
Purchased: 2018 Mar
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Fabien *Kuntz* in March 2018 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Granular chondrules (apparent diameter 950±450 μm) and irregularly-shaped, very fine grained CAI are set in a fine grained matrix (~40 vol.%, deep sepia brown in thin section).
Geochemistry: Olivine ($Fa_{1.2\text{-}58.7}$, N = 3), orthopyroxene ($Fs_{1.1\text{-}1.2}Wo_{0.7\text{-}4.2}$, N = 3), clinopyroxene ($Fs_{0.6}Wo_{46.7}$; $Fs_{0.8\text{-}1.0}Wo_{50.0\text{-}49.5}$, N = 3).
Classification: Carbonaceous chondrite (CV3).
Specimens: 21.82 g including one polished thin section at *UWB*; remainder with *Kuntz*.

Northwest Africa 11958 (NWA 11958)
(Northwest Africa)
Purchased: 2018 Feb
Classification: HED achondrite (Eucrite, monomict)
History: Purchased by Bob Falls in February 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.
Physical characteristics: A single stone (2112 g) composed of greenish beige crystalline clasts (up to 5 cm across) in a patchy, very dark and fine grained matrix.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of ophitic-textured eucrite clasts in a sparse, dark matrix composed of related crystalline debris within very fine grained quenched melt. Clasts are composed of exsolved pigeonite and calcic plagioclase (both microcrystalline) with accessory silica polymorph, ilmenite, Ti-chromite, troilite, Ni-free metal and minor secondary barite. Cross-cutting veinlets composed of vesicular glass, quenched crystals and entrained eucrite debris are also present.

Geochemistry: Orthopyroxene host ($Fs_{58.3-61.4}Wo_{6.5-3.0}$, FeO/MnO = 30-31, N = 3), clinopyroxene exsolution lamellae ($Fs_{26.4-29.1}Wo_{44.1-41.6}$, FeO/MnO = 32-36, N = 2), plagioclase ($An_{86.2-89.8}Or_{0.8-0.2}$, N = 2).
Classification: Eucrite (monomict breccia, shock melted).
Specimens: 25.5 g in the form of a large polished slice at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 11959 (NWA 11959)
(Northwest Africa)
Purchased: 2018 May
Classification: Ordinary chondrite (L4)
History: Purchased by Ben Hoefnagels in May 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules are set in a relatively coarse grained matrix containing relatively abundant altered metal plus accessory merrillite and chlorapatite.
Geochemistry: Olivine ($Fa_{23.5-23.8}$, N = 3), orthopyroxene ($Fs_{19.8-20.5}Wo_{1.3-1.0}$, N = 3), clinopyroxene ($Fs_{10.3-10.6}Wo_{35.7-34.6}$, N = 2).
Classification: Ordinary chondrite (L4).
Specimens: 26.2 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11960 (NWA 11960)
(Northwest Africa)
Purchased: 2018 Apr
Classification: Primitive achondrite (Lodranite)
History: Purportedly found near Smara, Morocco. Purchased from a nomad by a Moroccan dealer in March 2018 and then sold to Ben Hoefnagels in April 2018.
Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively coarse grained (1-2.5 mm) protogranular aggregate of olvine and clinopyroxene with accessory orthopyroxene, chromite, pyrrhotite, partly altered kamacite and taenite. Minor goethite from terrestrial alteration of metal is present as thin coatings on grain boundaries and in cracks.
Geochemistry: Olivine ($Fa_{10.4-10.6}$, FeO/MnO = 22-23, N = 3), clinopyroxene ($Fs_{4.2-4.4}Wo_{45.1-45.5}$, FeO/MnO = 10-11, N = 2), orthopyroxene ($Fs_{9.3-9.6}Wo_{1.5-2.0}$, FeO/MnO = 13-15, N = 2),
Classification: Lodranite (wehrlitic).
Specimens: 24.1 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 11962 (NWA 11962)
(Northwest Africa)
Purchased: 2013

Classification: Lunar meteorite

History: In 2013, the *NHMV* acquired a single stone weighing 85.8 g from a Moroccan dealer.

Physical characteristics: The specimen is a flat and rounded individual with regmaglypts exhibiting a black shiny surface with in places dull brownish areas. A cut and polished face (3 cm2) reveals two different lithologies comprising a fine-grained, dark-gray matrix with mainly submillimeter-sized light clasts and a black compact area (1 × 0.5 cm) of impact melt.

Petrography: Clast-rich breccia containing fine-grained lithic and mineral clasts, brownish vesicular glass, and brownish to orange glass spherules. In places, the glass exhibits a flow-banded texture with dark-grey to black schlieren. Lithic clasts include basalts, gabbroic lithologies, breccia-within-breccia clasts and granophyric intergrowths of K-feldspar and silica. Mineral clasts include ortho- and clinopyroxenes (some showing exsolution lamellae), olivine, plagioclase (mostly anorthitic), silica, spinel (chromite, ulvöspinel), ilmenite, zircon, troilite and Fe,Ni metal.

Geochemistry: Olivine $Fa_{38.0\pm13.5}$ (N = 40), plagioclase $An_{88.2\pm11.2}Or_{0.6\pm0.5}$ (N = 37), orthopyroxene $Fs_{14.3\pm0.4}Wo_{1.3\pm1.3}$ (N = 63), clinopyroxene $Fs_{30.8\pm9.1}Wo_{23.4\pm13.5}$ (N = 43), K-feldspar ($An_{4.5\pm1.0}Or_{73.9\pm6.4}$, (N = 11) BaO = 1.4-3.4 wt%), exsolved pyroxene: orthopyroxene host $Fs_{65.5\pm4.8}Wo_{4.0\pm1.3}$ (N = 19) with augite exsolution lamellae $Fs_{33.0\pm2.3}Wo_{41.6\pm2.3}$ (N = 20). The oxygen isotope composition (R. Greenwood, *OU*) is consistent with a lunar origin ($\delta^{17}O$ = 3.14 per mil, $\delta^{18}O$ = 6.03 per mil, $\Delta^{17}O$ = 0.01 per mil).

Classification: Lunar, regolith breccia. Moderate weathering.

Specimens: A mass of 80.8 g and two thin sections are on deposit at *NHMV*.

Northwest Africa 11963 (NWA 11963)

(Northwest Africa)

Purchased: 02/12/2015

Classification: Ordinary chondrite (LL6)

Petrography: The rock is brecciated and highly recrystallized. Chondrules are poorly defined. Plagioclase grains average 60 μm in size; many of them contain patches of maskelynite. There are black glassy shock veins in the rock. It contains chromite-plagioclase assemblages and polycrystalline troilite.

Northwest Africa 11964 (NWA 11964)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Howardite)

History: Purchased by Aziz Habibi in Morocco, 2017.

Physical characteristics: Saw cut reveals a fragmental breccia with dark and light clasts set in a gray groundmass.

Petrography: (C. Agee, *UNM*) This meteorite consists of approximately 50% diogenite and 50% eucrite clasts.
Geochemistry: (C. Agee, *UNM*) diogenite low-Ca pyroxene $Fs_{25.3\pm3.0}Wo_{2.3\pm0.6}$, Fe/Mn=30±1, n=10; eucrite low Ca pyroxene $Fs_{42.3\pm8.4}Wo_{5.8\pm3.2}$, Fe/Mn=31±2, n=9; eucrite high Ca pyroxene $Fs_{18.7}Wo_{42.4}$, Fe/Mn=27, n=1; plagioclase $An_{89.0\pm6.7}$, n=7.
Classification: Howardite
Specimens: 20.0 g including a probe mount on deposit at *UNM*, Kyle Ke holds the main mass

Northwest Africa 11965 (NWA 11965)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: Purchased by Aziz Habibi in Morocco 2018.
Physical characteristics: Complete individual stone, partially covered with fusion crust. A broken surface reveals black, fined-grained interior; very friable; some CAIs are visible.
Petrography: (C. Agee, *UNM*) This meteorite consists of scattered porphyritic chondrules set in a fine grained matrix. The matrix makes up approximately 75% of this meteorite. Ubiquitous Fe-sulfide, Fe,Ni-sulfide, Fe, Ni-metal, phyllosilicates, and carbonates are present in the matrix.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{12.5\pm17.6}$, range $Fa_{0.5\text{-}44.4}$, Cr_2O_3=0.32±0.16, n=11; low-Ca pyroxene $Fs_{3.5\pm3.3}Wo_{3.4\pm0.5}$, n=2. Oxygen isotopes (K. Ziegler, *UNM*) done by laser fluorination $\delta^{17}O$=1.681, $\delta^{18}O$=10.426, $\Delta^{17}O$=-3.825, normalized, all permil.
Classification: Carbonaceous chondrite (CM2)
Specimens: 11.5 g including a probe mount on deposit at *UNM*, Aziz Habibi holds the main mass.

Northwest Africa 11966 (NWA 11966)
(Northwest Africa)
Purchased: 2015
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased by Jay Piatek on April 27, 2015 from a Moroccan meteorite dealer.
Physical characteristics: Single stone, fresh fusion-crusted exterior. A saw cut reveals a fragmental breccia with many white feldspathic clasts and a large lithic clast set in a dark-gray groundmass.
Petrography: (C. Agee, *UNM*) This meteorite is a breccia of fragmental pyroxene, olivine, plagioclase grains. There are many domains that are fine-grained and cataclastic with shock melt and vesicles.
Geochemistry: (C. Agee, *UNM*) olivine $Fa_{35.8\pm5.0}$, Fe/Mn=98±11, n=10; pigeonite $Fs_{33.6\pm5.3}Wo_{12.6\pm6.8}$, Fe/Mn=58±3, n=8; augite $Fs_{29.0\pm2.9}Wo_{34.8\pm4.3}$, Fe/Mn=57±1, n=2;

plagioclase $An_{96.4\pm0.9}$, n=7; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): SiO_2=43.4±0.4, TiO_2=0.18±0.06, Al_2O_3=31.0±1.2, Cr_2O_3=0.06±0.03, MgO=3.0±0.6, FeO=3.6±0.8, MnO=0.05±0.03, CaO=17.5±0.5, Na_2O=0.35±0.04, K_2O=0.07±0.02 (all wt%), n=7.
Classification: Lunar feldspathic breccia
Specimens: 20.1 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11967 (NWA 11967)
(Northwest Africa)
Purchased: 2015
Classification: Ordinary chondrite (LL3)
History: Purchased by Jay Piatek on June 26, 2015, from a Moroccan meteorite dealer.
Physical characteristics: Single stone, weathered exterior. A saw cut reveals numerous distinct, closely packed chondrules set in a brown groundmass. Mild brecciation was observed.
Petrography: (C. Agee, *UNM*) This meteorite has many porphyritic chondrules, most with mesostasis or glass, set in abundant opaque matrix. Apparent mean chondrule size is 800±500 μm, n=19.
Geochemistry: (C. Agee, *UNM*) Coarse-grained (non-matrix) ferroan olivine $Fa_{23.3\pm8.2}$, Cr_2O_3=0.18±0.22 (wt%), n=17; low-Ca pyroxene $Fs_{15.5\pm11.1}Wo_{0.8\pm0.5}$, n=11.
Classification: Ordinary chondrite LL3 breccia. Cr_2O_3 distribution in olivine is similar to Ngawi (LL3.0-3.7) as described in Grossman and Brearley (2005)) with two populations, one resembling Semarkona Cr_2O_3=0.50±0.08 and one resembling BremervördeCr_2O_3=0.04±0.03 (wt%).
Specimens: 22.4 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11968 (NWA 11968)
(Northwest Africa)
Purchased: 2015
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased by Jay Piatek from Adam *Aaronson* in Morocco, 2015.
Physical characteristics: Single stone. Fresh, light green-brown fusion crust covers a significant part of the surface; the remainder of the exterior is a smooth, lustrous black color. Saw cut reveals a fragmental breccia with many white feldspathic clasts set in a dark gray ground mass.
Petrography: (C. Agee, *UNM*) This meteorite is a breccia of fragmental pyroxene, olivine, plagioclase grains set in a fine-grained matrix. Fe-metal, chromite, ilmenite, and troilite were detected.

Geochemistry: (C. Agee, *UNM*) Olivine Fa: 37.4±9.5, Fe/Mn=92±5, n=8; low-Ca pyroxene $Fs_{36.1\pm3.5}Wo_{5.4\pm1.3}$, Fe/Mn=54±0, n=2; high-Ca pyroxene $Fs_{19.9\pm2.3}Wo_{33.3\pm9.3}$, Fe/Mn=49±4, n=3; plagioclase $An_{95.7\pm1.4}$, n=4; Shock melt (20 µm defocused electron beam, proxy for bulk meteorite composition): SiO_2=43.7±1.0, TiO_2=0.20±0.11, Al_2O_3=30.7±3.6, Cr_2O_3=0.07±0.05, MgO=4.0±2.2, FeO=4.6±2.4, MnO=0.07±0.05, CaO=16.7±1.8, Na_2O=0.34±0.09, K_2O=0.05±0.02 (all wt%), n=12.
Classification: Lunar feldspathic breccia
Specimens: 20.0 g including a probe mount on deposit at *UNM*, Jay Piatek holds 407.8 g.

Northwest Africa 11969 (NWA 11969)
(Northwest Africa)
Purchased: 2015
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased by Jay Piatek on December 28, 2015 from a Moroccan meteorite dealer.
Physical characteristics: Single stone, saw cut show medium grained, equigranular, basaltic texture.
Petrography: (C. Agee, *UNM*) (C. Agee, *UNM*) Microprobe examination shows approximately 50% pyroxene and 50% plagioclase. Pyroxene grains show exsolution lamellae. Accessory troilite, chromite, silica, and ilmenite were detected.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{59.4\pm1.0}Wo_{3.5\pm1.6}$, Fe/Mn=30±1, n=3; high-Ca pyroxene $Fs_{33.7\pm8.6}Wo_{35.2\pm11.4}$, Fe/Mn=31±4, n=3; plagioclase $An_{89.6\pm0.3}$, n=3.
Classification: Eucrite, unbrecciated
Specimens: 21 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 11970 (NWA 11970)
(Northwest Africa)
Find: 2015
Classification: Primitive achondrite (Lodranite)
History: Acquired from a Moroccan meteorite dealer at the 2016 Tucson Gem and Mineral show.
Physical characteristics: Four similar looking stones, the largest being 87.1 g. The uncut stones are light gray with clumped protruding dark brown/red nodules and scattered visible bright green angular mm-scale minerals. The cut stones show a breccia of <1 cm-sized silicate grains.
Petrography: Observations from a thin section show a breccia dominated by angular to sub-rounded silicate grains the largest to 1 cm. Minerals dominated by olivine, orthopyroxene, and clinopyroxene; some of the pyroxene is polysynthetically twinned. Minor phases include chromite, troilite, stained

kamacite and taenite, and some composite metal grains. The metal is dominated by kamacite with minor tetrataenite. Metal grains (to 3 mm) are irregularly shaped (holly leaf-like), with polycrystalline structure dominated by >100 μm polygonal grains lacking Neumann bands. Troilite is dominantly single crystal.
Geochemistry: (E.T. Dunham, D. Kornau, T. Goodwyn, T. Fougner, N. Delafuente, and E. Smith, *ASU*) Olivine ($Fa_{11.5-11.9}$ (avg=11.7), FeO/MnO=24.0-26.8 (avg=25.9), n=10), orthopyroxene, $Fs_{11.3}Wo_{1.8}$ ($Fs_{10.4-12.4}Wo_{0.1-4.0}$), FeO/MnO=15.1-27.1 (avg=19.6), n=11; clinopyroxene, $Fs_{5.1}Wo_{42.3}$ ($Fs_{4.3-6.1}Wo_{39.7-44.5}$), FeO/MnO=10.8-13.1 (avg=11.5), n=9.
Classification: Lodranite breccia. This material is likely paired with NWA 8118, NWA 8216, and NWA 8251
Specimens: 180.9 g including 4 thin sections at *ASU*

Northwest Africa 11973 (NWA 11973)
(Northwest Africa)
Purchased: Nov 2015
Classification: Ordinary chondrite (H~5)
History: Purchased by Li Bofang from a Moroccan dealer at the mineral show in *Beijing* in Nov. 2015.
Physical characteristics: 344.8 g stone, about 70% of the surface is covered with yellowish oxidized crust; light-gray interior with many chondrules and metal specks. Some cracks are partly filled yellow colored adherent soil-like material.
Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows recrystallized matrix with chondrules of 0.2-1.0 mm (av. 0.6 mm), about 30% of chondrules are well defined.
Geochemistry: (R. Bartoschewitz, *Bart*) Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 5.01.
Classification: ordinary chondrite (H~5)
Specimens: 25.3 g on deposit at *Kiel*, B. Li holds the main mass and 40 g with *Bart*.

Northwest Africa 11974 (NWA 11974)
(Northwest Africa)
Purchased: Feb 2018
Classification: Ordinary chondrite (H~5)
History: Purchased by Li Bofang from a Morrocan dealer in Tucson in Feb 2017.
Physical characteristics: Brown globular stone of 73.7 g. Cut face shows brown matrix with many little chondrules and some tiny metal specks.
Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows recrystallized matrix with well-defined chondrules (0.1-0.6 mm, av. 0.3 mm) and sparsely distributed metal specks.
Geochemistry: (R. Bartoschewitz, *Bart*) Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.69.

Classification: ordinary chondrite (H~5)
Specimens: 15.2 g on deposit at *Kiel*, B. Li holds the main mass and 10.2 g with *Bart*.

Northwest Africa 11975 (NWA 11975)
(Northwest Africa)
Purchased: Feb. 2017
Classification: Ordinary chondrite (LL~5)
History: Purchased by Li Bofang from a Morrocan dealer in Tucson in Feb 2017.
Physical characteristics: Brown globular stone of 73.7 g. Cut face shows brown matrix with chondrules and some tiny metal specks.
Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows recrystallized matrix with well-defined gray chondrules (0.6 - 2.0 mm) and metal specks.
Geochemistry: (R. Bartoschewitz, *Bart*) Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.41.
Classification: ordinary chondrite (LL~5)
Specimens: 15.8 g on deposit at *Kiel*, B. Li holds the main mass and 9.6 g with *Bart*.

Northwest Africa 11976 (NWA 11976)
(Northwest Africa)
Purchased: Nov 2017
Classification: Ordinary chondrite (LL3)
History: Purchased by Li Bofang from a Morrocan who got a language lecture in *Beijing* in Nov. 2017.
Physical characteristics: 78.6 g stone covered by >80% dark, weak, shiny fusion crust; non-crusted surface is strong eroded and presents well-defined chondrules.
Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows poorly recrystallized matrix with well-defined light- to dark-gray and olive-gray chondrules of 0.4-2.0 mm and very few tiny metal specks.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{21.8\pm10.5}$ (n=28); pyroxene $Fs_{11.4\pm9.0}Wo_{0.9\pm0.8}$ (n=15); Ca-pyroxene $Fs_{26.9}Wo_{73.1}$ (n=1). Kamacite: Ni=5.0-6.3, Co=1.6-1.8 wt.% (n=6); tetrataenite, troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.95.
Classification: ordinary chondrite (LL3)
Specimens: 15.8 g on deposit at *Kiel*, B. Li holds the main mass and 4.4 g with *Bart*.

Northwest Africa 11977 (NWA 11977)
(Northwest Africa)

Purchased: Feb 2017
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Li Bofang from a Morrocan dealer in Tucson in Feb 2017.
Physical characteristics: Dark brown 72.9 g stone, numerous chondrules are visible on the glossy, desert-varnished surface.
Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) thin section shows many chondrules <2.5 mm of various types (PO, PP, POP, RP), fine-grained, olivine-rich aggregates and CAIs are embedded in a fine-grained, dark brown matrix (roughly 40 vol%). Fe,Ni-rich metal and troilite are less abundant.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $Fa_{14.7\pm5.0}$, Cr_2O_3=0.37±0.12, CaO=0.13±0.07 wt% (n=13); low-Ca pyroxene $Fs_{9.4\pm5.6}Wo_{0.8\pm0.7}$ (n=14); pigeonite $Fs_{17.3}Wo_{6.2}$ (n=1). Feldspar: $An_{14.2\pm1.3}Or_{8.0\pm0.6.}$ Chromite: CRAL=96.9.7±5.3, FFM=96.4.7±3.2 (n=3). Kamacite: Ni=4.8-6.6, Co=0.5-1.8 (n=3); taenite: Ni=44.1, Co=0.6 (n=1) (wt.%); tetrataenite, troilite.
Classification: Carbonaceous chondrite (CV3).
Specimens: 14.6 g on deposit at *Kiel*, B. Li holds the main mass and 3.7 g with *Bart*.

Northwest Africa 11978 (NWA 11978)
(Northwest Africa)
Purchased: Nov. 2015
Classification: Ordinary chondrite (L3-6)
History: Purchased by Li Bofang from a Morrocoan dealer at the mineral show in *Beijing* in Nov. 2015.
Physical characteristics: Brown 1159 g stone of about 10 cm in diameter.
Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows brown matrix with poor to well defined chondrules of 0.3 - 5 mm of various types (PO, PP, POP, RP), and dark xenolites. Metal is nearly complete oxidized.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{23.2\pm2.0}$ (n=23); pyroxene $Fs_{17.0\pm5.6}Wo_{1.5\pm1.4}$ (n=13); Ca-pyroxene $Fs_{26.9}Wo_{73.1}$ (n=1). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.48.
Classification: ordinary chondrite (L3-6)
Specimens: 20.1 g on deposit at *Kiel*, B. Li holds the main mass and 67 g with *Bart*.

Northwest Africa 11979 (NWA 11979)
(Northwest Africa)
Purchased: Nov 2015
Classification: Ordinary chondrite (H~6)
History: Purchased by Li Bofang from a Morrocoan dealer at the mineral show in *Beijing* in Nov. 2015. Later the main mass was donated to Qu Pan.

Physical characteristics: A 78.1 g dark brown elongated stone. Cut face shows fine distributed tiny metal specks all over the surface.
Petrography: (R. Bartoschewitz, *Bart*, B. Li, *Beijing*) cut surface shows light/dark phases with shock veins, strong recrystallized matrix and poor defined chondrules (0.2-0.5mm, av. 0.3 mm). The dark phase is finer grained than the lighter one.
Geochemistry: (R. Bartoschewitz, *Bart*) Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 5.11.
Classification: ordinary chondrite (H~6)
Specimens: 16.8 g on deposit at *Kiel*, B. Li holds the main mass and 11.2 g with *Bart*.

Northwest Africa 11980 (NWA 11980)
(Northwest Africa)
Purchased: 2017 March
Classification: Ordinary chondrite (L5)
History: Purchased from a local dealer in Quarzazate in 2017.
Physical characteristics: Two stones of 1210 and 160 g. Cut face is gray with some lighter gray chondrules, light brown inclusions, and fresh metal.
Petrography: (R. Bartoschewitz, *Bart*) Microscopic examination of a thin section shows recrystallized and shocked matrix: mosaicism and planar fractures in olivine, undulatory extinction in plagioclase and maskelynite. Chondrules moderatly developed (0.4-1.8 mm, average 0.9 mm).
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{22.1\pm0}$,6 (n=19); pyroxene $Fs_{19.2\pm1.1}Wo_{0.8\pm0.6}$ (n=9); Ca-pyroxene $Fs_{21.4\pm3.2}Wo_{9.6\pm2.4}$ (n=2). Kamacite Ni=5.9-6.7, Co=0.6 wt.% (n=5); taenite Ni=34.7-36.6, Co=0.3 wt.% (n=2). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.94.
Classification: Ordinary chondrite (type L5, S3, W1)
Specimens: 20.1 g on deposit at *Kiel*, main mass Dieter Janek.

Northwest Africa 11982 (NWA 11982)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L5)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules are present in a recrystallized matrix containing chlorapatite and merrillite.
Geochemistry: Olivine ($Fa_{24.6-25.5}$, N = 3), orthopyroxene ($Fs_{20.4-20.7}Wo_{1.5-1.0}$, N = 3), clinopyroxene ($Fs_{7.3-7.8}Wo_{44.1-45.5}$, N = 2).
Classification: Ordinary chondrite (L5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11984 (NWA 11984)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L6)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare remnant chondrules.
Geochemistry: Olivine ($Fa_{25.0\text{-}25.5}$ N = 3), orthopyroxene ($Fs_{21.0\text{-}21.2}Wo_{2.1\text{-}1.9}$, N = 3), clinopyroxene ($Fs_{8.8}Wo_{44.3}$; $Fs_{13.6}Wo_{41.7}$; N = 2).
Classification: Ordinary chondrite (L6).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11986 (NWA 11986)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L4)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, equilibrated chondrules are set in a matrix containing altered metal, chlorapatite and merrillite.
Geochemistry: Olivine ($Fa_{24.5\text{-}24.7}$, N = 3), orthopyroxene ($Fs_{19.6\text{-}20.9}Wo_{1.0\text{-}1.6}$, N = 3), clinopyroxene ($Fs_{8.3\text{-}9.5}Wo_{45.0\text{-}44.5}$, N = 2).
Classification: Ordinary chondrite (L4).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11991 (NWA 11991)
(Northwest Africa)
Purchased: 2018 Jan
Classification: Ordinary chondrite (LL3)
History: Found in northwest Africa.
Physical characteristics: In cut slices, interior is light gray to light brown with slight weathering staining, has well defined chondrules and metal contents typical of LL chondrites.
Petrography: (A. Ruzicka, S. Goudy, *Cascadia*) Thin section shows well-defined chondrules, many with glassy mesostases, and good examples of cluster chondrite texture with little intervening matrix. Multiple bleached chondrules. Analysis in reflected light shows thin section contains roughly 2.3% metal with ~10% metal weathered, and roughly 4.2% troilite; largest slice contains 2.8±0.3% metal and 5.4±0.6% troilite (area% values). Based on olivine, shock stage is S5. Matrix is

composed chiefly of <10 μm grains of ferroan olivine and albitic feldspar, reminiscent of that found in Lut 005 and Lut 006.
Geochemistry: (M. Hutson, *Cascadia*) Olivine ($Fa_{21.6\pm9.9}$, N = 156; Cr_2O_3 0.07±0.05 wt%, N = 126).
Classification: LL3, estimated subtype 3.5. LL indicated by low metal content and minor weathering. Type 3 indicated by texture, presence of chondrule glass, and variable olivine composition. Subtype estimated as 3.5 based on olivine Fa variability (subtype 3.4-3.6) and chrome content in olivine.
Specimens: A total of 48.4 g in two slices, a polished thin section, and potted butt are available at *Cascadia*. Mr. James *Tobin* holds the main mass.

Northwest Africa 11992 (NWA 11992)
(Northwest Africa)
Purchased: 2007, Sept
Classification: Ordinary chondrite (LL3)
History: Found in northwest Africa, donated to *Cascadia* July 2012.
Physical characteristics: In cut slices, exterior is dark gray and shiny, interior is gray with well-defined chondrules and has less metal than typically observed in fresh ordinary chondrites. Minimal weathering staining.
Petrography: (A. Ruzicka, S. Goudy, *Cascadia*) Thin section shows well-defined chondrules with cluster chondrite texture and little intervening matrix. Glassy chondrule mesostases present but not abundant. Roughly half of low-Ca pyroxene grains show twinning suggestive of clinoenstatite polytype. Shock stage is S4. Shock effects are heterogeneous with S1 and S4 olivine grains predominant. Some bleached chondrules. Minimal weathering effects.
Geochemistry: (M. Hutson, *Cascadia*) Olivine ($Fa_{30.0\pm4.0}$, N = 140; Cr_2O_3 0.05±0.02 wt%, N = 56), low-Ca pyroxene ($Fs_{20.2\pm6.8}Wo_{1.4\pm1.1}$, N = 143).
Classification: LL3 chondrite, estimated subtype 3.7. Iron contents in olivine and low-Ca pyroxene unusually high for LL3. LL indicated by low metal content and low weathering grade and overlap with LL for olivine Fa and low-Ca pyroxene Fs. Type 3 indicated by texture, presence of chondrule glass, abundance of clinoenstatite, and variable olivine and pyroxene compositions. Subtype indicators can be best reconciled with subtype of 3.7 to 3.8: Fa contents suggest 3.7-3.9, Fs contents suggest 3.4-3.9, olivine chrome contents suggest 3.5.
Specimens: A total of 22.7 g in one slice, a polished thin section, and potted butt are available at *Cascadia*. Mr. McKenzie holds the main mass.

Northwest Africa 11993 (NWA 11993)
(Northwest Africa)
Purchased: 2006 Sept
Classification: Ureilite
History: Samples were donated to *Cascadia* by Mr. Fred *Olsen* in July 2012.

Physical characteristics: Interior and slightly shiny exterior have a relatively uniform dark-gray color with occasional light reddish-brown patches.
Petrography: (A. Ruzicka, S. Goudy, *Cascadia*) Composed chiefly of olivine and pigeonite grains roughly 1 mm across, often separated by fine-grained materials, cracks, or Fe-hydroxide weathering product. No metal or sulfide minerals were found. Shock stage U-S4 (Stöffler et al. 2018)
Geochemistry: (A. Ruzicka, M. Hutson, *Cascadia*) Cores of olivine grains have ferroan olivine ($Fa_{22.6\pm0.7}$, N = 38) and rims are more magnesian ($Fa_{15.6\pm3.6}$, N = 9). Pigeonite ($Fs_{17.1\pm3.8}Wo_{11.1\pm3.5}$, , N = 28) shows less prominent magnesian rims.
Classification: Achondrite (ureilite). Silicate grain cores and rims were largely unaffected by weathering, but presence of hydroxide and reddish staining indicates some weathering occurred.
Specimens: A total of 20.6 g and 1 thin section are on deposit at *Cascadia*. Mr. McKenzie holds the main mass.

Northwest Africa 11994 (NWA 11994)
(Northwest Africa)
Purchased: 2017 Jan
Classification: Ordinary chondrite (L3)
Petrography: (K. Metzler, *IfP*) Ordinary chondrite of low petrologic type consisting of closely packed chondrules and metal grains with very low amounts of interchondrule matrix. Cluster chondrite texture. Chondrule shapes are mostly ellipsoidal with parallel alignment.
Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{22.1\pm3.1}$ ($Fa_{13.0\text{-}26.5}$; n=32); the mean low-Ca pyroxene composition is $Fs_{11.6\pm5.2}Wo_{1.0\pm1.1}$ ($Fs_{2.0\text{-}21.0}Wo_{0.0\text{-}5.0}$; n=28)
Classification: L chondrite based on olivine composition with a strong peak at ~$Fa_{24.}$ PMD of Fa values = 14, i.e. petrologic subtype estimated to be 3.8.

Northwest Africa 11995 (NWA 11995)
(Northwest Africa)
Purchased: 2012
Classification: Ordinary chondrite (H6)
Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{19.5\pm0.4}$ ($Fa_{19.0\text{-}20.0}$); n=15; the mean low-Ca pyroxene composition is $Fs_{17.0\pm0.3}Wo_{1.3\pm0.2}$ ($Fs_{16.5\text{-}17.5}Wo_{1.0\text{-}1.5}$); n=15
Classification: H chondrite based on the mean compostitions of olivine and pyroxene. Petrologic type 6 based on the size of secondary plagioclase (>50 µm) and small Fa and Fs variations.

Northwest Africa 11996 (NWA 11996)
(Northwest Africa)

Purchased: 2017 Apr
Classification: Carbonaceous chondrite (CO3)
History: Bought from an African mineral dealer in Alicante, Spain
Petrography: (K. Metzler, *IfP*) Chondrules, chondrule fragments, and CAIs, embedded in a fine-grained brownish matrix (about 20 vol% matrix). The vast majority of chondrules belong to chemical type I. Mean apparent chondrule size: 180 ±120 µm (70-930 µm; n=95).
Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{36.0\pm8.0}$ ($Fa_{6.0\text{-}40.5}$); n=25. Random measurements of low-Ca pyroxene grains revealed $Fs_{5.7\pm3.1}Wo_{2.8\pm1.4}$ ($Fs_{2.0\text{-}14.0}Wo_{1.0\text{-}5.0}$); n=21.
Classification: CO chondrite based on CAI occurrence, small chondrule size, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3.7 estimated from chemical variation of olivine and pyroxene (PMD-Fa = 22.2).

Northwest Africa 11997 (NWA 11997)
Morocco
Purchased: July 2018
Classification: HED achondrite (Howardite)
History: Purchased online by D. Sheikh in July 2018.
Physical characteristics: Single 30.2 gram stone covered by black fusion crust with flow lines, cut surface reveals fine-grained, light-gray interior.
Petrography: (D. Sheikh, *FSU*) Fine-grained polymict breccia, <4 mm clast size for diogenite clasts, <2 mm for cumulate and basaltic eucrite clasts. Modal content of howardite (in vol.%): diogenites, 40%; cumulate eucrites, 25%; basaltic eucrites, 25%; anorthosite clasts, 7%; shock melt zones, 2%; opaques, 1%.
Geochemistry: Eucrite pyroxene: pigeonite ($Fs_{47.5}Wo_{10.99}$), n=25; augite ($Fs_{35.45}Wo_{30.2}$), n=5; FeO/MnO=23. Diogenite pyroxene: orthopyroxene ($Fs_{24.4}Wo_{5.08}$), n=10; FeO/MnO=18. Calcic plagioclase (An_{87}), N=25. Ilmenite (Fe/(Fe+Mg)) =87.83%, N=4. FeS and FeO scattered throughout matrix. SiO_2-rich glass present.
Classification: Achondrite (Howardite)
Specimens: 8.98 g at *UCLA*, 2.67 g with C. Anderkin, main mass with D. Sheikh

Northwest Africa 11998 (NWA 11998)
Northwest Africa
Purchased: 2017
Classification: HED achondrite (Eucrite)
History: A 2241 g, partially fusion-crusted stone was found near Laayoune, Western Sahara, in 2016. J. Donald Cline and John Sinclair Purchased the stone from Mohamed Ismaily at the Tucson Gem and Mineral show in 2017.
Physical characteristics: Sample is dark blackish brown in color, non-magnetic and has an irregular shape. Clasts are readily visible on the exterior of the sample.

Clasts range in size from 0.25-2 cm, are light colored, rounded to angular in shape and have very-fine to coarse grained igneous textures.
Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of clasts of basaltic-cumulate lithologies contained by a host of similar clastic debris set within a micro-vesicular melted matrix. Clasts are: fine-grained recrystallized basalt (25-50 µm phenocrysts); gabbroic clast with 423-512 µm pyroxenes and 348-506 µm plagioclase and rare (<1vol%) diogenite. All pyroxenes are exsolved. Some clasts show breccia in breccia structure. Additional minerals and phases are: ilmenite, chromite, FeS, apatite, rare olivine and rare FeNi metal.
Geochemistry: (A. Love, *App*) Basaltic eucrite: Low-Ca pyroxene host $Fs_{43.9\pm2.2}Wo_{1.7\pm0.1}$ ($Fs_{40.7\text{-}46.4}Wo_{1.5\text{-}1.8}$, FeO/MnO=33.2-37.4), N=8; high-Ca pyroxene exsolution lamellae $Fs_{17.5\pm0.4}Wo_{44.6\pm0.4}$ ($Fs_{17.0\text{-}17.8}Wo_{44.1\text{-}44.8}$), N=3. Cumulate eucrite: Low-Ca pyroxene host $Fs_{61.7\pm2.7}Wo_{2.1\pm0.3}$ ($Fs_{54.1\text{-}64.3}Wo_{1.7\text{-}2.6}$, FeO/MnO=30.5-34.7 N=11); high-Ca pyroxene exsolution lamellae $Fs_{27.3\pm1.1}Wo_{43.0\pm0.6}$ ($Fs_{26.1\text{-}29.0}Wo_{42.2\text{-}44.1}$, N=6); plagioclase $An_{87.2\pm3.2}Or_{0.5\pm0.6}$ ($An_{80.3\text{-}90.9}Or_{0.0\text{-}2.3}$ N=10). Diogenite: Low-Ca pyroxene $Fs_{23.5}Wo_{2.6}$ (FeO/MnO=30.15, N=1); Olivine $Fa_{54.3\pm1.1}$, N=2.
Classification: HED (polymict eucrite breccia). FeO/MnO and Fs compositions of pyroxenes indicate this sample is a HED meteorite. Textural and compositional data indicate this is a polymict eucrite melt breccia.
Specimens: *PARI* holds the main mass. One slice totaling 35.6 g and a polished thin section are on deposit at *App*.

Northwest Africa 11999 (NWA 11999)
(Northwest Africa)
Purchased: 2011 Feb
Classification: HED achondrite (Eucrite)
History: Sample purchased by D. *Gregory* at the Tucson Gem and Mineral show in 2011. Sample originally named "*ROM* 057" and is listed in *ROM* catalogues as LM58492.
Physical characteristics: The meteorite is a flattened fist size sample with a dark-black patchy fusion crust, weathered to expose a light orange surface. The interior of the sample is pale gray with a fine-grained matrix and small crystalline clasts visible.
Petrography: Sample bears gabbroic clasts in a fine-grained fragmented matrix. Clasts range in size from 402-5500 µm and are composed of pyroxene and plagioclase. The fragmented matrix is of the same mineralogic composition and grains range in size from microcrystalline to 200 µm. Exsolution lamellae are visible in pyroxene grains.
Geochemistry: Mineral compositions and geochemistry: There is no difference in chemistry between the clasts and matrix. Low calcium pyroxenes have a composition of $Fs_{54.9\pm3.1}Wo_{4.8\pm3.9}$ FeO/MnO (wt%) = 29.6±0.7 (n=22). Augite has a composition of $Fs_{24.3\pm1.0}Wo_{42.8\pm1.3}$ FeO/MnO (wt%) = 29.7±1.1 (n=19). Plagioclase $An_{91.6\pm0.8}$ ($An_{90.3\text{-}93.7}$, n=39)

Classification: (V. Di Cecco, *ROM*) Sample is an equilibrated monomict basaltic eucrite breccia. Lamellae and compositions suggest the sample has experienced thermal equilibration. Mineral chemistry suggests the sample is a basaltic eucrite.

Northwest Africa 12000 (NWA 12000)
Morocco
Purchased: May 2017
Classification: Iron meteorite (IIAB)
History: Purchased by Zhang Qingyan in May 2017 from a Moroccan dealer during the China (Hunan) Mineral & Gem Show in Chenzhou City
Physical characteristics: The main mass is approximately 2 × 5 × 10 cm with a dark brown, regmaglypted exterior. Some rust-red spots and adhered caliche are visible.
Petrography: (C. Herd) A 1 × 2 cm polished and etched slice shows an equant texture of kamacite crystals at least as wide as the slice (1 cm) with interstitial schreibersite. The cm-scale kamacite is replaced by sub-500 μm equant crystals. Neumann lines are present.
Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 5.7, Co = 0.49 (both wt%); Cu = 123, Ga = 55, As = 9.5, Ru = 3.4, W = 0.7, Ir = 0.03, Pd = 2.5, Pt = 4.5, Au = 1.1 (all μg/g).
Classification: Iron, IIAB. Recrystallized texture.
Specimens: Type specimen of 24.3 g at *UAb*. Zhang Qingyan 103 g, Liang Chengguang 28 g, M. Ouzillou 69.3 g.

Northwest Africa 12001 (NWA 12001)
Morocco
Purchased: 2018 Feb
Classification: Ordinary chondrite (H5)
History: Purchased from Mohammed *Hmani* during the Tucson Gem and Mineral show February 2018.
Physical characteristics: Stones have a brownish exterior exposing many small chondrules and some specimens are partially covered with a brownish black crust. Some specimens also display prominent metal veining in positive relief.
Petrography: (C. Herd and L. Tunney, *UAb*) Optical and microprobe examination of a polished thin section shows well-delineated chondrules of a variety of textural types. No metal veins were observed in the specimen studied. Weathering grade according to Zurfluh et al. (2016).
Geochemistry: (C. Herd and L. Tunney, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine $Fa_{18.3\pm0.3}$ (n=42); Low-Ca Pyroxene $Fs_{16.0\pm0.2}Wo_{1.2\pm0.2}$ (n=39).
Classification: Ordinary chondrite, H5

Specimens: Type specimen of 71.8 g, including one thin section, is at *UAb*. 3 stones totaling 2108 g with M. Ouzillou, 911 g stone with *GHupé*, and 2 stones totaling 2211 g with D. Dickens.

Northwest Africa 12002 (NWA 12002)
Morocco
Purchased: 2017
Classification: Martian meteorite (Shergottite)
History: Purchased from a France-based Moroccan dealer in 2017, via internet.
Physical characteristics: The main mass is a single, green-gray chip with adhering red-brown dust and fusion crust on one side.
Petrography: (C. Herd and L. Tunney, *UAb*; E. Walton and H. Jurak, MacEwan U) Optical and microprobe examination of a polished thin section shows low-Ca pyroxene oikocrysts up to 3.5 mm in longest dimension enclosing equant, rounded olivine and subhedral rounded to euhedral chromite chadacrysts. Assemblages of plagioclase, low- and high-Ca pyroxene, Ti-bearing chromite comprise the non-poikilitic areas. Shock deformation and transformation effects in host rock minerals include strong mosaicism of olivine and pyroxene, mechanical twinning in pyroxene and complete transformation of plagioclase to maskelynite. Small, isolated pockets of shock melt are heterogeneously distributed throughout the host rock, from which needles of stishovite have crystallized. Thin black veinlets of quenched shock melt cut across and displace igneous minerals.
Geochemistry: (C. Herd and L. Tunney, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine $Fa_{39.7\pm1.5}$ (range $Fa_{34.1\text{-}41.2}$), FeO/MnO = 51 (n=35); low-Ca pyroxene $Fs_{29.4\pm2.4}Wo_{10.6\pm3.3}$ (range $Fs_{24.6\text{-}32.8}Wo_{2.8\text{-}16.6}$), FeO/MnO = 30 (n=23); high-Ca pyroxene $Fs_{18.4\pm1.2}Wo_{33.8\pm2.2}$ (range $Fs_{16.5\text{-}20.7}Wo_{31.2\text{-}38}$), FeO/MnO = 25 (n=9); plagioclase $An_{50.9\pm4.8}Or_{2.8\pm1.3}$ (range $An_{40.6\text{-}56.9}Or_{1.4\text{-}6.2}$) (n=20). Chromite range TiO_2 = 0.9-17 wt% (n=16).
Classification: Martian (shergottite, poikilitic)
Specimens: Type specimen of 3.2 g, including one thin section, at *UAb*. 1 g with M. Ouzillou.

Northwest Africa 12004 (NWA 12004)
Morocco
Purchased: 2018 Mar
Classification: Angrite
History: Found near Touignin in southern Morocco and purchased by Ben Hoefnagels in March 2018 from a Moroccan dealer.
Physical characteristics: A gray stone (183 g) lacking fusion crust and with visible sparse vesicles.
Petrography: (A. Irving and S. Kuehner, *UWS*) Diabasic texture (mean grainsize 0.5 mm) with sparse vesicles. Major minerals are zoned calcic olivine (with

kirschsteinite rims), zoned Al-Ti-augite and anorthite, together with accessory titanomagnetite, troilite, silicoapatite and ferroan rhönite.
Geochemistry: Olivine ($Fa_{36.6-84.1}Ln1.4-15.4$, FeO/MnO = 70-95, N = 7), clinopyroxene ($Fs_{20.9-46.7}Wo_{52.0-52.9}$, FeO/MnO = 77-148, TiO_2 = 1.4-4.2 wt.%, Al_2O_3 =7.3-11.6 wt.%, N = 5), kirschsteinite ($Fa_{62.4}Ln33.8$, FeO/MnO = 69), anorthite ($An_{99.5-99.6}Ab_{0.3}Or_{0.0}$, N = 2). Oxygen isotopes (K. Ziegler, *UNM*) Analyses of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}O$ 2.258, 2.197, 2.285; $\delta^{18}O$ 4.440, 4.284, 4.431; $\Delta^{17}O$ -0.086, -0.065, -0.055 per mil.
Classification: Angrite (diabasic).
Specimens: 22.3 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12007 (NWA 12007)
(Northwest Africa)
Purchased: 2018 Feb
Classification: Ordinary chondrite (LL6)
History: Purchased by Blaine *Reed* in February 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with regions of hollyleaf-shaped, stained metal grains and accessory chlorapatite. Some rare chondrule remnants were observed.
Geochemistry: Olivine ($Fa_{33.0-33.1}$, N = 3), orthopyroxene ($Fs_{26.4-26.6}Wo_{1.9-1.8}$, N = 3), clinopyroxene ($Fs_{10.2-11.1}Wo_{44.9-44.2}$, N = 2).
Classification: Ordinary chondrite (LL6).
Specimens: 21.2 g including one polished thin section at *UWB*; remainder with Mr. B. *Reed*.

Northwest Africa 12008 (NWA 12008)
Morocco
Purchased: 2018 Aug
Classification: Lunar meteorite (basalt)
History: Purportedly found in Morocco and purchased by Ben Hoefnagels in August 2018 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Small olivine phenocrysts (stained orange-brown) are set in an intersertal groundmass composed mainly of zoned clinopyroxene and elongate lath-like maskelynite with accessory skeletal ilmenite, Ti-chromite, Cr-Ti-Fe spinel, troilite and minor barite. Olivine contains inclusions of chromite and quenched melt inclusions (surrounded by radial cracks) composed of Al-Ti-bearing augite + K-bearing glass.
Geochemistry: Olivine (cores $Fa_{36.6-42.3}$, rim $Fa_{90.0}$, FeO/MnO = 96-99, N = 3), pigeonite ($Fs_{31.1}Wo_{14.0}$, FeO/MnO = 50), subcalcic augite ($Fs_{25.9-71.4}Wo_{28.6-23.1}$, FeO/MnO = 50-75, N = 5), augite ($Fs_{23.2}Wo_{39.7}$, FeO/MnO = 49), ferropigeonite

($Fs_{80.1}Wo_{19.5}$, FeO/MnO = 79), augite in melt inclusion ($Fs_{28.8}Wo_{50.1}$, FeO/MnO = 71, Al_2O_3 = 10.5 wt.%, TiO_2 = 5.3 wt.%), plagioclase ($An_{86.8\text{-}87.6}Or_{0.4\text{-}0.3}$, N = 2).
Classification: Lunar (mare basalt).
Specimens: 25.2 g including two polished thin sections at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12009 (NWA 12009)
(Northwest Africa)
Purchased: 2017 Jun
Classification: Ordinary chondrite (LL3)
History: Purchased by Marc Jost in June 2017 from a Moroccan dealer at the Ensisheim Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, fairly closely packed chondrules (apparent diameter 950±610 μm, N = 24) are set in relatively fine grained matrix containing altered metal, merrillite and chlorapatite.
Geochemistry: Olivine ($Fa_{1.2\text{-}98.0}$, Cr_2O_3 in ferroan examples 0.09-0.18 wt.%, mean 0.1±0.04 wt.%, N = 7), orthopyroxene ($Fs_{2.1\text{-}17.0}Wo_{0.4\text{-}2.4}$, N = 3), subcalcic augite ($Fs_{47.1}Wo_{31.2}$), augite ($Fs_{9.4}Wo_{42.5}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 3.61.
Classification: Ordinary chondrite (LL3).
Specimens: 22.7 g including one polished thin section at *UWB*; remainder held by *SJS*.

Northwest Africa 12010 (NWA 12010)
(Northwest Africa)
Purchased: 2018 Apr
Classification: Ordinary chondrite (H6)
History: Purchased by Martin Goff in April 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare chondrule remnants. Accessory minerals include sodic plagioclase, stained kamacite, chromite, merrillite, chlorapatite and troilite.
Geochemistry: Olivine ($Fa_{19.5\text{-}19.8}$, N = 3), orthopyroxene ($Fs_{16.7\text{-}17.4}Wo_{1.5\text{-}1.3}$, N = 3), clinopyroxene ($Fs_{5.6\text{-}6.7}Wo_{46.4\text{-}45.2}$, N = 2).
Classification: Ordinary chondrite (H6).
Specimens: 20.1 g including one polished thin section at *UWB*; remainder with Mr. M. Goff.

Northwest Africa 12011 (NWA 12011)
(Northwest Africa)
Purchased: 2018 Jan
Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Darryl Pitt on behalf of the Maine Mineral and Gem Museum in January 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh breccia composed of gabbroic eucrite clasts (grainsize up to 0.8 mm) and related mneral debris. Minerals are exsolved pigeonite and calcic plagioclase with accessory silica polymorph, ilmenite, Ti-chromite, troilite and baddeleyite.
Geochemistry: Orthopyroxene host ($Fs_{59.0\text{-}59.4}Wo_{1.8\text{-}1.5}$, FeO/MnO = 31-32, N = 3), clinopyroxene exsolution lamellae ($Fs_{24.9\text{-}26.3}Wo_{43.3\text{-}42.0}$, FeO/MnO = 28-29, N = 2), plagioclase ($An_{91.8\text{-}92.0}Or_{0.4\text{-}0.3}$, N = 2).
Classification: Eucrite (monomict gabbroic breccia).
Specimens: 20.2 g including one polished thin section at *UWB*; remainder at *MMGM*.

Northwest Africa 12013 (NWA 12013)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)
History: A single stone weighing 332.1 g was found in Morocco and subsequently purchased by Blaine *Reed* at the 2018 Tucson Gem and Mineral Show.
Physical characteristics: The stone is dark-orangish-brown in color, has a flattened ovoid shape, lacks fusion crust and has a weathered exterior with some chondrules protruding from the surface. The cut face showing the interior of the stone is dark greenish-brown and shows readily discernible dark-colored chondrules and irregular to circular dark-gray metallic grains.
Petrography: Description and classification (Anthony Love, *App*): Sample contains distinct chondrules (average diameter of 940 µm (N=24), fragments and refractory inclusions (CAIs up to 3 mm) all set within an opaque dark brown matrix. Matrix contains FeO-rich olivine, andradite, magnetite framboids and one prominent type B dark inclusion. Type I olivine chondrules are dominant (some of which contain isotropic glass). Sample has ~50% matrix.
Geochemistry: (A.Love-*App*) Type I chondrules $Fa_{3.2\pm2.5}$ ($Fa_{0.4\text{-}8.2}$), Fe/Mn=37.7±27.3 n=17; Type II chondrules $Fa_{11.14}$, n=1 low-Ca pyroxene $Fs_{1.1\pm0.3}Wo_{1.8\pm1.8}$ ($Fs_{0.7\text{-}1.5}Wo_{0.7\text{-}5.0}$), n=4; high Ca pyroxene $Fs_{1.4}Wo_{26.9}$, n=1.
Classification: Carbonaceous Chondrite (CV3, S2, high weathering)
Specimens: Blaine *Reed* holds the main mass. Two sliced fragments weighing 42.38 g and one polished thin section are on deposit at *App*.

Northwest Africa 12014 (NWA 12014)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (H6)
History: Purchased by Christian Anderkin in 2017.

Physical characteristics: The sample is a single 43 g stone with visible weathered fusion crust. There are several weak fractures that span the minor axis of the stone.
Petrography: Sample is highly shocked, with no discernable chondrules and many dark shock melt veins. Matrix contains veins of sulfides and oxides amongst small grains of pyroxene and olivine. Plagioclase grains are approximately 55 µm across (N=2).
Geochemistry: Olivine, $Fa_{17.8-21.8}$, N = 15, mean $Fa_{19.6}$, N = 15; orthopyroxene, $Fs_{16.8 - 22.4}$, mean 18.8, $Wo_{1.2-3.7}$, mean 1.9
Classification: H6
Specimens: 26.9 g at *UCLA*. Remainder of mass with C. Anderkin at UF.

Northwest Africa 12015 (NWA 12015)
(Northwest Africa)
Purchased: 2007 Feb
Classification: Ordinary chondrite (LL6)
Petrography: Chondrules are relatively difficult to recognize. The matrix is mostly recrystilized with fine secondary grains. Weak mosaicism is seen in parts with undulatory extinction. Pervasive shock veins are seen with melt pockets. Minor oxidation is taking place in the metals. (S. Yokoyama, *ROM*).

Northwest Africa 12016 (NWA 12016)
(Northwest Africa)
Purchased: 2005 Feb
Classification: Ordinary chondrite (LL6)
Petrography: Very few chondrules are visible. Minor opaque and mostly recrystalized fine grained matrix surrounds chondrule fragments. A series of large dark patches with fine grained crystals are seen. Minor mosaicism is seen in some pyroxenes and undulatory extinction is present in olivines. Opaque shock veins are also seen. <3% of oxidation has affected metal. (S. Yokoyama, *ROM*).

Northwest Africa 12017 (NWA 12017)
(Northwest Africa)
Purchased: 2008 Feb
Classification: Ordinary chondrite (LL4)
Petrography: Well defined chondrules are seen in the slide surrounded by some opaque and clastic matrix. Minor undulatory extinction is seen with some mosaicism. Shock veins also seen in parts. >60% of metal has been affected by oxidation from weathering. (S. Yokoyama, *ROM*).

Northwest Africa 12018 (NWA 12018)
(Northwest Africa)

Purchased: 2012 Feb
Classification: Ordinary chondrite (H6)

Petrography: Sample is divided into darker and lighter clasts throughout the slide. Chondrules are difficult to detect as not many of them are intact. A fine grained matrix is observed. Although maskelynite is not observed, undulatory extinction and mosaicism are quite common. Interconnected shock veins are also seen. Not many metal grains are affected by oxidation. However, pervasive and interconnected oxide veins are seen throughout the slide. (S. Yokoyama, *ROM*).

Northwest Africa 12019 (NWA 12019)
(Northwest Africa)
Purchased: 2012
Classification: Ordinary chondrite (H4)

Petrography: Some patches of dark coexist with the brown. Chondrules are well defined in a mainly recrystalized matrix. Some opaque shock veins and undulatory extinctions are seen while sharp optial extinctions are still common in many olivine grains. Between 50 and 60% of Ni-Fe metal has been replaced by oxidation. Oxide rims are common as well as oxidation veins. (S. Yokoyama, *ROM*).

Northwest Africa 12020 (NWA 12020)
(Northwest Africa)
Purchased: 2017 Dec
Classification: Ordinary chondrite (LL6)

Petrography: (K. Metzler, *IfP*) Monomict breccia with recrystallized texture, showing some relict BO chondrules. Most secondary feldspar grains are >50 µm. Melt pockets and melt veins are present.

Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{31.3\pm0.4}$ ($Fa_{30.7\text{-}32.0}$); n=13. The mean low-Ca pyroxene composition is $Fs_{24.9\pm0.4}Wo_{1.6\pm0.1}$ ($Fs_{24.2\text{-}25.6}Wo_{1.3\text{-}1.8}$), n=13.

Classification: LL chondrite based on mineral chemistry. Petrologic type 6 based on the equilibrated state of olivine and pyroxene and grain size of secondary plagioclase

Northwest Africa 12180 (NWA 12180)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)

History: The meteorite was bought from a local meteorite dealer in Morocco.

Physical characteristics: Dark grayish-greenish individual lacking any fusion crust.

Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 2.5 mm sized), CAIs (up to 5 mm sized), and olivine amoeboids

all set into a fine-grained brownish to almost black matrix. Type II chondrules are absent.

Northwest Africa 12181 (NWA 12181)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L4, melt breccia)
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish individual lacking any fusion crust.
Petrography: The meteorite is a breccia composed of large regions of recrystallized shock melt containing characteristic FeNi metal and sulfide globules and regions displaying chondritic textures with well preserved chondrules. In chondritic portions olivine is compositionally equilibrated and pyroxene is unequilibrated.

Northwest Africa 12182 (NWA 12182)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite, brecciated)
History: The meteorite was bought from a local meteorite dealer in Tagant, Mauritania.
Physical characteristics: Grayish individual partly covered with fusion crust.
Petrography: The meteorite is a fine-grained basaltic breccia composed of up to 2 mm sized basaltic clasts and up to 3.5 mm sized impact melt clasts set into a basaltic matrix. Mineral phases are predominantly up to 400 μm sized pyroxene and lath shaped calcic plagioclase. Pyroxene often shows magmatic zoning attesting to a low degree of thermal metamorphism. Minor phases include silica, ilmenite, chromite, and troilite. No metallic iron has been detected.
Geochemistry: low-Ca pyroxene: $Fs_{42.3\pm8.3}Wo_{4.1\pm1.4}$ ($Fs_{30.5\text{-}54.4}Wo_{1.9\text{-}6.3}$, n=11, FeO/MnO=28-39); Ca-pyroxene: $Fs_{29.6\pm2.2}Wo_{37.5\pm5.9}$ ($Fs_{25.8\text{-}34.4}Wo_{23.1\text{-}41.6}$, n=10, FeO/MnO=29-36); calcic plagioclase: $An_{88.8\pm4.0}$ ($An_{81.0\text{-}93.4}$, n=15)

Northwest Africa 12183 (NWA 12183)
(Northwest Africa)
Purchased: 2018
Classification: Ureilite
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Dark-brownish individual lacking any fusion crust.
Petrography: The meteorite shows a characteristic cumulate texture of up to 1 mm sized olivine and pigeonite grains. Olivine is enriched in Cr_2O_3 and displays typical reduced rims. The meteorite contains abundant flaky graphite.

Geochemistry: reduced rims in olivine: $Fa_{5.1\text{-}11.0}$; olivine contains 0.67±0.18 wt% Cr_2O_3 and 0.31±0.02 wt% CaO

Northwest Africa 12184 (NWA 12184)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was bought from a local meteorite dealer in Algeria.
Physical characteristics: Almost black individual partly covered with fusion crust.
Petrography: Brecciated carbonaceous chondrite composed of chondrules (mean diameter about 0.3 mm), chondrule pseudomorphs, CAIs, and mineral fragments set into abundant Fe-rich matrix. Many of the components are surrounded by fine-grained dust rims. The fine-grained almost black meteorite matrix consists of abundant Ca-carbonates, sulfides and phyllosilicates.

Northwest Africa 12185 (NWA 12185)
(Northwest Africa)
Purchased: 2009
Classification: Ordinary chondrite (LL3)
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Brownish individual partly covered with fusion crust.
Petrography: The meteorite shows a chondritic texture of densely packed and partly flattened chondrules, with an apparent mean diameter of about 0.9 mm; low FeNi metal content and low magnetic susceptibility.

Northwest Africa 12186 (NWA 12186)
(Northwest Africa)
Purchased: 2018
Classification: Pallasite
History: The meteorite was bought from a local meteorite dealer in Algeria.
Physical characteristics: Brownish individual lacking any fusion crust.
Petrography: The meteorite is composed of typically 5 mm sized brownish olivine set into abundant and well preserved FeNi metal matrix. Ni-poor regions contain about 5 wt% and Ni-rich regions up to 31.6 wt% Ni.

Northwest Africa 12187 (NWA 12187)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was bought from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish individual lacking any fusion crust.

Petrography: Strongly weathered carbonaceous chondrite composed of chondrules (mean diameter about 0.8 mm; up to 2 mm sized), CAIs, and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are absent. Nearly all chondrules show reddish staining due to terrestrial alteration.

Northwest Africa 12188 (NWA 12188)
Mauritania
Purchased: May 2018
Classification: Ureilite
History: Found in the Adrar region of Mauritania, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone; sandblasted exterior; saw cut reveals an interior mosaic of light- and dark-gray crystals; minor amount iron-staining present.
Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and augite. Ubiquitous Fe-metal is present along grain boundaries, small (<100 μm) metal blebs are scattered throughout, and there are numerous Fe-metal/oxide veinlets crosscutting the silicate grains. Silicates are highly equilibrated both compositionally and texturally, no oxidation reduction rims observed on olivine grains. No graphite or diamond was observed.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{12.1\pm0.1}$, Fe/Mn=21±1, Cr_2O_3=0.50±0.01 (wt%), n=6; pigeonite $Fs_{11.1\pm1.6}Wo_{4.5\pm0.1}$, Fe/Mn=15±1, n=2; augite $Fs_{6.0\pm0.2}Wo_{36.5\pm0.5}$, Fe/Mn=10±0, n=2.
Classification: Augite-bearing ureilite
Specimens: 22.2 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12189 (NWA 12189)
Algeria
Purchased: May 2018
Classification: Ureilite
History: Found near Tindouf, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone; irregular, sandblasted exterior; saw cut reveals an interior mosaic of light and dark gray-brown crystals.
Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, graphite and Fe-metal. Ubiquitous, finely disseminated Fe-metal is occupies zones between silicate grain boundaries. Elongate graphite grains up to 1 mm are present throughout. Significant oxidation reduction rims observed on olivine grains with compositions of ~$Fa_{08.}$
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{21.5\pm0.1}$, Fe/Mn=47±4, Cr_2O_3=0.54±0.10 (wt%), n=5; pigeonite $Fs_{17.8\pm0.1}Wo_{4.8\pm0.8}$, Fe/Mn=30±1, n=6.
Classification: Ureilite, graphite-bearing.

Specimens: 21.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12190 (NWA 12190)
Western Sahara
Purchased: May 2018
Classification: HED achondrite (Howardite)
History: Found in Gdeim Ashham, Western Sahara, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone; sandblasted exterior; saw cut reveals a brecciated interior with numerous feldspar, pyroxene, and lithic clasts; significant domains of recrystallized shock melt are present.
Petrography: (C. Agee, *UNM*) This meteorite is a polymict breccia consisting of approximately 50% diogenite material and 50% cumulate eucrite material.
Geochemistry: (C. Agee, *UNM*) Diogenite mineralogy: olivine $Fa_{45.7}$, Fe/Mn=49, n=1, low-Ca pyroxene 25.4±3.3$Wo_{2.6\pm1.0}$, Fe/Mn=30±1, n=5; eucrite mineralogy: low-Ca pyroxene 47.8±4.7$Wo_{8.7\pm9.0}$, Fe/Mn=31±1, n=5; plagioclase $An_{92.9\pm3.4.}$
Classification: Howardite
Specimens: 25.3 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12191 (NWA 12191)
Western Sahara
Purchased: May 2018
Classification: Ureilite
History: Found in Agmamin region, Western Sahara, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone; irregular, weatherd exterior; saw cut reveals an interior mosaic of light-brown and dark-gray crystals.
Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and Fe-metal. Ubiquitous, finely disseminated Fe-metal is occupies zones between silicate grain boundaries. A carbon polymorph (diamond or graphite) is present.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{15.4\pm0.1}$, Fe/Mn=36±1, Cr_2O_3=0.59±0.01 (wt%), n=6; pigeonite $Fs_{9.8\pm2.1}Wo_{7.0\pm1.8}$, Fe/Mn=14±4, n=6.
Classification: Ureilite
Specimens: 20.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12192 (NWA 12192)
Algeria
Purchased: May 2018
Classification: Carbonaceous chondrite (CK5)

History: Found north of Tindouf, Algeria, January 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone with irregular weathered surface, saw cut reveals distinct chondrules up to 1mm in diameter set in a dark-gray groundmass.
Petrography: (C. Agee, *UNM*) Microprobe examination shows scattered, distinct, texturally equilibrated chondrules set in a fine-grained matrix. Plagioclase grain size up to 50 μm in diameter. Abundant chromium-rich magnetite observed throughout, some up to 300 μm in diameter.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{29.9\pm1.0}$, Fe/Mn=104±8, NiO=0.30±.03 (wt%), n=13; low-Ca pyroxene $Fs_{25.4\pm1.0}Wo_{0.7\pm0.0}$, Fe/Mn=66±6, n=6; plagioclase $Ab_{69.2\pm3.3}An_{22.1\pm6.9}Or_{8.7\pm8.8}$, n=5.
Classification: Carbonaceous chondrite (CK5) CK chondrite based Fe/Mn of olivine and pyroxenes, and on the presence of chromium-rich magnetite. Petrologic type 5 based on the equilibrated state of olivine and pyroxene, distinct chondrules, and secondary plagioclase size.
Specimens: 9 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12193 (NWA 12193)
Western Sahara
Purchased: May 2018
Classification: HED achondrite (Eucrite, polymict)
History: Found in Gdeim Asham, Western Sahara, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone, with weathered exterior. A saw cut reveals a fragmental breccia of lithic clasts set in a light colored, fine-grained groundmass.
Petrography: (C. Agee) Microprobe examination of a polished mount shows a mixture of unequilibrated, zoned pyroxenes and equilibrated pyroxenes with exsolution lamellae, leading to the conclusion that there are at least two distinct eucrite lithologies present.
Geochemistry: (C. Agee, *UNM*) Pyroxene $Fs_{48.1\pm14.0}Wo_{10.7\pm7.3}$, Fe/Mn=31±5, n=13; plagioclase $An_{87.9\pm4.7}$, n=4.
Classification: Polymict eucrite
Specimens: 21.9 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12194 (NWA 12194)
Algeria
Purchased: May 2018
Classification: HED achondrite (Howardite)
History: Found near Oum El Assel, Algeria, September 2017. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone, with weathered exterior. A saw cut reveals a very dark-gray surface with faint appearing clasts and mineral fragments.

Petrography: (C. Agee) Microprobe examination of a polished mount shows a fragmental breccia of pyroxene, plagioclase, and lithic clasts. The meteorite consists of approximately 33% diogenite, 33% cumulate eucrite, and 33% basaltic material.
Geochemistry: (C. Agee, *UNM*) Pyroxene $Fs_{38.6\pm13.9}Wo_{7.5\pm9.6}$, Fe/Mn=30±2, n=12; plagioclase $An_{88.8\pm1.3}$, n=5. Diogenite pyroxenes $Fs_{25.1\pm4.8}Wo_{3.5\pm1.5}$, n=4.
Classification: Howardite
Specimens: 22.8 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12195 (NWA 12195)
Algeria
Purchased: May 2018
Classification: HED achondrite (Eucrite, polymict)
History: Found north of Tindouf, Algeria, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone, partial dark fusion-crusted exterior. Saw cut reveals a light-gray fragmental breccia.
Petrography: (C. Agee) Microprobe examination of a polished mount shows a mixture of unequilibrated, zoned pyroxenes with a population of equilibrated pyroxenes with exsolution lamellae and a clear compositional separation between low-Ca and high-Ca pyroxenes, leading to the conclusion that there are at least two distinct eucrite lithologies present.
Geochemistry: (C. Agee, *UNM*) Pyroxene $Fs_{42.6\pm11.4}Wo_{9.8\pm9.1}$, Fe/Mn=30±2, n=12; plagioclase $An_{87.1\pm3.5}$, n=6.
Classification: Polymict eucrite
Specimens: 12.5 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12196 (NWA 12196)
Western Sahara
Purchased: May 2018
Classification: Carbonaceous chondrite (CV3)
History: Found near the Algerian-Western Sahara border region, January 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone, weathered exterior. A saw cut reveals numerous distinct chondrules up to 3 mm in diameter and some CAIs up to 5 mm in size. Gray colored groundmass makes up about 40% of this meteorite.
Petrography: (C. Agee, *UNM*) Microprobe examination showed many porphyritic chondrules most of which were type I. Abundant fine grained matrix throughout.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{4.4\pm4.1}$, n=16; enstatite $Fs_{1.1\pm0.3}Wo_{0.9\pm0.2}$, n=8.
Classification: Carbonaceous chondrite (CV3)

Specimens: 21.2 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12197 (NWA 12197)
Western Sahara
Purchased: May 2018
Classification: Carbonaceous chondrite (CR2)
History: Found near the Algerian-Western Sahara border region, March 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone, weathered exterior. A saw cut reveals numerous chondrules up to 1 mm in diameter many with irregular or decorated rims, and sparse CAIs, but one observed was ~5 mm in size. Dark, gray-colored groundmass makes up about 30% of this meteorite, ubiquitous opaques visible.
Petrography: (C. Agee, *UNM*) Microprobe examination showed many porphyritic chondrules most of which were type I. Many chondrules are metal-rich. Abundant fine grained, hydrous matrix throughout.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{3.3\pm3.3}$, Cr_2O_3=0.20±0.11 (wt%), n=21; pyroxene $Fs_{1.3\pm0.4}Wo_{1.9\pm1.3}$, n=10.
Classification: Carbonaceous chondrite (CR2)
Specimens: 22.3 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12198 (NWA 12198)
Western Sahara
Purchased: May 2018
Classification: Ureilite
History: Found in Western Sahara, April 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone; irregular, weathered exterior; saw cut reveals an interior mosaic of light brown and dark gray crystals.
Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and Fe-metal. Ubiquitous, finely disseminated Fe-metal is occupies zones between silicate grain boundaries. Graphite observed.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{21.6\pm0.3}$, Fe/Mn=50±3, Cr_2O_3=0.49±0.27 (wt%), n=6; pigeonite $Fs_{9.8\pm3.0}Wo_{9.8\pm3.0}$, Fe/Mn=18±3, n=5.
Classification: Ureilite
Specimens: 20 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12199 (NWA 12199)
Western Sahara
Purchased: May 2018
Classification: Primitive achondrite (Acapulcoite)

History: Found near the Western Sahara-Mauritania border region, February 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Two identically looking stones with weathered exterior. Saw cut reveals an interior fine-grained mosaic of light-brown and dark-gray crystals.
Petrography: (C. Agee, *UNM*) Recrystallized texture with triple junctions. Grain size about 250 μm. This meteorite consists of olivine, low-Ca pyroxene, and Fe-metal. No plagioclase detected.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{12.0\pm0.1}$, Fe/Mn=22±1, Cr_2O_3=0.50±0.01 (wt%), n=6; low-Ca pyroxene $Fs_{10.4\pm0.1}Wo_{4.5\pm0.1}$, Fe/Mn=14±0, n=7.
Classification: Acapulcoite
Specimens: 21.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12200 (NWA 12200)
Mauritania
Purchased: May 2018
Classification: Carbonaceous chondrite (CK6)
History: Found in the Adrar Region, Mauritania, March 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone with irregular weathered surface. A saw cut reveals numerous faint chondrules up to 2mm in diameter set in a dark-gray groundmass. Orange-reddish oxidation staining is visible.
Petrography: (C. Agee, *UNM*) Microprobe examination shows recrystallized relict texturally equilibrated chondrules set in a recrystallized matrix. Plagioclase grain size up to 300 μm in length. Abundant chromium-rich magnetite observed throughout, some up to 200 μm in size. Only trace amounts of pyroxene are present. Melt pockets observed.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{27.2\pm0.9}$, Fe/Mn=89±7, NiO=0.49±0.11, n=13; melt SiO_2=34.1±1.9, TiO_2+0.15±0.02, Al_2O_3=5.7±1.9, Cr2O2=0.63±0.11, MgO=21.5±1.0, FeO=26.6±3.3, MnO=0.21±0.03, CaO=5.3±0.3, NiO=0.34±0.05, Na_2O=0.65±0.23, K_2O=0.08±0.00, Fe/Mn=128±10, n=3; plagioclase $Ab_{52.0\pm4.3}An_{41.6\pm7.8}Or_{6.4\pm5.6}$, n=6.
Classification: Carbonaceous chondrite (CK6)
Specimens: 15.9 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12201 (NWA 12201)
Western Sahara
Purchased: May 2018
Classification: HED achondrite (Eucrite, unbrecciated)
History: Found in Western Sahara, March 2018. Purchased by Darryl Pitt in Mauritania, May 2018.

Physical characteristics: Single stone, weathered exterior. Saw cut reveals a dark gray surface with plagioclase and pyroxene crystals.
Petrography: (C. Agee) Microprobe examination of a polished mount shows a mixture of approximately 50% pyroxene and 40% plagioclase. Pyroxenes show a clear compositional separation of low-Ca and high-Ca pyroxene typical of equilibrated basaltic eucrites. No brecciation observed.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{57.1\pm1.4}Wo_{3.8\pm2.4}$, Fe/Mn=33±1, n=8; high-Ca pyroxene $Fs_{26.5\pm2.3}Wo_{41.5\pm2.9}$, Fe/Mn=31±2, n=5; plagioclase $An_{85.4\pm0.8}$, n=6.
Classification: Unbrecciated basaltic eucrite
Specimens: 17.1g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12202 (NWA 12202)
Western Sahara
Purchased: May 2018
Classification: HED achondrite (Eucrite, polymict)
History: Found in Western Sahara, January 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone, partial dark fusion-crusted exterior. Saw cut reveals a light-gray fragmental breccia.
Petrography: (C. Agee) Microprobe examination of a polished mount shows a fragmental breccia of predominately plagioclase and pyroxene. The pyroxene is mixture of cumulate eucrite compositions with a population of basaltic eucrite compositions leading to the conclusion that there are at least two distinct eucrite lithologies present.
Geochemistry: (C. Agee, *UNM*) Basaltic eucrite: low Ca pyroxene $Fs_{60.9\pm1.3}Wo_{3.3\pm2.2}$, Fe/Mn= 31±1, n=4; high Ca pyroxene $Fs_{47.9\pm6.2}Wo_{23.2\pm2.1}$, Fe/Mn=31±0, n=3. Cumulate eucrite: low Ca pyroxene $Fs_{35.9\pm1.9}Wo_{5.0\pm2.8}$, Fe/Mn= 29±2, n=4.
Classification: Polymict eucrite
Specimens: 20.4 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12203 (NWA 12203)
Algeria
Purchased: May 2018
Classification: HED achondrite (Howardite)
History: Found near Oum El Assel, Algeria, March 2018. Purchased by Darryl Pitt in Mauritania, May 2018.
Physical characteristics: Single stone, with weathered exterior. A saw cut reveals a very dark gray surface with faint appearing clasts and mineral fragments.

Petrography: (C. Agee) Microprobe examination of a polished mount shows a fragmental breccia of pyroxene, plagioclase, and lithic clasts. The meteorite consists of approximately 50% diogenite and 50% eucrite.
Geochemistry: (C. Agee, *UNM*) Diogenite pyroxene $Fs_{28.1\pm2.5}Wo_{2.6\pm1.0}$, Fe/Mn=29±2, n=7; eucrite pigeonite $Fs_{47.5\pm5.9}Wo_{6.7\pm3.1}$, Fe/Mn=30±2, n=6, eucrite high-Ca pyroxene $Fs_{29.3\pm2.6}Wo_{39.1\pm1.9}$, Fe/Mn=30±2, n=2, plagioclase $An_{88.7\pm5.6}$, n=5.
Classification: Howardite
Specimens: 23.3 g including a probe mounts on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12210 (NWA 12210)
(Northwest Africa)
Purchased: 2018 Jun
Classification: Martian meteorite (Shergottite)
History: Purchased by Ben Hoefnagels in June 2018 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Poikilitic texture. Large pyroxene oikocrysts (up to 6 mm across) enclose olivine chadacrysts, and are set in a relatively coarse grained groundmass containing olivine, pyroxenes, lath-like maskelynite, abundant phosphates (both merrillite and chlorapatite), Ti-poor chromite and pyrrhotite. Mafic silicates exhibit very limited compositional zoning. Cores of pyroxene oikocrysts are stained orange.
Geochemistry: Olivine ($Fa_{38.1\text{-}40.7}$, FeO/MnO = 49-51, N = 3), low-Ca pyroxene core ($Fs_{24.7}Wo_{4.1}$, FeO/MnO = 30), pigeonite ($Fs_{26.4\text{-}30.8}Wo_{11.0\text{-}7.5}$; $Fs_{28.1}Wo_{16.3}$; FeO/MnO = 25-29; N = 3), subcalcic augite ($Fs_{16.8\text{-}18.5}Wo_{33.7\text{-}36.6}$, FeO/MnO = 23-25, N = 2), maskleynite ($An_{53.8\text{-}54.4}Or_{2.1\text{-}2.2}$, N = 2).
Classification: Martian (shergottite, poikilitic).
Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12211 (NWA 12211)
(Northwest Africa)
Purchased: 2018 Apr
Classification: Ordinary chondrite (H5)
History: Purchased by Thierry Simard in April 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules are present within a coarsely recrystallized assemblage containing abundant altered metal (some now replaced by red-brown iron hydroxides) and accessory merrillite.
Geochemistry: Olivine ($Fa_{18.3\text{-}18.4}$, N = 3), orthopyroxene ($Fs_{15.4\text{-}15.9}Wo_{1.0\text{-}1.7}$, N = 4), clinopyroxene ($Fs_{5.1\text{-}6.6}Wo_{46.3\text{-}45.3}$, N = 2).
Classification: Ordinary chondrite (H5).
Specimens: 20.6 g including one polished thin section at *UWB*; remainder with Monsieur T. Simard.

Northwest Africa 12212 (NWA 12212)
(Northwest Africa)
Purchased: 2005
Classification: Mesosiderite
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and donated to the Planetary Studies Foundation.
Petrography: (A. Irving and S. Kuehner, *UWS*) Aggregate of predominantly kamacite (containing wispy regions of taenite), low-Ca pyroxene and anorthite together with accessory Mg-merrillite, schreibersite and minor troilite.
Geochemistry: Low-Ca pyroxene ($Fs_{32.7\text{-}32.9}Wo_{4.2\text{-}5.1}$, FeO/MnO = 21-28, N = 3), anorthite ($An_{90.8\text{-}94.4}Or_{0.9\text{-}0.8}$, N = 2).
Classification: Mesosiderite.
Specimens: The entire specimen polished on one side is at *PSF*.

Northwest Africa 12215 (NWA 12215)
(Northwest Africa)
Purchased: 2018 May
Classification: Ordinary chondrite (H5)
History: Purchased by SunChul Lee from a dealer in Florida, who had obtained the specimen from a Moroccan source.
Petrography: (A. Irving and S. Kuehner, *UWS*) Extensively recrystallized with sparse chondrules, abundant altered metal and accessory merrillite.
Geochemistry: Olivine ($Fa_{19.5\text{-}19.9}$, N = 3), orthopyroxene ($Fs_{16.8\text{-}16.9}Wo_{1.1\text{-}1.0}$, N = 3), clinopyroxene ($Fs_{5.7\text{-}5.9}Wo_{44.4\text{-}45.7}$, N = 2).
Classification: Ordinary chondrite (H5).
Specimens: 122.1 g including one polished thin section at *UWB*; remainder with Mr. S. Lee.

Northwest Africa 12217 (NWA 12217)
(Northwest Africa)
Purchased: 2015
Classification: Ungrouped achondrite
History: Purchased by Jay Piatek in 2015 from a Moroccan meteorite dealer.
Physical characteristics: Single stone, partially covered with black fusion crust. The surface also exposes a fragmental breccia interior with coarse cream-colored grains crosscut by fine dark veinlets. Saw-cut surface reveals light colored angular mineral fragments up to 1 cm in size bounded by darker gray, fine grained material. A prominent, partially oxidized metal grain was visible in the saw cut surface.
Petrography: (C. Agee, *UNM*) Backscatter electron mapping gives the approximate modal abundances: 93% olivine, 4% pyroxene, with minor chromite,

troilite, Fe-metal, alkali feldspar, plagioclase, silica, and fluorapatite, primarily occupying boundaries and pockets between the larger olivine grains.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{9.6\pm2.5}$, Fe/Mn=36±3, n=19; low-Ca pyroxene $Fs_{19.3\pm0.8}Wo_{2.6\pm0.4}$, Fe/Mn=25±1, n=8; alkali feldspar $An_{2.9\pm1.1}Or_{56.2\pm10.3}Ab_{41.0\pm10.1}$, n=18; plagioclase $An_{43.5\pm3.7}Or_{1.6\pm0.3}Ab_{54.9\pm4.0}$, n=4; apatite CaO=46.3±0.4, MgO=3.6±0.0, FeO=0.27±0.01, Na_2O=2.5±0.1, P_2O_5=45.3±0.7, F=0.53±0.04, Cl (not detected) all wt%, n=3; metal Fe=97.8±0.6, Ni=2.1±0.6 (wt%), n=5; chromite Al_2O_3=3.4±0.1, Cr_2O_3=64.4±0.8, MgO=7.9±0.4, MnO=0.69±0.05, FeO=19.4±0.3 (wt%), n=3. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$= 3.723, 3.869, 3.660; $\delta^{17}O$= 1.793, 1.884, 1.796; $\Delta^{17}O$= -0.173, -0.159, -0.136 (linearized, all per mil, TFL slope=0.528).
Classification: Ungrouped achondrite, dunite breccia. The oxygen isotope values of this meteorite plot midway between the eucrite fractionation line (EFL) and the angrite fractionation line (AFL), however its mineralogy is unlike HEDs or angrites; in particular this meteorite possesses alkali feldspar and lacks Ca-rich plagioclase. Furthermore, the Fe/Mn of this meteorite is somewhat lower than for HEDs and much lower than angrites. Brachinites have similar oxygen isotope values, however this meteorite has olivine with much lower Fa and Fe/Mn values than brachinites.
Specimens: 20.7 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 12218 (NWA 12218)
(Northwest Africa)
Purchased: 2007 Jun
Classification: Carbonaceous chondrite (CO3)
History: Purchased from a moroccan dealer at the meteorite show in Ensisheim, France
Petrography: (K. Metzler, *IfP*) Chondrules, chondrule fragments, and CAIs are embedded in a fine-grained black matrix (about 20 vol% matrix). The vast majority of chondrules are type I chondrules. Apparent chondrule sizes mostly between 50 and 300 µm.
Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{12.3\pm16.7}$ (2.7-77.5); n=25. Random measurements of low-Ca pyroxene grains revealed $Fs_{2.7\pm2.4}Wo_{1.7\pm0.9}$ ($Fs_{1.1\text{-}11.9}Wo_{0.8\text{-}4.6}$); n=25
Classification: CO chondrite based on CAI occurrence, small chondrule size, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene. Very low petrologic subtype (<3.5) based on the PMD of Fa values (136).

Northwest Africa 12219 (NWA 12219)
(Northwest Africa)

Purchased: 2007 Jun
Classification: Carbonaceous chondrite (CO3)

History: Purchased from a Moroccan dealer at the meteorite show in Ensisheim, France

Petrography: (K. Metzler, *IfP*) Chondrules, chondrule fragments, and CAIs are embedded in a fine-grained brownish matrix (about 20 vol% matrix). The vast majority of chondrules are type I chondrules. Apparent chondrule sizes mostly between 50 and 300 µm.

Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{21.5\pm14.3}$ (2.5-48.3); n=23. Random measurements of low-Ca pyroxene grains revealed $Fs_{3.6\pm3.0}Wo_{1.9\pm1.1}$ ($Fs_{1.0\text{-}13.9}Wo_{0.3\text{-}4.4}$); n=24

Classification: CO chondrite based on CAI occurrence, small chondrule size, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene. Low petrologic subtype (<3.5) based on the PMD of Fa values (67).

Northwest Africa 12221 (NWA 12221)
(Northwest Africa)
Purchased: 2006 June
Classification: Carbonaceous chondrite (CV3)

History: Purchased from a Moroccan dealer at the meteorite show in Ensisheim, France

Petrography: (K. Metzler, *IfP*) Chondrules, CAIs and AOAs are embedded in a fine-grained dark matrix (about 40 vol% matrix). Most chondrules have apparent diameters between 0.2 and 1.0 mm, some up to 2.3 mm. Very few type II chondrules. Many chondrules with distinctive fine-grained rims; some chondrules with igneous rims. CAIs with sizes up to 2.3 mm have been observed.

Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{5.7\pm3.0}$ (0.7-9.6); n=19. Random measurements of low-Ca pyroxene grains revealed $Fs_{1.6\pm0.7}Wo_{1.3\pm0.8}$ ($Fs_{0.7\text{-}3.2}Wo_{0.4\text{-}3.7}$); n=21.

Classification: CV chondrite based on CAI and AOA occurrence, size of chondrules and CAIs, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene.

Northwest Africa 12222 (NWA 12222)
(Northwest Africa)
Purchased: 2018 Mar
Classification: Martian meteorite (basaltic breccia)

Petrography: (K. Metzler, *IfP*) Achondritic breccia, consisting of lithic and mineral clasts, set in a fine-grained clastic matrix. The following minerals were identified: Plagioclase, pyroxene (occasionally with exsolution lamellae), Cl-bearing apatite, ilmenite, and pyrrhotite. Beside complex fine-grained lithologies two different basalt clasts were found.

Geochemistry: Mineral compositions and geochemistry: Basalt clast #1: Pyroxene (n=5) $Fs_{37.6\pm0.2}Wo_{35.7\pm0.4}$ ($Fs_{37.3-37.8}Wo_{35.2-36.1}$); mean Fe/Mn (at.)=36. Plagioclase (n=6): $An_{55.2\pm3.5}Or_{1.9\pm0.3}$ ($An_{50.2-59.3}Or_{1.3-2.2}$). Basalt clast #2: Pyroxene (n=7) $Fs_{33.5\pm3.1}Wo_{4.0\pm0.9}$ ($Fs_{25.6-34.6}Wo_{1.6-4.6}$); mean Fe/Mn (at.)=38. Plagioclase (n=7): $An_{53.5\pm4.2}Or_{1.9\pm0.4}$ ($An_{49.5-60.9}Or_{1.4-2.7}$).
Classification: Martian (basaltic breccia), based on texture and mineral composition. An values in Feldspar and Fe/Mn in pyroxene are typical of Martian basalts. This sample is most probably paired to NWA 7034 and pairings.

Northwest Africa 12223 (NWA 12223)
(Northwest Africa)
Purchased: 2005 Jun
Classification: HED achondrite (Eucrite, melt breccia)
History: Purchased from a Moroccan dealer at the mineral show in Sainte-Marie-aux-Mines, France
Petrography: (K. Metzler, *IfP*) Melt breccia, consisting of eucritic basalt clasts (ophitic to subophitic textures) with sizes up to several cm and mineral fragments (pyroxene, plagioclase, silica polymorph), set in a dark matrix. This matrix represents a crystallized melt with subophitic texture consisting of pyroxene and skeletal plagioclase crystals. Melt pockets of partly devitrified glass also occur. Most pyroxene fragments show augite exsolution lamellae. Accessories are ilmenite, chromium spinel, and metal (mostly oxidized).
Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene (host; n=10): $Fs_{63.3\pm0.5}Wo_{2.4\pm0.3}$ ($Fs_{62.6-63.9}Wo_{.9-2.8}$); mean Fe/Mn (at.): 33. Ca-rich pyroxene (exsolution lamellae; n=10) $Fs_{27.8\pm0.9}Wo_{43.2\pm0.7}$ ($Fs_{27.0-30.2}Wo_{41.7-44.0}$); Plagioclase (n=10): $An_{87.8\pm1.7}$ ($An_{84.9-89.9}$).

Northwest Africa 12224 (NWA 12224)
(Northwest Africa)
Purchased: 2006 Jun
Classification: HED achondrite (Howardite)
History: Purchased from a Moroccan dealer at the mineral show in Sainte-Marie-aux-Mines, France
Petrography: (K. Metzler, *IfP*) Shock-compacted fine-grained breccia of dark gray appearance, criss-crossed by black shock melt veins up to several mm in width. It consists of gabbroic and basaltic (ophitic to subophitic) rock fragments and related debris. The majority of pyroxenes is free of exsolution lamellae, but exsolved pyroxenes also occur. Three grains of Fe-rich olivine have been found. This breccia contains devitrified melt droplets as well as clast-rich and clast-poor impact melt rocks. About 10-15% diogenitic components. Accessories are ilmenite, chromium spinel, troilite, silica polymorph, and Ni-poor metal (mostly oxidized).
Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene (n=19): $Fs_{35.1\pm5.1}Wo_{5.4\pm0.7}$ ($Fs_{29.3-49.7}Wo_{4.1-7.1}$); mean Fe/Mn (at.): 33. Ca-rich

pyroxene (n=5) $Fs_{49.3\pm2.8}Wo_{16.8\pm3.6}$ ($Fs_{45.4\text{-}53.0}Wo_{13.1\text{-}20.5}$); mean Fe/Mn (at.): 31. Diogenitic pyroxene (n=3) $Fs_{24.1}Wo_{1.9}$ ($Fs_{21.8\text{-}26.0}Wo_{1.6\text{-}2.1}$) mean Fe/Mn (at.): 32. Olivine (n=3) $Fa_{77.7}$ ($Fa_{76.5\text{-}78.6}$); mean Fe/Mn (at.): 47. Plagioclase (n=9): $An_{83.8\pm3.9}$ ($An_{78.9\text{-}92.0}$).

Northwest Africa 12225 (NWA 12225)
(Northwest Africa)
Purchased: 2007 Jun
Classification: HED achondrite (Eucrite, polymict)
History: Purchased from a Moroccan dealer at the mineral show in Sainte-Marie-aux-Mines, France
Petrography: (K. Metzler, *IfP*) Polymict breccia consisting of gabbroic and basaltic rock fragments and related debris. Partly brown appearance due to oxidized Ni-free metal. This breccia contains clast-rich impact melt rocks. Accessories are ilmenite, chromium spinel, silica polymorph, and traces of merrilite and zircon.
Geochemistry: Mineral compositions and geochemistry: Basalt clast #1: Pyroxene (n=10): $Fs_{26.7\pm0.9}Wo_{43.0\pm0.6}$ ($Fs_{25.4\text{-}28.4}Wo_{42.0\text{-}43.9}$); mean Fe/Mn (at.): 29. Plagioclase (n=10): $An_{74.5\pm3.9}$ ($An_{71.2\text{-}82.4}$). Basalt clast #2: Pyroxene (n=10): $Fs_{56.0\pm0.5}Wo_{5.2\pm1.1}$ ($Fs_{55.1\text{-}56.6}Wo_{3.7\text{-}8.0}$); mean Fe/Mn (at.): 26. Plagioclase (n=10): $An_{87.3\pm3.5}$ ($An_{82.6\text{-}92.4}$).

Northwest Africa 12226 (NWA 12226)
(Northwest Africa)
Purchased: 2007 Dec
Classification: HED achondrite (Eucrite)
History: Purchased from a Moroccan dealer at the mineral show (CCH) in Hamburg, Germany
Petrography: (K. Metzler, *IfP*) Unbrecciated ophitic basalt with exsolved pyroxene. Accessories are ilmenite, chromium spinel, silica polymorph, Ni-free iron metal, and troilite.
Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene (n=15): $Fs_{58.3\pm1.2}Wo_{6.7\pm1.2}$ ($Fs_{55.5\text{-}59.5}Wo_{5.7\text{-}9.1}$); mean Fe/Mn (at.): 32. Exsolved Ca-rich pyroxene lamellae (n=9): $Fs_{35.3\pm2.6}Wo_{34.4\pm3.3}$ ($Fs_{32.3\text{-}39.0}Wo_{29.4\text{-}38.5}$); mean Fe/Mn (at.): 34. Plagioclase (n=5): $An_{88.4\pm1.8}$ ($An_{86.4\text{-}90.5}$).

Northwest Africa 12227 (NWA 12227)
Algeria
Find: April 2018
Classification: HED achondrite (Howardite)
Petrography: (D. Sheikh, *FSU*) Fine-grained polymict breccia, <7 mm clast size for basaltic eucrite clasts, <3 mm for diogenite clasts, < 2mm for cumulate eucrite

clasts. Modal content (in vol.%): diogenites, 46%; cumulate eucrites, 12%; basaltic eucrites, 35%; anorthosite clasts, 5%; shock melt zones, 1%; opaques, 1%.
Geochemistry: Eucrite pyroxene: pigeonite ($Fs_{44.95}Wo_{18.29}$), n=25; augite ($Fs_{39.9}Wo_{34.4}$), n=6; FeO/MnO=28. Diogenite pyroxene: orthopyroxene ($Fs_{27.4}Wo_{6.84}$), n=10; FeO/MnO=22. Calcic plagioclase (An_{89}), N=25. Ilmenite (Fe/(Fe+Mg)) = 88.42%, N=2. FeS and SiO_2-rich glass present.
Classification: Achondrite (howardite)
Specimens: 25.65 grams at *UCLA*, main mass with Matthew Stream.

Northwest Africa 12229 (NWA 12229)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CV3)
History: A single stone weighing 675 g was found in Morocco prior to 2016. J. Donald Cline and John Sinclair acquired the sample from a meteorite dealer at the Tucson Gem and Mineral Show in February 2017.
Physical characteristics: Sample is dark brown in color, rounded to irregular in shape and lacks fusion crust. Sample is coated on the bottom and sides with caliche, some of which contains rounded sand grains. Chondrules and CAIs are visible through the patina. The cut face shows abundant chondrules, CAIs and AOAs.
Petrography: Description and classification (A. Love, *App*): Sample contains distinct chondrules (average diameter of 743 µm (N=29), fragments and refractory inclusions (CAIs up to 1 mm) all set within an opaque dark brown matrix. Matrix contains FeO-rich olivine and has a weak fabric defined by slightly elongated chondrules and oriented amoeboid olivine aggregates. Type I olivine chondrules are dominant. Sample has 40% matrix.
Geochemistry: (A. Love, *App*) Olivine $Fa_{11.3\pm15.6}$ (0.6-49.7), N=16; low Ca pyroxene $Fs_{1.4\pm0.4}Wo_{1.1\pm0.8}$ ($Fs_{0.8\text{-}2.2}Wo_{0.5\text{-}3.6}$), N=11.
Classification: CV3. CV based on diameter of chondrules, matrix abundance and ubiquitous CAIs. CV subgroup based on magnetic susceptibility. Type 3 based upon unequilibrated compositions of chondrules.
Specimens: *PARI* holds the main mass. One endcut weighing 28 g and a polished thin section are on deposit at *App*.

Northwest Africa 12230 (NWA 12230)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite, polymict)
History: 34 identical stones with a total weight 1024.7 g were found by a meteorite prospector in Morocco. John Sinclair purchased the specimens at the 2017 Tucson Gem and Mineral Show.

Physical characteristics: The stones have a dark-brownish-gray weathered exterior that has a granular texture and contains circular pits where clasts have been plucked out. The cut face of the interior is dark greenish-grey and shows a brecciated texture composed of lithic clasts and mineral fragments.
Petrography: Description and classification (A. Love, *App*): Sample is a polymict breccia composed of rounded to irregular-shaped mineral clasts and sparse lithic clasts (up to 2 cm) from cumulate and vitrophyric eucrites, and diogenites (~6 vol%). Pyroxenes are exsolved. Accessory minerals are FeNi grains, silica polymorph, ilmenite, chromite and olivine.
Geochemistry: (A. Love, *App*) Pigeonite host: $Fs_{51.4\pm9.8}Wo_{5.8\pm2.3}$ ($Fs_{34.8\text{-}65.6}Wo_{3.6\text{-}9.3}$, FeO/MnO=27.4-34.2), N=8; high-Ca pyroxene exsolution lamellae: $Fs_{26.2\pm5.8}Wo_{40.5\pm0.9}$ ($Fs_{20.5\text{-}34.8}Wo_{39.2\text{-}41.4}$), N=6; diogenitic orthopyroxene: $Fs_{23.5\pm4.8}Wo_{2.7\pm1.3}$ ($Fs_{14.2\text{-}28.2}Wo_{0.3\text{-}3.8}$, FeO/MnO=24.4-32.4), N=6; olivine ($Fa_{43.5\pm6.5}$, FeO/MnO=50.0-65.3), N=3; plagioclase $An_{92.0\pm2.1}$ ($An_{88.5\text{-}94.3}$), N=10.
Classification: Textural and compositional data (Fe/Mn of pyroxenes) indicate this is an HED achondrite. Sample contains 6% diogenite indicating this is a polymict eucrite breccia. The distinctive granular exterior and magnetic susceptibility suggest these stones are paired.
Specimens: John Sinclair holds the remainder of this material. A polished thin section, epoxy mount and 2 slices weighing 41.5 g are on deposit at *App*.

Northwest Africa 12231 (NWA 12231)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Howardite)
History: Purchased by V. Ouellet in Zagora in 2018.
Physical characteristics: The sample is a small stone with black fusion crust and a light grey, fine-grained interior.
Petrography: The sample is a fine-grained polymict breccia. Modal percentages of lithic fragments (in vol.%): cumulate eucrite clasts, 40%; basaltic eucrites, 30%; diogenitic clasts, 20%; anorthosite clasts, 5%; opaques, 3%; glass, 2%.
Geochemistry: Eucritic pyroxene: pigeonite ($Fs_{47.1\pm4.3}Wo_{15.8\pm4.3}$), n=15; augite ($Fs_{38.9\pm3.8}Wo_{31.2\pm3.6}$), n=6. Diogenitic pyroxene: orthopyroxene ($Fs_{18.05\pm1.6}Wo_{4.54\pm1.6}$), n=9. Calcic plagioclase ($An_{88.4\pm4.2}$), N=15. Ilmenite (Fe/(Fe+Mg)) = 90.06%, N=4. Chromite, FeS and FeO Present. Silica-rich glass present.
Classification: howardite
Specimens: 3 g part slice at *UCLA*. 1 g powdered sample with C. Anderkin. Remainder of mass with V. Oullet.

Northwest Africa 12234 (NWA 12234)
Algeria
Find: 2016 March
Classification: Ordinary chondrite (LL3)

Petrography: (D. Sheikh, *FSU*) Composed of small to medium-sized chondrules (average ~0.7 mm) in a fine-grained matrix. Olivine and pyroxene are both heterogeneous in composition throughout. Low amount of metal present.
Geochemistry: Olivine, $Fa_{20.8\pm9.6}$ ($Fa_{4.5\text{-}38.7}$, N=55); orthopyroxene $Fs_{16.2\pm5.3}Wo_{3.2\pm0.4}$ ($Fs_{8.2\text{-}31.5}Wo_{2.2\text{-}3.8}$, N=50).
Classification: Ordinary Chondrite (LL3)
Specimens: 22.13 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12235 (NWA 12235)
Morocco
Purchased: Jan. 2017
Classification: Ordinary chondrite (H4)
History: Purchased from S. Tutorow via Ebay. Place of origin is stated as Morocco.
Physical characteristics: Physical Characteristics: One mass of 1740 g. Completely fusion encrusted. Brown fusion crust. Sample cut once for preparing sections and a 21.88 g slice for Yale.
Petrography: Average chondrule diameter is 0.35 mm. No matrix, but sharp chodrule boundaries. Almost all Fe,Ni metal altered, but considerable volumes of troilite remain.
Classification: Ordinary Chondrite (H4).
Specimens: Main mass is at *WesU*, Joe Webb Peoples Museum. Several thick sections were prepared as well. *YPMNH*.

Northwest Africa 12236 (NWA 12236)
Morocco
Purchased: 2018 Jan
Classification: Ordinary chondrite (H7)
History: Specimen is cataloged at the Royal Ontario Museum as LM58922.
Petrography: Specimen is composed of olivine, pyroxene and minor plagioclase and is devoid of chondrules or relict chondrule rims. Texture is mainly poikilitic, with large olivine oikocrysts (averaging 2383 µm in diameter, n=12) enclosing small olivine phenocrysts (averaging 104 µm in diameter, n=26).
Geochemistry: Olivine: 17.9±1.4, Fe/Mn=35.9±5.5 (n=27); Low Ca-pyroxene: $15.0\pm0.7Wo_{2.1\pm1.1}$, Fe/Mn=23.3±5.0 (n=24); Augite $Fs_{6.6\pm1.0}Wo_{42.0\pm3.6}$, Fe/Mn=15.9±1.5, Cr_2O_3=1.22±0.23 wt% (n=7). Oxygen Isotopes: (Karen Ziegler, *UNM*) $\delta^{17}O$ = 2.937 permil, $\delta^{18}O$ = 4.497 permil, $\delta^{17}O$ = 0.562 permil

Northwest Africa 12237 (NWA 12237)
(Northwest Africa)
Purchased: 2017
Classification: Ureilite

History: Purchased by Suzanne Morrison from a Moroccan meteorite dealer in Tucson, 2017.
Physical characteristics: Single stone with dark brown, weathered exterior.
Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and Fe-metal. Ubiquitous, finely disseminated Fe-metal occupies zones between silicate grain boundaries. Graphite is present.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{22.0\pm0.2}$, Fe/Mn=50±3, Cr_2O_3=0.72±0.18 (wt%), n=6; pigeonite $Fs_{18.8\pm0.1}Wo_{6.0\pm0.2}$, Fe/Mn=32±2, n=6.
Classification: Ureilite
Specimens: 20.2 g including a probe mount on deposit at *UNM*, Suzanne Morrison holds the main mass.

Northwest Africa 12238 (NWA 12238)
(Northwest Africa)
Purchased: 2011
Classification: Ordinary chondrite (L5)
History: Purchased by Brad Kern in January 2011 from Morocco.
Physical characteristics: Three identical appearing stones.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows porphyritic chondrules and plagioclase grains up to 25 μm.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{25.5\pm0.3}$, Fe/Mn=50±1, n=6; low-Ca pyroxene $Fs_{20.3\pm0.6}Wo_{1.8\pm1.3}$, Fe/Mn=28±1, n=5.
Classification: Ordinary chondrite (L5)
Specimens: 30.6 g including a probe mount on deposit at *UNM*, Brad Kern holds the main mass of 1092.2 g.

Northwest Africa 12239 (NWA 12239)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (H5)
History: Purchased by Suzanne Morrison in Tucson, 2017.
Physical characteristics: Many identical appearing stones.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows porphyritic chondrules and plagioclase grains up to 25 μm.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{18.7\pm0.3}$, Fe/Mn=38±2, n=6; low-Ca pyroxene $Fs_{15.4\pm0.1}Wo_{1.4\pm1.2}$, Fe/Mn=22±2, n=4, plagioclase $Ab_{75.2\pm11.1}$, n=4.
Classification: Ordinary chondrite (H5)
Specimens: 20 g including a probe mount on deposit at *UNM*, Suzanne Morrison holds the main mass.

Northwest Africa 12240 (NWA 12240)
Mauritania

Find: 2017
Classification: Ordinary chondrite (H4)
Petrography: The rock contains well-defined RP, PP, PO, and BO chondrules ranging from 80 to 1100 µm in diameter and averaging ~400 µm. Opaques include metallic Fe-Ni, troilite and chromite. There are many shock features: (1) Most troilite grains are polycrystalline. (2) Some kamacite grains contain small irregular grains of troilite, some also containing metallic Cu (up to 8x30 µm in size) adjacent to the trolite. (3) Also present are chromite-plagioclase assemblages and chromite veinlets inside olivine grains. The typical plagioclase grain is 5-10 µm in size. All of the low-Ca pyroxene grains are orthorhombic.

Northwest Africa 12241 (NWA 12241)
Algeria
Purchased: 2018 Aug
Classification: Martian meteorite (Shergottite)
History: Purportedly found in Algeria and purchased by Mohamed Brahim Sueilem in August 2018 from a dealer in Bordj Badji Mokhtar, Algeria.
Physical characteristics: The material (total weight 1150 g) comprises multiple broken fragments, some with adhering black fusion crust. The friable pieces are pale green in color and contain white plagioclase but no evident maskelynite.
Petrography: (A. Irving and S. Kuehner, *UWS*) This fresh specimen has an orthocumulate texture with ~15 vol.% lath-like, birefringent plagioclase occurring interstitially to more abundant and coarser grained (0.2-1.6 mm, mean 0.7 mm) mafic silicate grains (unzoned olivine and patchily zoned low-Ca and high-Ca clinopyroxene with very limited compositional variation). Accessory phases include Mg-merrillite, chlorapatite, ilmenite, Ti-rich chromite, Cr-rich chromite and pyrrhotite (some associated with minor pentlandite). Levels of shock are judged to be low, based on the absence of optical effects in plagioclase and the complete lack of any conversion to maskelynite; the presence of widespread microcracks in mafic silicates is the only clear evidence of shock.
Geochemistry: Olivine ($Fa_{32.7-34.3}$, FeO/MnO = 47-48, N = 4), pigeonite ($Fs_{25.0-30.4}Wo_{5.5-10.0}$, FeO/MnO = 28-30, N = 4), subcalcic augite ($Fs_{17.1-18.1}Wo_{32.7-32.4}$, FeO/MnO = 23-25, N = 2), aluminous augite inclusion in olivine ($Fs_{17.1}Wo_{39.5}$, FeO/MnO = 28, TiO_2 = 1.1 wt.%, Al_2O_3 = 6.2 wt.%), plagioclase ($An_{43.0-57.8}Or_{2.4-1.3}$, N = 3). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ 2.907, 2.635, 2.808; $\delta^{18}O$ 5.092, 4.620, 4.875; $\Delta^{17}O$ 0.218, 0.195, 0.234 per mil.
Classification: Martian (shergottite, olivine gabbroic, orthocumulate, low shock).
Specimens: 22.4 g including one polished thin section at *UWB*; remainder held jointly by Naji Ben Faraji and Mohamed Brahim Sueilem.

Northwest Africa 12243 (NWA 12243)
Mauritania

Purchased: 2018 May
Classification: HED achondrite (Eucrite, polymict)
History: Found in Mauritania and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh breccia specimen consisting of larger angular mineral clasts derived mostly from gabbroic eucrites in a finer matrix of the same phases. Minerals are exsolved pigeonite, anorthite, silica polymorph, unexsolved ferroan pigeonite, minor (<10 vol.%) diogenitic orthopyroxene, olivine, ilmenite, chromite and troilite.
Geochemistry: Diogenitic orthopyroxene ($Fs_{27.9\text{-}29.0}Wo_{2.1\text{-}3.6}$, FeO/MnO = 27-28, N = 2), olivine ($Fa_{42.3\text{-}51.0}$, FeO/MnO = 50, N = 2), low-Ca pyroxene host in exsolved pigeonite ($Fs_{43.5\text{-}45.9}Wo_{2.6\text{-}5.5}$, FeO/MnO = 27-34, N = 2), clinopyroxene exsolution lamella ($Fs_{17.7}Wo_{44.2}$, FeO/MnO = 26), subcalcic augite ($Fs_{62.5}Wo_{26.0}$ FeO/MnO = 34), anorthite ($An_{91.5\text{-}93.9}Or_{0.6\text{-}0.5}$, N = 2).
Classification: Eucrite (polymict breccia).
Specimens: 20.1 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12244 (NWA 12244)
Morocco
Purchased: 2018 May
Classification: Ordinary chondrite (LL3)
History: Found near Bir Lahlou, Western Sahara, and purchased by *DPitt* in May 2018 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed, well-formed chondrules (apparent diameter 780 ± 630 μm, N = 21) are set in a sparse finer grained matrix.
Geochemistry: Olivine ($Fa_{0.3\text{-}49.1}$, Cr_2O_3 in ferroan examples 0.07-0.10 wt.%, mean 0.09±0.01 wt.%, N = 8), orthopyroxene ($Fs_{2.3\text{-}25.2}Wo_{0.5\text{-}3.8}$, N = 3), pigeonite ($Fs_{18.0}Wo_{14.6}$), subcalcic augite ($Fs_{23.7}Wo_{22.4}$). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.80.
Classification: Ordinary chondrite (LL3).
Specimens: 25.6 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12245 (NWA 12245)
(Northwest Africa)
Purchased: 2018 Apr
Classification: HED achondrite (Diogenite)
History: Purchased by Fred *Olsen* in April 2018 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of angular grains of orthopyroxene (exhibiting undulose extinction and containing sparse exsolution lamellae of clinopyroxene), anorthite (~15 vol.%,

polycrystalline), silica polymorph, chromite, troilite and Ni-free metal. Some composite clasts containing both orthopyroxene and anorthite are present, as well as pockets composed of radially-quenched shock melt.
Geochemistry: Orthopyroxene host ($Fs_{34.0-34.1}Wo_{2.3-2.8}$, FeO/MnO = 27-29, N = 3), clinopyroxene exsolution lamellae ($Fs_{14.3-15.6}Wo_{44.4-42.8}$, FeO/MnO = 24-25, N = 2), anorthite ($An_{94.0-95.1}Or_{0.4-0.3}$, N = 2).
Classification: Diogenite (noritic breccia, shocked).
Specimens: 16.32 g including one polished thin section at *UWB*; remainder with the estate of Mr. F. *Olsen* managed by D. Baldwin.

Northwest Africa 12246 (NWA 12246)
Morocco
Purchased: 2018 May
Classification: HED achondrite (Eucrite, unbrecciated)
History: Found near Bir Tighisit, southern Morocco and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh gabbroic eucrite composed mostly of zoned low-Ca and high-Ca pyroxene (grainsize up to 1.5 mm) and anorthite (as interstitial stubby laths) with accessory silica polymorph, fayalite, ilmenite, chromite and troilite.
Geochemistry: Low-Ca pyroxene cores ($Fs_{30.2-30.7}Wo_{5.8-6.1}$, FeO/MnO = 26-27, N = 2), orthopyroxene rims ($Fs_{57.2-62.8}Wo_{3.9-2.1}$, FeO/MnO = 33-34, N = 2), subcalcic augite ($Fs_{39.2}Wo_{30.3}$; $Fs_{45.7}Wo_{23.4}$; FeO/MnO = 31, N = 2), fayalite ($Fa_{80.5-82.6}$, FeO/MnO = 39-41), anorthite ($An_{91.4-92.1}Or_{0.6-0.8}$, N = 2).
Classification: Eucrite (unbrecciated, gabbroic).
Specimens: 21.1 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12247 (NWA 12247)
Algeria
Purchased: 2018 May
Classification: Carbonaceous chondrite (CV3)
History: Found in Algeria and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter 900±350 μm, N = 21; some rimmed) and fine grained CAI are set in a fine grained matrix (~30 vol.%, orange-brown in thin section) containing minor calcite and barite.
Geochemistry: Olivine ($Fa_{0.3-37.3}$, N = 3), orthopyroxene ($Fs_{0.7-1.2}Wo_{0.8-0.7}$, N = 3), augite ($Fs_{5.0}Wo_{39.8}$; $Fs_{47.9}Wo_{50.1}$; N = 2).
Classification: Carbonaceous chondrite (CV3).
Specimens: 15.8 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12248 (NWA 12248)
Mauritania
Purchased: 2018 May
Classification: Lunar meteorite (feldspathic breccia)
History: Found in Mauritania and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.
Physical characteristics: A small (37.3 g) dark stone lacking fusion crust but coated by a shiny desert patina. The fresh interior conatins small white and beige clasts set in a dark-gray matrix.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of mineral clasts of anorthite, olivine, low-Ca pyroxenes, augite, ilmenite and troilite in a fine grained matrix containing Ni-poor metal and minor barite.
Geochemistry: Olivine ($Fa_{44.5}$, FeO/MnO = 105; $Fa_{13.1}$, FeO/MnO = 54; N = 2), low-Ca pyroxene ($Fs_{38.2}Wo_{4.5}$, FeO/MnO = 59), pigeonite ($Fs_{32.0\text{-}32.5}Wo_{14.6\text{-}9.7}$, FeO/MnO = 55-62, N = 2), augite ($Fs_{22.4}Wo_{43.1}$, FeO/MnO = 51), anorthite ($An_{94.3\text{-}95.9}Or_{0.2}$, N = 2).
Classification: Lunar (feldspathic breccia).
Specimens: 9.5 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12250 (NWA 12250)
(Northwest Africa)
Purchased: 2018 May
Classification: HED achondrite (Howardite)
History: Found in Algeria and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed mainly of mineral clasts derived from gabbroic eucrites, rare lithic clasts of gabbroic eucrite, and ~15 vol.% diogenitic orthopyroxene (~15 vol.%) in a finer grained matrix of related debris. Other minerals are olivine, exsolved pigeonite, unexsolved pigeonite, subcalcic augite, calcic plagioclase, ilmenite and troilite.
Geochemistry: Diogenitic orthopyroxene ($Fs_{16.0\text{-}18.3}Wo_{1.3\text{-}1.5}$, FeO/MnO = 29-31, N = 2), olivine ($Fa_{52.0\text{-}57.1}$, FeO/MnO = 47-50, N = 2), orthopyroxene host in exsolved pigeonite ($Fs_{54.3}Wo_{1.1}$; $Fs_{61.7}Wo_{1.4}$; FeO/MnO = 28-29; N = 2), pigeonite ($Fs_{58.0}Wo_{15.1}$, FeO/MnO = 34), subcalcic augite ($Fs_{55.6}Wo_{24.6}$ FeO/MnO = 30), plagioclase ($An_{82.0\text{-}89.4}Or_{0.9\text{-}0.3}$, N = 2).
Classification: Howardite.
Specimens: 12.2 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12262 (NWA 12262)

(Northwest Africa)
Purchased: 2018 Jul
Classification: Martian meteorite (Shergottite)
History: Purchased in Ouarzazate, Morocco by Mohamed Aid in July 2018.
Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Medium-grained with diabasic texture and some small, dark glassy shock melt pockets. Composed predominantly of zoned clinopyroxene and maskelynite with accessory fine grained intergrowths of hedenbergite+fayalite+silica, Fe-Ti oxide (finely exsolved), merrillite and pyrrhotite.
Geochemistry: Subcalcic augite ($Fs_{28.5-30.6}Wo_{28.2-23.7}$, FeO/MnO = 30, N = 2), pigeonite ($Fs_{41.3}Wo_{15.5}$, FeO/MnO = 31), ferropigeonite ($Fs_{71.1-83.4}Wo_{17.1-11.3}$, FeO/MnO = 38-45, N = 4), maskelynite ($An_{50.9-52.1}Or_{2.1}$, N = 2).
Classification: Martian (shergottite, diabasic)
Specimens: 26.3 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12265 (NWA 12265)
(Northwest Africa)
Purchased: 2015 Jan
Classification: HED achondrite (Eucrite, melt breccia)
History: Purchased in Rissani, Morocco by Adam *Aaronson* in January 2015.
Petrography: (A. Irving and S. Kuehner, *UWS*) Composed predominantly of a vesicular quenched melt rock lithology enclosing sparse remnant clasts of shocked gabbroic eucrite. The fine grained melt rock lithology consists of aluminous pigeonite (with two distinct Fe/Mg ratios) and calcic plagioclase with accessory Ti-poor chromite, Cr-ulvöspinel and troilite. Gabbroic eucrite clasts contain recrystallized pigeonite and polycrystalline calcic plagioclase with minor fayalite, silica polymorph, Ti-poor chromite, Ti-chromite, trolite and minor barite.
Geochemistry: Pigeonite ($Fs_{31.2-38.4}Wo_{12.0-17.1}$, FeO/MnO = 26-28, Al_2O_3 = 2.3-5.7 wt.%, N = 3), ferroan pigeonite ($Fs_{56.6-58.7}Wo_{16.8-19.6}$, FeO/MnO = 32-33, Al_2O_3 = 0.8-1.1 wt.%), fayalite ($Fa_{80.4-80.8}$, FeO/MnO = 45-47, N = 2), plagioclase ($An_{88.0-89.9}Or_{0.4-0.8}$, N = 2).
Classification: Eucrite (vesicular, shock-melted breccia).
Specimens: 20.6 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12267 (NWA 12267)
(Northwest Africa)
Purchased: 2018 Jun
Classification: HED achondrite (Diogenite)
History: Purchased by Craig Zlimen in June 2018 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed predominantly of larger and smaller angular clasts of orthopyroxene with accessory

chromite, Ti-chromite, calcic plagioclase, troilite and rare olivine (as inclusions in orthopyroxene). Some cross-cutting veinlets of goethite are present.
Geochemistry: Orthopyroxene ($Fs_{22.8-28.5}Wo_{2.9-1.3}$, FeO/MnO = 27-31, N = 3), plagioclase ($An_{83.4}Or_{1.1}$; $An_{96.3}Or_{0.1}$; N = 2), olivine ($Fa_{22.6}$, FeO/MnO = 49).
Classification: Diogenite (breccia).
Specimens: 18.1 g including one polished thin section at *UWB*; remainder with Mr. C. Zlimen.

Northwest Africa 12268 (NWA 12268)
(Northwest Africa)
Purchased: 2018 Jun
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Craig Zlimen in June 2018 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed granular chondrules (apparent diameter 950 ± 450 μm, N = 22) plus amoeboid to irregular, fine grained CAI are set in a very fine grained matrix (~30 vol.%, black in thin section).
Geochemistry: Olivine ($Fa_{0.8-53.0}$, N = 6), orthopyroxene ($Fs_{0.7-2.4}Wo_{1.0-1.2}$, N = 2), clinopyroxene ($Fs_{1.0-1.7}Wo_{37.9-38.3}$, N = 2).
Classification: Carbonaceous chondrite (CV3).
Specimens: 24.5 g including one polished thin section at *UWB*; remainder with Mr. C. Zlimen.

Northwest Africa 12269 (NWA 12269)
(Northwest Africa)
Purchased: 2018 Jul
Classification: Martian meteorite (Shergottite)
History: Purchased in Ouarzazate, Morocco by Mohamed Aid in July 2018.
Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Relatively fine grained with intersertal texture. Composed predominantly of zoned clinopyroxene and maskelynite (some exhibiting a curved, narrow lath-like habit) with accessory fine grained intergrowths of hedenbergite+fayalite+silica, Fe-Ti oxides, merrillite and pyrrhotite.
Geochemistry: Subcalcic augite ($Fs_{24.8-41.8}Wo_{31.4-24.3}$, FeO/MnO = 30-33, N = 3), ferropigeonite ($Fs_{66.9-73.0}Wo_{16.6-16.5}$, FeO/MnO = 41-43, N = 2), maskelynite ($An_{51.9-53.1}Or_{1.3-1.2}$, N = 2).
Classification: Martian (shergottite, fine-intersertal)
Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. Aaronson.

Northwest Africa 12270 (NWA 12270)
Mauritania

Purchased: 2018
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased by Terry *Boudreaux* from a meteorite dealer in Mauritania.
Physical characteristics: Six identically appearing pieces, no fusion crust, saw cut reveals a fragmental breccia with numerous white feldspathic clasts set in a dark gray ground mass.
Petrography: (C. Agee, *UNM*) This meteorite consists of primarily of fragmental pyroxene, olivine, feldspathic clasts and shock melt. Ubiquitous Ti-rich chromite and ilmenite present, rare Fe-Ni metal detected.
Geochemistry: (C. Agee, *UNM*) olivine $Fa_{42.7\pm7.3}$, Fe/Mn=94±9, n=14; pigeonite $Fs_{37.0\pm8.0}Wo_{17.9\pm6.9}$, Fe/Mn=56±5, n=13; plagioclase $An_{96.6\pm0.4}$, n=6; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): SiO_2=44.8±1.3, TiO_2=0.31±0.08, Al_2O_3=26.0±3.9, Cr_2O_3=0.15±0.09, MgO=5.0±2.2, FeO=5.9±1.7, MnO=0.08±0.03, CaO=16.1±1.8, NiO=0.02±0.01, Na_2O=0.44±0.07, K_2O=0.08±0.01 (all wt%), n=7.
Classification: Lunar feldspathic breccia
Specimens: 29.2 g including a probe mount on deposit at *UNM*,
Terry *Boudreaux* holds the main mass.

Northwest Africa 12271 (NWA 12271)
(Northwest Africa)
Purchased: 2018
Classification: Ureilite
History: Purchased in Guelmim, Morocco, July 2018.
Physical characteristics: Single stone; sandblasted exterior; saw cut reveals an interior mosaic of brown crystals; minor amount iron-staining present.
Petrography: (C. Agee, *UNM*) This meteorite consists of olivine, pigeonite, and augite. Ubiquitous graphite throughout. Fine grained Fe-metal is present along grain boundaries.
Geochemistry: (C. Agee) olivine $Fa_{20.8\pm0.1}$, Fe/Mn=44±1, n=7; pigeonite $Fs_{17.4\pm0.2}Wo_{4.3\pm0.2}$, Fe/Mn=27±2, n=5; augite $Fs_{10.9\pm0.1}Wo_{34.5\pm0.1}$, Fe/Mn=19±0, n=2.
Classification: Augite and graphite-bearing ureilite
Specimens: 20.2 g including a probe mount on deposit at *UNM*, Zouhair Fettouh holds the main mass.

Northwest Africa 12272 (NWA 12272)
(Northwest Africa)
Purchased: 2017 Oct
Classification: Ordinary chondrite (LL7)
Petrography: (K. Metzler, *IfP*) Unbrecciated ordinary chondrite with distinct recrystallization texture. Large areas of secondary feldspar grains (many with sizes >100 μm) which poikilitically enclose olivine and pyroxene grains. Many plagioclase grains with rectangular outlines due to the alignement along boundaries

of recrystallized pyroxene crystals. Some metal veins up to 4 mm are observed. The outlines of a few large chondrules are still dimly visible.
Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{29.9\pm0.3}$ (29.1-30.5); n=14. The mean low-Ca pyroxene composition is $Fs_{23.9\pm0.4}Wo_{4.1\pm0.3}$ ($Fs_{23.3\text{-}24.4}Wo_{3.6\text{-}4.5}$), n=14; Mean CaO concentration in low-Ca pyroxene: 2.1±0.2 (1.9-2.3) wt%. The mean composition of Ca-rich pyroxene is $Fs_{12.8\pm0.9}Wo_{38.5\pm1.9}$ ($Fs_{10.8\text{-}13.9}Wo_{36.7\text{-}41.9}$), n=16.
Classification: LL chondrite based on mineral chemistry. Petrologic type 7 based on the equilibrated state of olivine and pyroxene, and large grain size of secondary plagioclase. According to Tait et al. (2014) the transition between types 6 and 7 is a CaO concentration in low-Ca pyroxene of 1.0 wt%; in this sample the respective value is 2.1 wt%. According to Brearley and Jones (1998) Ca-rich pyroxene in type 6 chondrites has a Wo value of 45 mol%, which decreases in type 7 chondrites to 45-36 mol%. In this sample the respective value is 38.5 mol%.

Northwest Africa 12273 (NWA 12273)
(Northwest Africa)
Purchased: 2018
Classification: Ungrouped chondrite
History: Purchased by Jay Piatek from a Moroccan meteorite dealer on October 25, 2018.
Physical characteristics: Dense, single individual. Fusion crust absent; abundant bright metal; scattered small chondrules are visible.
Petrography: (C. Agee, *UNM*) This meteorite consists of approximately 75% metal in the form of kamacite (~90%) and taenite (~10%) grains, diameters ranging from 50-500 μm. Minor troilite was observed throughout. Silicates occur primarily in the form of chondrules, most are porphyritic, diameters in the range 100-500 μm, making up approximately 20% of this meteorite.
Geochemistry: (C. Agee) Olivine $Fa_{26.2\pm3.3}$, Fe/Mn=55±5, n=29; low-Ca pyroxene $Fs_{15.3\pm1.8}Wo_{0.7.\pm0.2}$, Fe/Mn=23±2, n=11. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$= 5.258, 5.613, 7.249; $\delta^{17}O$= 3.939, 3.971, 4.786; $\Delta^{17}O$= 1.163, 1.007, 0.959 (linearized, all per mil, TFL slope=0.528).
Classification: Ungrouped chondrite. This is a metal-rich chondrite with oxygen isotopes that overlap with LL-chondrites. The olivine Fa content is consistent with L3, however the low-Ca pyroxene Fs is consistent with H4. The high metal content is inconsistent with ordinary chondrite. Texturally, this meteorite resembles a CB-b, however the oxygen isotopes and Fa and Fs are unlike CB chondrites.
Specimens: 23.2 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass of 240 g.

Northwest Africa 12279 (NWA 12279)
Tindouf, Algeria

Find: 2016 Oct 10
Classification: Lunar meteorite (feldspathic breccia)

History: The meteorite was purchased in Denver USA by Zhouping Guo and Guobing Zhong on September, 2017 from Adam *Aaronson*.

Physical characteristics: A single bulk specimen, with sepia fresh fusion crust and low weathering degree. A large impact molten mass was observed in the specimen.

Petrography: This lunar meteorite comprises two petrographic areas: impact melt breccia and anorthosite. The anorthosite includes forsterite, pigeonite, low-Ca pyroxene, plagioclase and minor minerals such as ilmenite, chromite, quartz and other opaque minerals. It has a subophitic structure. The impact-melt breccia contains various types of lithic clasts (anorthosite, olivine-gabbro, gabbro), mineral and glassy fragments. The matrix consists of very fine-grained, cryptocrystalline (~0.1mm) and vitric particles with sporadic small vesicles.

Geochemistry (JK. Zhou, HY. Chen, ZP. Xia *GUT*): Olivine, $Fa_{12.8\text{-}46.3}Fo_{53.8\text{-}87.3}$, FeO/MnO=66.3-96.9 (n=29); Orthopyroxene, $Fs_{15.5\text{-}32.2}Wo_{2.98\text{-}4.22}En_{64.9\text{-}80.3}$, Fe/Mn(mol)=54.5-69.3 (n=3); Pigeonite: $Fs_{23.2\text{-}53.1}Wo_{7.19\text{-}23.7}En_{39.8\text{-}57.4}$, Fe/Mn(mol)=51.1-61.7 (n=6); Augite, $Fs_{8.42\text{-}44.4}Wo_{31.4\text{-}44.1}En_{18.7\text{-}47.5}$, Fe/Mn(mol)=37.1-53.9 (n=14); Plagioclase: $An_{92.9\text{-}98.5}Or_{0.06\text{-}0.69}$ (n=15); Spinel: MgO, 20.1%-23.6%; Al_2O_3, 59.5%-69.2%; Cr_2O_3, 3.91%-6.00%; FeO,6.05%-7.46%.

Classification: Lunar (anorthositic impact-melt breccia)

Specimens: 30.2 g including one polished thin section are deposited in *GUT*; Remaining material with Guobing Zhong and Zhouping Guo.

Northwest Africa 12280 (NWA 12280)
Tindouf, Algeria
Find: 2016 Oct 10
Classification: Martian meteorite (Shergottite)

History: The meteorite was purchased in Denver USA by Zhouping Guo and Guobing Zhong on September, 2017 from Adam *Aaronson*.

Physical characteristics: A single bulk specimen, no fusion crust. Coarse-grained absinthe-green minerals can be observed. Weathering is strong.

Petrography: This meteorite is composed of a moderate-grained (20-100 μm) assemblage of pyroxene (38 vol%), olivine (51 vol%), maskelynite (7 vol%) and minor opaque minerals such as ilmenite, chromite and spinel. Maskelynite appears to be injected between pyroxene and olivine crysts.

Geochemistry (JK. Zhou, HY. Chen, ZP. Xia *GUT*): olivine: $Fa_{35.2\text{-}37.3}$ (n=42), Fe/Mn(mol)=48.3-53.3 (n=42) ; pigeonite: $Fs_{18.8\text{-}28.2}Wo_{6.50\text{-}15.4}En_{56.8\text{-}68.6}$, Fe/Mn(mol)=24.5-30.0, Mg#=67.1-73.8 (n=15); augite: $Fs_{13.9\text{-}20.4}Wo_{26.4\text{-}43.3}En_{42.8\text{-}53.3}$, Fe/Mn(mol)=23.6-30.0, Mg#=70.9-73.3 (n=20); Maskelynite: $An_{49.5\text{-}59.9}Or_{2.29\text{-}3.62}Ab_{36.9\text{-}46.9}$ (n=17); Spinel: MgO, 2.85%-4.15%; Al_2O_3, 4.08%-7.17%; TiO_2,12.6%-19.6%; Cr_2O_3,20.1%-31.7%; FeO,44.3%-52.8%.

Classification: Martian (shergottite)

Specimens: 18.5 g including one polished thin section are deposited in *GUT*; Remaining material 60.5 g with Guobing Zhong and Zhouping Guo.

Northwest Africa 12281 (NWA 12281)
(Northwest Africa)
Purchased: 2013
Classification: Ordinary chondrite (LL3)
History: Acquired from Ruben Garcia from 2013 Tucson Gem and Mineral Show.
Physical characteristics: Sub-rounded, 30.6 g meteorite partially covered in fusion crust. Interior is dominantly light colored with well-developed chondrules and mineral fragments supported by a sparse dark matrix. Metals and sulfides fine-grained. Weathering is heterogeneous and is dominantly W1 with patches of W3.
Petrography: (Bercovici, H., Dolinschi, J., Dunham, E., Franco, G., Garani, J., Loescher, G., *ASU*): Visually, the meteorite is estimated to be 80% chondrules and fragments, 16% matrix, and 3% opaques. Chondrules typically 0.2 to 1.5 mm in diameter, with an estimated mean of 0.8 mm. Range of chondrules types present including PP, PO, POP, BO, and RP. Some PO chondrules contain purple (plane polarized light) glass. Several chondrules are mantled by sulfides with minor metal. The largest chondrule (9 × 5 mm) is composed of a barred olivine core, PO mantle, and porphyritic low-Ca pyroxene rim. Another chondrule (3 × 4 mm troilite-mantled PO) contains euhedral olivine phenocrysts that have a comb-like overgrowth of olivine (with different BSE brightness) protruding into the devitrified mesostatis. Sulfide is more abundant than metal. Metal and troilite occur in three settings: fine-grained and dispersed in the matrix; rounded grains to 100 microns; and rarely as nodules. The largest nodule (1.5 × 1 mm) consists of a troilite with rounded grains of kamacite. This nodule contains a few grains (to 20 μm) of native copper. Troilite is polycrystalline with occasional shock twins. Shock grade consistent with S2 and weathering with W2/3.
Geochemistry: Olivine $Fa_{20.0\pm6.2}$, range $Fa_{12.0\text{-}29.9.}$ Cr_2O_3 in olivine grain cores is 0.62±0.07, range 0.46-0.69, n=10. Low-Ca pyroxene $Fs_{15.7\pm7.8}Wo_{1.4\pm1.2}$, range $Fs_{1.9\text{-}33.7}Wo_{0.2\text{-}4.8}$, n=49. High-Ca pyroxene $Fs_{17.4\pm8.6}$ $Wo_{16.1\pm9.5}$, range $Fs_{11.0\text{-}42.1}Wo_{5.1\text{-}41.2}$, n = 18. Feldspar grains, found in only one chondrule, are $An_{97.9\pm2.5}Ab_{2.1\pm2.5}$, ranging $An_{95.1\text{-}100.0}Ab_{0.0\text{-}4.8}$, n=3. Metal compositions in wt% are Fe78.46±14.98Ni21.14±14.91Co0.40±0.14 n=5.
Classification: LL based on he low metal content. Estimated petrologic type of 3.4 based on Fa and Fs spread and Cr_2O_3 content in olivine grain cores.

Northwest Africa 12282 (NWA 12282)
(Northwest Africa)
Find: 2016
Classification: HED achondrite (Eucrite, polymict)
History: Purchased by Michael Farmer from a Moroccan meteorite dealer at the 2016 Tucson Gem and Mineral show.

Physical characteristics: Sand-blasted, angular, orange-stained 141.5 g meteorite with patches of fusion crust. Light-colored clasts to 8 mm readily visible at the surface of the stone and supported by a gray matrix. Fresh stone with low weathering.
Petrography: (Dillon, S., Dunham, E., Fitch, R., Karageozian, M., Sedler, M., Teichert, Z., *ASU*): The meteorite is a breccia dominated by angular to sub-rounded grains and clasts to 8 mm. The petrography is based on two slices (4 × 3 cm and 4 × 4 cm), and a polished mount. The 4 × 3 cm slice is light colored with angular to sub-angular clasts to 4 mm in a poorly sorted clastic matrix dominated by pyroxene and plagioclase. The 4 × 4 cm slice is petrographically more varied with a range of clast textures (subophitic, diabasic, granulitic) supported by the eucritic debris. This slice has a prominent 6 × 5 mm subangular fine-grained dark clast containing a 3-mm spherical fine-grained clast with similar mineralogy as the bulk eucrite. Accessory minerals include silica, troilite, chromite, and ilmenite. The majority of the pyroxene grains exhibit exsolution lamellae. Plagioclase shows extensive twinning. Pyroxene grains are primarily Ca-poor pyroxene with Ca-rich pyroxene present in exsolution lamellae. Plagioclase grains are primarily anorthite rich end members. The sample has a low shock grade; one melt clast within a pyroxene clast is present and is potentially representative of a previous higher-stage shock event.
Geochemistry: Pyroxene without exsolution lamellae is pigeonite $Fs_{52.6\pm4.4}Wo_{10.4\pm5.6}$, range $Fs_{43.7\text{-}55.8}Wo_{6.5\text{-}22.0}$, FeO/MnO=33.2±2.2, n=8. Pyroxene with exsolution lamellae is predominantly clinopyroxene $Fs_{57.2\pm0.7}Wo_{4.4\pm0.9}$, range $Fs_{55.8\text{-}58.2}Wo_{2.7\text{-}5.4}$, FeO/MnO=33.0±2.1, n=12, the lamellae are orthopyroxene $Fs_{27.3\pm0.9}Wo_{41.9\pm0.7}$, range $Fs_{26.3\text{-}28.8}Wo_{40.7\text{-}42.8}$, FeO/MnO=34.1±1.7, n=8. Plagioclase has composition $An_{88.5\pm6.0}$, n = 18.
Specimens: An original mass of 141.5 g was acquired by *MFarmer*; 21.99 g and one thin section is held by *ASU*. The main mass is held by Michael Farmer.

Northwest Africa 12283 (NWA 12283)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Agadir, Morocco.
Physical characteristics: Grayish fragments without fusion crust.
Petrography: The meteorite is a brecciated medium-grained basalt predominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase with average grains sizes of about 500 μm. Minor phases include silica, ilmenite, chromite, and troilite. No metallic iron has been detected.
Geochemistry: low-Ca pyroxene: $Fs_{60.3\pm0.5}Wo_{2.4\pm0.7}$ ($Fs_{59.3\text{-}60.9}Wo_{1.8\text{-}4.0}$, n=12, FeO/MnO=31-34); Ca-pyroxene: $Fs_{26.7\pm0.4}Wo_{43.4\pm0.7}$ ($Fs_{25.7\text{-}27.4}Wo_{41.7\text{-}44.0}$, n=12, FeO/MnO=29-33); calcic plagioclase: $An_{89.9\pm2.1}$ ($An_{86.4\text{-}92.5}$, n=12)

Northwest Africa 12284 (NWA 12284)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Brownish fragments without fusion crust.
Petrography: The meteorite displays a chondritic texture with mostly rounded chondrules (mean diameter about 0.7 mm) in a fine-grained brownish and strongly altered matrix that contains sulfides and rare FeNi metal.
Classification: LL based on magnetic susceptibility.

Northwest Africa 12285 (NWA 12285)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish individual without fusion crust.
Petrography: The meteorite displays a chondritic texture with mostly rounded and well packed chondrules (mean diameter about 0.6 mm) in a more fine-grained dark matrix that contains sulfides and FeNi metal.

Northwest Africa 12286 (NWA 12286)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CK5)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Grayish to slightly greenish individual lacking any fusion crust.
Petrography: The meteorite displays a greyish to greenish interior and is predominantly composed of recrystallized Fe-rich olivine dominated matrix with scattered well defined chondrules. Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, Ca-pyroxene and troilite; metal was not detected.
Geochemistry: olivine: $Fa_{29.9\pm0.5}$, n=14, FeO/MnO=110.5±8.4; low-Ca pyroxene: $Fs_{25.7\pm0.3}Wo_{0.8\pm0.1}$, n=3; Ca-pyroxene: $Fs_{7.0\pm0.4}Wo_{47.5\pm0.3}$, n=3

Northwest Africa 12287 (NWA 12287)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.

Physical characteristics: Dark grayish individual without fusion crust.
Petrography: Brecciated carbonaceous chondrite composed of small chondrules (mean diameter about 230 μm), CAIs, and mineral fragments most of which are surrounded by fine-grained dust rims. The matrix is Fe-rich and contains abundant sulfides, calcite and phyllosilicates.

Northwest Africa 12288 (NWA 12288)
(Northwest Africa)
Purchased: 2017
Classification: Pallasite
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Many up to 1 cm sized brownish fragments without fusion crust.
Petrography: The meteorite is composed of about 5 mm sized subrounded olivine grains surrounded by a matrix of partly layered brownish iron oxides or hydroxides. No pristine FeNi-metal has been found in the two fragments studied.
Geochemistry: olivine: $Fa_{12.6\text{-}13.2}$, FeO/MnO: 38-48

Northwest Africa 12289 (NWA 12289)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L5, melt breccia)
History: The meteorite was purchased from a local meteorite dealer in Errachidia, Morocco.
Physical characteristics: Brownish individual without fusion crust.
Petrography: The meteorite is a melt breccia composed of abundant recrystallized shock melt regions with characteristic FeNi metal and sulfide globules and embedded relict mineral fragments and some preserved chondrules. In chondritic portions olivine and low-Ca pyroxene are compositionally equilibrated and the plagioclase grain size is about 30 μm.

Northwest Africa 12290 (NWA 12290)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Layaoune, Morocco.
Physical characteristics: Brownish individual without fusion crust.
Petrography: The meteorite is an unbrecciated medium-grained basalt predominantly composed of exsolved pyroxene and mostly lath-shaped calcic plagioclase with average grains sizes of about 400 μm. Minor phases include silica, ilmenite, chromite, troilite, barite, and zircon. No metallic iron has been detected.

The meteorite is strongly shock metamorphosed and crosscut by several shock melt veins. All plagioclase has been transformed into maskelynite.
Geochemistry: low-Ca pyroxene: $Fs_{60.3\pm0.7}Wo_{2.6\pm0.8}$ ($Fs_{58.2\text{-}61.1}Wo_{2.1\text{-}5.3}$, n=16, FeO/MnO=31-35); Ca-pyroxene: $Fs_{26.3\pm1.0}Wo_{42.9\pm1.3}$ ($Fs_{25.2\text{-}29.4}Wo_{39.1\text{-}44.1}$, n=14, FeO/MnO=28-37); calcic plagioclase: $An_{89.3\pm1.0}$ ($An_{88.1\text{-}90.7}$, n=14)

Northwest Africa 12291 (NWA 12291)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL3)
History: The meteorite was purchased from a local meteorite dealer in Layaoune, Morocco.
Physical characteristics: Two brownish fragments with some fusion crust.
Petrography: The meteorite shows a chondritic texture with sharply defined, mostly flattened and well packed chondrules (mean diameter about 0.9 mm) in a fine-grained matrix, that contains sulfides and FeNi metal.

Northwest Africa 12293 (NWA 12293)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Layaoune, Morocco.
Physical characteristics: Grayish individual with some fusion crust.
Petrography: Unbrecciated coarse-grained basalt predominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase with average grains sizes of about 1 mm. Minor phases include silica, ilmenite, chromite, and barite. No metallic iron has been detected. The meteorite contains abundant shock melt veins and pockets.
Geochemistry: low-Ca pyroxene: $Fs_{60.3\pm0.7}Wo_{2.1\pm0.2}$ ($Fs_{59.1\text{-}61.3}Wo_{1.7\text{-}2.6}$, n=14, FeO/MnO=29-33); Ca-pyroxene: $Fs_{26.4\pm0.3}Wo_{42.8\pm0.5}$ ($Fs_{25.8\text{-}26.8}Wo_{41.9\text{-}43.6}$, n=15, FeO/MnO=28-32); calcic plagioclase: $An_{90.5\pm0.4}$ ($An_{89.8\text{-}91.4}$, n=15)

Northwest Africa 12297 (NWA 12297)
(Northwest Africa)
Purchased: 2015
Classification: Ordinary chondrite (L~5)
History: (Ziyao Wang) Purchased by Wang Ziyao from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2015
Physical characteristics: (Wang Ziyao) Black 110.5 g stone with dark black-brown fusion crust

Petrography: (R. Bartoschewitz, *Bart*) Light-gray recrystallized matrix with well recognizable lighter chondrules (0.5-1.6 mm, av. 0.8 mm) and irregular metal and sulphide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 5.06
Classification: Ordinary chondrite (L~5, W0)
Specimens: 20.1 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 4.5 g with *Bart*.

Northwest Africa 12298 (NWA 12298)
(Northwest Africa)
Purchased: 2015
Classification: Ordinary chondrite (LL6)
History: (Ziyao Wang) Purchased by Wang Ziyao from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2015
Physical characteristics: (Wang Ziyao) 87.6 g Partly with fresh black fusion crust coverd gray-blue elongated stone.
Petrography: (R. Bartoschewitz, *Bart*) brecciated texture of light gray recrystallized matrix with poor developed chondrules up to 1.2 mm, mineral fragments, tiny sulphide grains that somtimes build larger assemblages, and few metal specks up to 0.5 mm.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 3.49
Classification: Ordinary chondrite (LL~6, W0)
Specimens: 18.2 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 19 g with *Bart*.

Northwest Africa 12299 (NWA 12299)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (H~6)
History: (Ziyao Wang) Purchased by Wang Ziyao from Fayssal Mezgouri during the China (Hubei) Mineral & Gem Show in Huangshi City in Sept 2018.
Physical characteristics: (Wang Ziyao) A red-purple stone of 4500 grams with some fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) Gray recrystallized matrix with poor developed chondrules (0.2-0.8 mm, av. 0.4 mm), and much homogenous distributed irregular metal and sulphide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 5.39
Classification: Ordinary chondrite (H~6, W0)
Specimens: 20.8 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 131 g with *Bart*.

Northwest Africa 12300 (NWA 12300)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Wang Ziyao from Sadam Sbai during the China (Hunan) Mineral & Gem Show in Chenzhou City in May 2018.
Physical characteristics: (Wang Ziyao) Gray-black stone of 273 g, metal bumps are recognizable on the surface.
Petrography: (R. Bartoschewitz, *Bart*) Gray-black recrystallized matrix with poor developed chondrules (0.2-1.4 mm, av. 0.5 mm), irregular shaped metal and sulphide grains (<0.1-1.5 mm).
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.12
Classification: Ordinary chondrite (H~5, W1)
Specimens: 21.2 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 38 g with *Bart*.

Northwest Africa 12301 (NWA 12301)
(Northwest Africa)
Purchased: 2017 Apr
Classification: Ordinary chondrite (L5)
History: Discovered by an anonymous person and purchased in Erfoud in April 2017
Physical characteristics: One brown stone with regmaglypts. Cut face shows tiny metal specks.
Petrography: (R. Bartoschewitz, *Bart*) Microscopic examination of a thin section shows recrystallized and shocked matrix: mosaicism and planar fractures in olivine, undolatory extinction in plagioclase. Chondrules poor developed. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.04.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{24.3\pm0}$,9 (n=32); pyroxene $Fs_{20.4\pm1.2}$ $Wo_{1.5\pm0.2}$ (n=19); Ca-pyroxene $Fs_{48.8}Wo_{43.1}$ (n=1); feldspar $An_{10.1\pm0.3}Or_{5.9\pm1.2}$ (n=9). Kamacite Ni=2.9-5.3, Co=1.0 wt.-% (n=2). Sulfides: troilite, pyrrhotite, and pyrite.
Classification: Ordinary chondrite (type L5)
Specimens: 20.2 g on deposit at *Kiel*, main mass *Kuntz*.

Northwest Africa 12320 (NWA 12320)
Mauritania
Purchased: 2018 Apr
Classification: Angrite

History: Two large, dark gray stones (2379 g and 1946 g) plus several smaller stones were found together at an unspecified site in Mauritania, and subsequently purchased by Darryl Pitt in April-July 2018 from a dealer in Nouakchott, Mauritania. An additional 14.2 g of the same material (confirmed by electron microprobe analyses) was purchased by Ben Hoefnagels in October 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Diabasic texture (grainsize 0.3-0.5 mm) with sparse vesicles containing partial interior coatings of secondary calcite and barite. Major minerals are zoned calcic olivine (with kirschsteinite rims), zoned Al-Ti-augite and anorthite (with slightly more sodic rims), together with accessory titanomagnetite, troilite and silicoapatite. Sparse xenocrysts of magnesian olivine with more ferroan reaction rims are present.
Geochemistry: Olivine ($Fa_{39.6-79.7}Ln1.7-14.8$, FeO/MnO = 72-96, N = 5), clinopyroxene ($Fs_{20.5-45.9}Wo_{51.6-52.8}$, FeO/MnO = 68-143, TiO_2 = 1.5-4.3 wt.%, Al_2O_3 = 6.9-7.8 wt.%, N = 4), kirschsteinite ($Fa_{57.9-63.3}Ln36.7-34.3$, FeO/MnO = 68-75, N = 2), olivine xenocryst (core $Fa_{13.8}Ln0.6$; rim $Fa_{35.2}Ln1.3$; FeO/MnO = 85-103; N = 2), anorthite (core $An_{99.7}Ab_{0.2}Or_{0.0}$; rim $An_{96.6}Ab_{3.3}Or_{0.1}$; N = 2).
Oxygen isotopes (K. Ziegler, *UNM*) Analyses of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}O$ 2.268, 2.281, 2.339; $\delta^{18}O$ 4.416, 4.407, 4.545; $\Delta^{17}O$ -0.063, -0.046, -0.060 per mil.
Classification: Angrite (diabasic).
Specimens: 20.6 g including one polished thin section at *UWB*; remainder with *DPitt*, except for 14.2 g with Mr. B. Hoefnagels.

Northwest Africa 12321 (NWA 12321)
(Northwest Africa)
Purchased: 2004 Oct
Classification: Ureilite
History: Purchased in Erfoud, Morocco by Adam *Aaronson* in October 2004.
Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate of olivine (~80 vol.%) and pigeonite (~20 vol.%). Olivine exhibits dark reduced, magnesian rims. Minor grain boundary graphite was observed.
Geochemistry: Olivine (cores $Fa_{21.9-22.2}$; rim $Fa_{7.4}$; N = 3), pigeonite ($Fs_{18.4-18.5}Wo_{9.3-9.2}$, N = 2).
Classification: Ureilite.
Specimens: 20.1 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12322 (NWA 12322)
Niger
Purchased: 2018 Aug
Classification: Carbonaceous chondrite (CV3)

History: Found in Niger and purchased in Morocco by Adam *Aaronson* in August 2018.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed granular and BO chondrules (some composite; apparent diameter 1250 ± 690 μm) and fine grained CAI (some up to 4.5 mm across) are set in a fine grained matrix (~30 vol.%, orange-brown in thin section).
Geochemistry: Olivine ($Fa_{0.2\text{-}45.3}$, N = 3), orthopyroxene ($Fs_{0.7\text{-}0.9}Wo_{1.1}$, N = 2), clinopyroxene ($Fs_{2.5}Wo_{36.0}$; $Fs_{21.4}Wo_{44.1}$; N = 2).
Classification: Carbonaceous chondrite (CV3).
Specimens: 42 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12323 (NWA 12323)
(Northwest Africa)
Purchased: 2018 Aug
Classification: Martian meteorite (Shergottite)
History: Purchased by Ben Hoefnagels in August 2018 from a dealer in Agadir, Morocco.
Physical characteristics: Single stone (447 g) exhibiting a brown weathered exterior and a fresh interior with obvious glassy maskelynite. The specimen is crosscut by several thin, dark shock melt veinlets.
Petrography: (A. Irving and S. Kuehner, *UWS*) Gabbroic assemblage of predominantly prismatic, zoned and twinned grains of clinopyroxene (up to 3.6 mm long) and maskelynite (some as thin, curved laths in sheaf-like groups) with accessory merrillite, ilmenite, ulvöspinel and pyrrhotite, plus minor secondary barite and calcite.
Geochemistry: Orthopyroxene core ($Fs_{22.1}Wo_{3.1}$, FeO/MnO = 32), pigeonite ($Fs_{29.9}Wo_{7.3}$; $Fs_{31.9\text{-}76.8}Wo_{13.7\text{-}15.7}$; FeO/MnO = 31-46; N = 5), subcalcic augite ($Fs_{28.9\text{-}39.3}Wo_{31.7\text{-}27.1}$, FeO/MnO = 33-37, N = 2), maskelynite ($An_{54.6\text{-}54.7}Or_{0.6\text{-}0.5}$, N = 2).
Classification: Martian (shergottite, gabbroic).
Specimens: 22.1 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12324 (NWA 12324)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish individual with some fusion crust.
Petrography: The meteorite displays a chondritic texture with slightly flattened and slightly packed chondrules (mean diameter about 0.6 mm) in a more fine-

grained dark matrix that contains sulfides and FeNi metal. The meteorite contains shock melt veins.

Northwest Africa 12326 (NWA 12326)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, polymict)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Two grayish individuals with fusion crust.
Petrography: The meteorite is a polymict breccia composed of mineral and lithic clasts set into a fine-grained clastic matrix. Lithic clasts are fine- and coarse-grained about 0.2 to 1.5 mm sized basaltic clasts and dark about 0.1 to 4 mm sized impact melt clasts. Main minerals in basaltic clasts and matrix are exsolved pyroxene and calcic plagioclase. Minor phases include silica, chromite, ilmenite, and zircon. No metallic Fe has been detected.
Geochemistry: low-Ca pyroxene: $Fs_{55.1\pm0.3}Wo_{3.4\pm0.4}$ ($Fs_{54.5\text{-}55.6}Wo_{2.7\text{-}4.2}$, n=14, FeO/MnO=31-36); Ca-pyroxene: $Fs_{31.6\pm5.0}Wo_{34.9\pm5.8}$ ($Fs_{25.2\text{-}39.3}Wo_{26.1\text{-}42.2}$, n=16, FeO/MnO=29-34); calcic plagioclase: $An_{80.0\pm1.7}$ ($An_{77.2\text{-}82.3}$, n=13)

Northwest Africa 12327 (NWA 12327)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, polymict)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Two dark grayish individuals with fusion crust.
Petrography: The meteorite is a coarse-grained basaltic breccia composed of up to 6 mm sized basaltic and up to 5 mm sized dark impact melt clasts set into a clastic matrix. Mineral phases are predominantly up to 1.5 mm sized exsolved pyroxene and lath shaped calcic plagioclase. Several low-Ca pyroxene grains are magmatically zoned indicating a low degree of thermal metamorphism. Minor phases include silica, chromite, and FeNi metal.
Geochemistry: low-Ca pyroxene: $Fs_{41.1\pm4.2}Wo_{2.6\pm0.9}$ ($Fs_{33.3\text{-}45.8}Wo_{1.2\text{-}3.8}$, n=21, FeO/MnO=28-37); Ca-pyroxene: $Fs_{21.0\pm0.3}Wo_{41.9\pm0.6}$ ($Fs_{20.4\text{-}21.7}Wo_{40.8\text{-}42.5}$, n=15, FeO/MnO=23-27); calcic plagioclase: $An_{91.0\pm1.6}$ ($An_{88.5\text{-}93.2}$, n=15)

Northwest Africa 12328 (NWA 12328)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM1)
History: Ruben Garcia and Bob Cucchiara purchased eight similar-looking, partially fusion-crusted meteorite fragments weighting 43.2 g from Adam *Aaronson* at the 2017 Denver Gem show.

Physical characteristics: The largest fragments 20.2 g and 10.6 g have one surface with well-developed, ropy fusion crust. Pieces without fusion crust are gray and show slight wind abrasion. Fresh broken surfaces exhibit an earthy fracture, are black and studded with tiny crystalline white flecks and sparse protruding chondrules and nodules. Stones are very soft and can be easily crushed by hand to a fine powder.
Petrography: (L. Garvie, *ASU*) Powder x-ray diffraction of the bulk meteorite shows a pattern dominated by serpentine, with low-intensity reflections for sulfides (mackinawite, pentlandite), magnetite, bassanite, carbonates (ankerite, calcite), and very weak reflections possibly from olivine. The 001 serpentine is a well-resolved doublet with maxima at 0.735 and 0.724 nm. Powder XRD from each of the fragments comprising the 43.2 g shows the double-peaked 001 serpentine reflection. Powder XRD patterns from several nodules and chondrules shows patterns dominated by the 0.735 nm clay. One chondrule also shows a three-component 0.7 nm reflection and weak 1.4 nm peak, suggesting the presence of minor chlorite. A polished mount of a 2 × 1.5 cm fragment shows two well-defined chondrules (1 mm and 0.9 m diameter), smaller (<0.5 mm) chondrules and dark nodules, and sparse sulfide grains (<100 μm) set in a dark matrix with abundant fine-grained sulfide. Analysis of a 2 × 2 mm region of the section shows that chondrules, relict chondrules, and clay-rich nodules comprise 41 areal% of the section. Chondrules and relict chondrules have a mean diameter of 331 μm (n=25). An Mg x-ray map shows magnesium "hot-spots" in a few chondrules corresponding to relict olivine grains. BSE images show that the olivine is deeply corroded and partially replaced by clays. Olivine represents ~1 areal% of the section, consistent with the weak peaks in the powder XRD profile. No CAIs were found. Some of the fine-grained sulfide may be partially replaced by terrestrial oxides.
Geochemistry: (L. Garvie, *ASU*) WDX of a few relict olivine grains. BO chondrule with olivine bars largely replaced by clay. One bar has $Fa_{1.1.}$ A 200 μm grain in matrix, $Fa_{18.3.}$ The 1 mm chondrule contains a 0.5 mm olivine grain, $Fa_{0.5.}$ A 100 μm olivine grain in 300 μm-sized chondrule, $Fa_{1.4.}$
Classification: Carbonaceous chondrite (CM1). The chondrules to matrix ratio and average diameter of the chondrules are consistent with a CM chondrite. The predominance of serpentine and only minor amounts of olivine (~1 areal%), which show extensive alteration to clays, argue for a petrologic grade 1 carbonaceous chondrite.
Specimens: 8.7 g and one polished mount at *ASU*.

Northwest Africa 12331 (NWA 12331)
(Northwest Africa)
Purchased: March 2018
Classification: Ordinary chondrite (L3)

Geochemistry: Olivine $Fa_{25.4\pm2.5}$, PMD=8%, range $Fa_{23.5\text{-}29.9}$, Cr_2O_3=0.02±0.03wt%, n=5. Low-ca pyroxene $Fs_{14.4\pm4.7}Wo_{0.6\pm0.3}$, range $Fs_{8.9\text{-}21.7}Wo_{0.3\text{-}1.1}$ (n=4).
Specimens: 23.13 g and a polished section at *CEREGE*. Main mass with Fabien *Kuntz*

Northwest Africa 12335 (NWA 12335)
(Northwest Africa)
Purchased: 2018
Classification: Martian meteorite (Shergottite)
History: Purchased in Guelmim, Morocco by Ali Fettouh in July 2018
Physical characteristics: Six identically appearing pieces with the following weights: 2290 g, 1486 g, 170 g, 20.7 g, and 2 smaller fragments of 4 g. No fusion crust. Broken surface reveals a mix of brown pyroxene grains and black maskelynite domains and shock melt.
Petrography: (C. Agee, *UNM*) The two major phases in this meteorite are clinopyroxene and maskelynite. The pyroxene compositions range from pigeonite to sub-calcic augite to ferro-pigeonite with a modal abundance of approximately 60%, and significant core to rim zoning in backscatter electron images. Maskelynite has modal abundance of approximately 35%.
Geochemistry: (C. Agee, *UNM*) Pigeonite $Fs_{48.0\pm10.7}Wo_{16.8\pm6.0}$, Fe/Mn=35±3, n=8; sub-calcic augite $Fs_{29.4\pm3.9}Wo_{34.7\pm2.1}$, Fe/Mn=32±2, n=4; ferro-pigeonite $Fs_{81.8\pm1.9}Wo_{13.7\pm1.4}$, Fe/Mn=36±3, n=8: maskelynite $An_{48.2\pm6.0}Ab_{49.6\pm4.5}Or_{2.2\pm1.7}$, n=10; alkali feldspar $An_{3.8}Ab_{24.1}Or_{72.1}$, n=1.
Classification: Evolved Martian basalt, pyroxene trends are similar to QUE 94201.
Specimens: 20.7 g including a probe mount on deposit at *UNM*. John Higgins holds the 2290 g stone; remainder with Ali Fettouh.

Northwest Africa 12337 (NWA 12337)
(Northwest Africa)
Purchased: 2015 Apr
Classification: Ordinary chondrite (LL5)
Petrography: (Z.G. Guo, *UWO*) This meteorite comprises 60-70% chondrules with mean diameter of 800 μm. Undulatory extinction is present in olivine. There is ~10% metal found within thin section.
Geochemistry: (EMPA, Z.G. Guo and M. Beauchamp, *UWO*) Olivine $Fa_{28.2\pm0.4}$, Fe/Mn=53.9±2.5 (N=15), high-Ca pyroxene $Fs_{8.5\pm0.8}Wo_{43.6\pm3.0}$; Fe/Mn=22.5±2.9 (N=3); low-Ca pyroxene $Fs_{23.1\pm0.4}Wo_{1.3\pm0.1}$, Fe/Mn=31.0±0.9 (N=15); plagioclase $An_{12.6\pm0.5}$ (N=12).
Classification: Ordinary chondrite (LL5, S2)
Specimens: 42.7 g at *UWO* including a probe mount

Northwest Africa 12338 (NWA 12338)
(Northwest Africa)
Purchased: 2016 Nov
Classification: Ungrouped achondrite
Physical characteristics: The repository specimen has a brown fusion crust surface and a light-gray, fresh interior.
Petrography: (Z.G. Guo, *UWO*) This is an unbrecciated basaltic meteorite with fine-grained ophitic texture including ~100 μm-sized clinopyroxene (~55%), and 100-500 μm-sized plagioclase (~35%). Plagioclase is not acicular, as usually found in eucrites, but instead is interstitial between clinopyroxene crystals. Olivine (~5%) is found as ~100 μm individual crystals. It has a low content (<1%) of metal (partially weathered), chromite and troilite. Undulatory (up to mosaic) extinction is observed in plagioclase, with silica veinlets, which indicate a moderate shock stage.
Geochemistry: (EMPA, Z.G. Guo and M. Beauchamp, *UWO*) Olivine $Fa_{70.0\pm0.2}$, Fe/Mn=44±1 (n=10); pigeonite $Fs_{40.5\pm3.3}Wo_{10.6\pm4.1}$, Fe/Mn=30±1 (n=20); plagioclase $An_{89.1\pm1.4}$ (n=10); Bulk chemistry (INAA, R. Korotev, *WashU*) Na_2O 0.495%, CaO 10.2%, FeO 15.3%, and (all in ppm) Cr 3043, Co 16, Sr 92, Ba 19, La 1.05, Sm 0.74, Hf 0.52, Th 0.10, and U 0.16. (laser fluorination oxygen isotope analyses, A. Alexandre; L. Webb, *UWO*) acid-washed bulk rock powder $\Delta^{17}O$=-0.18±0.01, $\delta^{17}O$=1.980±0.203, $\delta^{18}O$=4.16±0.37 (n=2).
Classification: Achondrite, ungrouped. This meteorite is an anomalous eucrite-like basaltic meteorite similar to other specimens which have been found to diverge from the HED oxygen mass fractionation line (similarly to PCA 91007 and Pasamonte, and significantly above the HED line). It has geochemical characteristics of eucrites for major element mineral compositions, and of cumulate eucrites for bulk trace element chemistry. But its mineral sssemblage with the presence of igneous olivines, texture, and its oxygen isotopic composition indicate a different parent body from HED, thus an ungrouped achondrite classification.
Specimens: 24.0g at *UWO* including a probe mount.

Northwest Africa 12339 (NWA 12339)
(Northwest Africa)
Purchased: 2017
Classification: HED achondrite (Eucrite, polymict)
Physical characteristics: Stone is partially crusted with black glassy fusion crust. The interior is light gray with brown staining.
Petrography: (Z.G. Guo, *UWO*) This is a brecciated meteorite, in which the size of clasts varies from 300 μm to 8 mm. The metal content is low (<1%). A silica polymorph was observed. Other shock features like shock melt veins and sheared pyroxene exsolution lamellae were observed in thin section.
Geochemistry: (EMPA, Z.G. Guo and M. Beauchamp, *UWO*) The compositions of two pyroxenes vary among clasts and host matrix. Host: low-Ca pyroxene $Fs_{63.9\pm2.0}Wo_{2.3\pm2.0}$, Fe/Mn=28.6±0.7 (N=5), high-Ca pyroxene $Fs_{31.7\pm3.7}Wo_{39.9\pm4.2}$,Fe/Mn=29.0±1.3 (N=5) and plagioclase $An_{90.1\pm2.7}$ (N=13); Clasts:

low-Ca pyroxene $Fs_{55.4\pm3.9}Wo_{13.3\pm4.8}$, Fe/Mn=28.6±0.2 (N=3); high-Ca pyroxene $Fs_{36.5\pm3.8}Wo_{32.6\pm4.5}$, Fe/Mn=27.8±0.5 (N=3), and plagioclase (2) $An_{72.0\pm4.2}$, N=6.
Classification: Polymict eucrite
Specimens: 20.8g at *UWO* including a probe mount.

Northwest Africa 12340 (NWA 12340)
(Northwest Africa)
Purchased: 2006 Jun
Classification: HED achondrite (Eucrite, polymict)
History: Purchased from a Moroccan mineral dealer at the meteorite show in Ensisheim, France
Petrography: (K. Metzler, *IfP*) Polymict breccia consisting of eucritic lithic clasts with ophitic, subophitic and granulitic textures, and mineral fragments (eucritic and diogenitic pyroxene, plagioclase). Breccia-in breccia clasts and impact melt rock clasts are also present. These components are set in a fine-grained matrix of related debris, cemented by thin films of intergranular shock-melt. Most eucritic pyroxenes exhibit exsolution lamellae. Percentage of diogenitic components in the investigated sample is below 10 vol%. Accessories are silica polymorph, ilmenite, Cr-spinel, troilite, and metal. Secondary calcite occurs.
Geochemistry: Mineral compositions and geochemistry: Eucritic low-Ca pyroxene: $Fs_{45.6\pm10.1}Wo_{4.7\pm1.6}$ ($Fs_{32\text{-}61}Wo_{3\text{-}8}$); mean Fe/Mn (at.): 32; n=15. Eucritic Ca-rich pyroxene: $Fs_{27.3\pm6.3}Wo_{40.1\pm2.8}$ ($Fs_{15\text{-}35}Wo_{36\text{-}44}$; n=8). Diogenitic pyroxene: $Fs_{26.1\pm1.8}Wo_{3.3\pm0.5}$ ($Fs_{23\text{-}29}Wo_{2\text{-}4}$); mean Fe/Mn (at.): 33; n=8. Plagioclase $An_{91.1\pm0.7}Or_{0.2\pm0.2}$ ($An_{90\text{-}92}Or_{0\text{-}0.5}$); n=13.

Northwest Africa 12341 (NWA 12341)
(Northwest Africa)
Purchased: 2018 Aug
Classification: Ordinary chondrite (L3)
Petrography: (K. Metzler, *IfP*) Unshocked ordinary chondrite of low petrologic type, consisting of chondrules (types I and II) of all major textural types (PO, POP, PP, BO, C) with small amounts of interchondrule matrix. The apparent mean chondrule size is 470 µm (n=49). Nearly all metal has been oxidized by terrestrial weathering.
Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{18.4\pm12.3}$ ($Fa_{2.3\text{-}39.9}$; n=21); the mean low-Ca pyroxene composition is $Fs_{7.3\pm6.4}Wo_{0.7\pm0.5}$ ($Fs_{1.3\text{-}23.8}Wo_{0.2\text{-}2.4}$); n=22.
Classification: L chondrite based on mean apparent chondrule size. Petrologic type based on the chemical variation of olivine and pyroxene. The PMD of Fa values is 67%, indicating that the petrologic subtype is <3.5.

Northwest Africa 12342 (NWA 12342)

(Northwest Africa)
Purchased: 2018 Aug
Classification: HED achondrite (Eucrite, melt breccia)

Petrography: (K. Metzler, *IfP*) Subrounded eucritic lithic clasts (up to 2 cm) with ophitic to subophitic textures and mineral fragments (pyroxene, plagioclase, silica polymorph) embedded in a vesicular crystallized melt. The modal amount of melt is 30-50 vol%. The latter shows a fan-spherulitic texture consisting of skeletal pyroxene and plagioclase crystals with sizes up to 100 µm. Vesicles can reach sizes of ~400 µm. Many lithic clasts are surrounded by a thin dark layer of a more fine-grained crystallized melt. Most pyroxene fragments show shock-deformed exsolution lamellae. Accessories are silica polymorph, ilmenite, Cr-spinel, and troilite.

Geochemistry: Mineral compositions and geochemistry: Lithic clasts: Low-Ca pyroxene $Fs_{59.8\pm2.0}Wo_{3.5\pm1.4}$ ($Fs_{56.1\text{-}62.8}Wo_{1.8\text{-}6.2}$); mean Fe/Mn (at.): 33; n=14. Ca-pyroxene $Fs_{26.7\pm0.4}Wo_{43.2\pm0.4}$ ($Fs_{25.9\text{-}27.3}Wo_{42.7\text{-}44.1}$; n=12). Plagioclase $An_{88.9\pm1.1}Or_{0.4\pm0.3}$ ($An_{87.9\text{-}90.6}Or_{0\text{-}0.8}$); n=8.

Northwest Africa 12343 (NWA 12343)
(Northwest Africa)
Purchased: 2018 Mar
Classification: Carbonaceous chondrite (CV3)

Petrography: (K. Metzler, *IfP*) Chondrules, CAIs and AOAs are embedded in a fine-grained dark matrix (about 30 vol% matrix). Most chondrules have apparent diameters between 0.3 and 1.5 mm, some up to 2.2 mm. Several chondrules show reddish staining due to terrestrial weathering. A slight alignement of chondrules is visible. CAIs with sizes of a few mm are observed.

Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{7.4\pm2.7}$ ($Fa_{1.3\text{-}12.7}$; n=26); n=23. Random measurements of low-Ca pyroxene grains revealed $Fs_{1.8\pm0.8}Wo_{1.6\pm1.2}$ ($Fs_{0.8\text{-}3.6}Wo_{0.8\text{-}4.4}$; n=13).

Classification: CV chondrite based on CAI and AOA occurrence, size of chondrules, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene.

Northwest Africa 12344 (NWA 12344)
(Northwest Africa)
Purchased: 2018 Jan
Classification: HED achondrite (Eucrite, polymict)

Petrography: (K. Metzler, *IfP*) Polymict breccia consisting of eucritic lithic clasts with ophitic textures and mineral fragments (pyroxene, plagioclase, silica polymorph) set in a fine-grained matrix of related debris. The matrix is clastic, bound by intergranular shock-melt, and intermingled with vesicular melt pockets (up to 5 mm). The latter show quench tetxtures, consisting of parallel aligned pyroxene and plagioclase skeletal crystals. Both pyroxenes with and without

exsolution lamellae occur. Iron-rich olivine was found as isolated fragments and in the shape of veins in lithic clasts. Accessories are silica polymorph, ilmenite, Cr-spinel, troilite, and Ni-poor metal.
Geochemistry: Mineral compositions and geochemistry: Low-Ca pyroxene: $Fs_{64.5\pm4.4}Wo_{2.4\pm0.7}$ ($Fs_{55.8\text{-}68.4}Wo_{1.9\text{-}4.7}$); mean Fe/Mn (at.): 29.8; n=13. Ca-rich pyroxene: $Fs_{30.8\pm1.0}Wo_{42.5\pm0.6}$ ($Fs_{28.4\text{-}32.2}Wo_{41.6\text{-}43.4}$) n=12. Olivine: $Fa_{75.0}$ ($Fa_{74.6\text{-}75.7}$); mean Fe/Mn (at.): 44.1; n=3. Plagioclase $An_{90.6\pm2.5}Or_{0.3\pm0.3}$ ($An_{86.9\text{-}94.0}Or_{0.0\text{-}0.8}$); n=8.

Northwest Africa 12346 (NWA 12346)
Morocco
Purchased: 2017 Feb
Classification: Ordinary chondrite (L5)
Physical characteristics: Small stone with visible oxidation of the matrix.
Petrography: (P. Reger, *UWO*) Mostly olivine and pyroxene, recrystallized matrix, with few secondary plagioclase grains (generally smaller than 50 μm), metal abundance ~ 5%, large chondrules generally easily discernible, smaller ones have fewer sharp boundaries. Mostly PP, RP chondrules, some POP and BO chondrules; mean diameter ~0.5 mm, larger (>0.5 mm) round, but fractured, smaller ones (<0.5 mm) can be less rounded; chondrule glass absent. Undulutory extinction in olivine and pyroxene, in addition to planar fractures in olivine (S3). All metal oxidized, but no alteration in silicates visible (W4).
Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine ($Fa_{24.4\pm0.3}$; Fe/Mn = 45.7±1.6; n=10), Orthopyroxene ($Fs_{20.6\pm0.4}Wo_{1.1\pm0.1}$, n=10), Plagioclase $An_{9.7\pm0.7}$ (n=6). Maximum Ni content in metal phases is > 20%. Bulk rock ICP-MS analysis shows enrichment of incompatible rare earth elements compared to CI chondrites in G701
Classification: Ordinary chondrite L5 (W4, S3)
Specimens: 89.6 g including a thin section at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12347 (NWA 12347)
Morocco
Purchased: 2017 Feb
Classification: Ordinary chondrite (H5)
Physical characteristics: A dark-brown fusion crust covers the outer edges of the hand sample. The sample appears to be at least moderately weathered due to an overall dark brown appearance and the absence of abundant visible metal grains. The largest chondrule visible in the type specimen has a diameter of 3.5 mm.
Petrography: (J. Laughton, *UWO*) Model abundances were determined using a combination of optical microscopy and ImageJ software: 74% chondrules, 12% matrix, 6% oxide, 5% metal, and 3% sulphide [+ trace amount of calcium phosphate]. The silicates present include: olivine, orthopyroxene, minor clinopyroxene and plagioclase, and metal (~5%). The sulfide present was in the

form of troilite with <0.5 wt.% Ni content. Chondrule diameters ranged in size from 3.5 to 0.1 mm, with an average diameter of 0.4 mm (n = 50). Majority of the chondrules could be discerned, but not all had sharp boundaries. Very minor undulatory extinction patterns were observed in olivine and pyroxene crystals, as well as some minor irregular fractures within the crystals. In thin section ~70% of the metal and troilite has been replaced by a dark red iron oxide (hematite). Oxidation of silicates has also started along the cracks of some crystals.
Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine ($Fa_{16.7\pm0.2}$; Fe/Mn = 29.2±1.0; n=10), Orthopyroxene ($Fs_{14.6\pm0.2}Wo_{1.7\pm0.0}$; Fe/Mn = 17.8±0.6; n=11) and Plagioclase $An_{8.8\pm0.4}$ (n=10).
Classification: Oridinary chondrite H5, S2, W3.
Specimens: 54.0 g including a thin section at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12348 (NWA 12348)
Morocco
Purchased: 2017 Feb
Classification: Ordinary chondrite (L4)
Physical characteristics: The meteorite has a reddish-brown colored matrix containing chondrules and chondrule fragments.
Petrography: (G. Ibe, *UWO*) Chondrules constitute about 75 vol% of this meteorite and have well-defined rims, up to 2.2 mm in the thin section. Opaque minerals in the meteorite include Fe-Ni metal, troilite, chromite. The amounts of Fe-Ni metal and troilite are ~1% and ~3%, respectively. Plagioclase is present as a minor phase. Undulatory optical extinction could be observed in olivine. About 60 ? 70% of the metal and sulfides were oxidized, but no similar features were observed in the silicates.
Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine $Fa_{25.0\pm2.0}$ (n=10), low-Ca pyroxenes ($Fs_{20.5\pm0.6}Wo_{1.5\pm0.2}$, n=10), and plagioclase $An_{12.1\pm0.02.}$
Classification: Ordinary Chondrite (L4, S4, W3).
Specimens: 51.3 g including a thin section at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12349 (NWA 12349)
Morocco
Purchased: 2017 Feb
Classification: Ordinary chondrite (H4)
Physical characteristics: A dark-brown to black fusion crust with regmaglypts is observed over approximately 80% of the exterior. Faint chondrules set in a brown-orange matrix are observed on the saw-cut face.
Petrography: (T.V. Kizovski, *ROM*) In thin section and in backscattered electron view, chondrules are discernible with opaque boundaries set in a semi-recrystallized matrix. The chondrules vary in size with an average diameter of 0.4

mm (n = 41). The majority of the chondrules are porphyritic and are mainly comprised of pyroxene with varying amounts of olivine and devitrified glass. Barred olivine and cryptocrystalline chondrules are also observed. The matrix is mainly composed of iron oxide with some devitrified glass, pyroxene, terrestrial barite, and rare metal. The stone shows multiple signs of significant desert weathering. Several cracks, approximately 0.03 mm in width, cross-cut the sample and appear to be filled with terrestrial weathering products. The metals and sulfides in the matrix have been completely oxidized, although there has been no alteration of silicates. Subtle undulatory extinction is observed in the olivine and pyroxene grains. Plagioclase is rare, and only observed in the porphyritic chondrules.
Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine ($Fa_{19.5\pm0.1}$; Fe/Mn = 37.6±1.6; n=10), low-Ca pyroxene ($Fs_{16.3\pm1.4}Wo_{1.4\pm1.1}$; Fe/Mn = 25.7±7.1; n=10), plagioclase ($An_{8.8\pm4.7}Ab_{78.1\pm12.7}Or_{13.1\pm16.5}$; n=6).
Classification: Ordinary Chondrite (H4, S2, W4)
Specimens: 23.2 g including a thin section at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12350 (NWA 12350)
Morocco
Purchased: 2006
Classification: Ordinary chondrite (H4)
History: Purchased in 2006 by Sean Tutorow in Quartzsite, Arizona.
Physical characteristics: Typing specimen has a fusion crust and displays minor weathering.
Petrography: (M. Spencer, *UWO*) Olivine has irregular fractures. One large barred olivine crystal (>1 mm) is present in the thin section. Plagioclase displays twinning and undulatory extinction (S2). Pyroxene displays pleochroism in plain polarized light, undulatory extinction. Metal Abundance: Fe-Ni metals (mostly taenite, some kamacite present), Fe-Ni oxides, Fe-sulfides are still present (W1). Most chondrules display sharp boundaries, with an average diameter of 0.27 mm (n=13).
Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine: $Fa_{19.1\pm0.5}$; Fe/Mn=36.8±1.5 (n=10), Pyroxene: $Fs_{16.2\pm0.1}Wo_{1.0\pm0.3}$; Fe/Mn=21.8±1.1 (n=10), Plagioclase: $An_{10.7\pm3.3}$ (n=10).
Classification: Ordinary Chondrite (H4), Weathering W1, Shock S2
Specimens: 206 g including a thin section at *UWO*. Main mass with S. Tutorow.

Northwest Africa 12351 (NWA 12351)
Morocco
Purchased: 2017 Feb
Classification: Ordinary chondrite (H5)
Physical characteristics: Repository specimen has a fresh surface.
Petrography: (C. Zhu, *UWO*) Mostly granular pyroxene chondrule (200-500 μm) and porphyritic pyroxene chondrules (200-600 μm) Mostly barred olivine, radial

olivine (200-400 μm) and porphyritic olivine (200-300 μm). Plagioclase grains range from 10 to 40 μm in diameter with tabular shape. Olivine and pyroxene grains show undulatory extinction, and some display planar fractures. Fe-Ni metal (~10-15 vol%) is slightly oxidized. Other phases found include Fe-Ni-sulfides, and minor chromite and chlorapatite.
Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine ($Fa_{18.8\pm0.5}$; 18.2-19.6; Fe/Mn = 36.7±2.0; n=15), low-Ca pyroxene ($Fs_{15.9\pm1.7}Wo_{0.5\pm0.3}$; $Fs_{13.3\text{-}19.2}Wo_{0.1\text{-}1.1}$; Fe/Mn =28.5±8.8; n=10), and plagioclase $An_{12.2\pm2.9}$ ($An_{5.6\text{-}17.8}$; n=10).
Classification: Ordinary chondrite (H5, S3, W1)
Specimens: 32.2 g including a polished thin section are on deposit at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12352 (NWA 12352)
Morocco
Purchased: 2017 Feb
Classification: Ordinary chondrite (H5)
Physical characteristics: This sample has a dar-brown fusion crust. The inside shows a dark-gray matrix with a significant number of chondrules and metals.
Petrography: (B. Borba de Carvalho, *UWO*) The thin section exhibits numerous chondrules (up to 1.6 mm) in a dark matrix of medium-grained silicates, metals, minor oxides and sulfides. Most of the chondrules lack well-delineated edges. Major mineral phases are olivine and low-Ca pyroxene. Minor plagioclase and clinopyroxene were observed. No alteration and strong shock features were observed, except for irregular fractures and undulutory extinction in olivine and pyroxene. Fe-Ni metal phases have minor oxide rims.
Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine ($Fa_{17.7\pm0.2}$; Fe/Mn = 35.6±1.2; n=10), Pyroxene ($Fs_{15.5\pm0.2}$ $Wo_{1.4\pm0.1}$; Fe/Mn = 20.7±1; n=10), Plagioclase ($An_{13.1\pm0.5}$; n=10).
Classification: Ordinary chondrite (H5, S2, W1).
Specimens: 30.2 g including a thin section at *UWO*. Main mass with S. Tutorow.

Northwest Africa 12353 (NWA 12353)
Morocco
Purchased: 2017 Feb
Classification: Ordinary chondrite (H5)
Physical characteristics: The repositiory specimen has a very dark interior and contains visible chondrules.
Petrography: (Z. Jiang, *UWO*) Porphyritic and radial pyroxene chondrules are found with an average size of ~0.3 mm. There are planar and irregular fractures in olivine and orthopyroxene. Minor plagioclase was found.
Geochemistry: (EMPA, M. Beauchamp, *UWO*) Olivine ($Fa_{18.7\pm0.2}$; Fe/Mn = 36.8±1.5; n=15), orthopyroxene ($Fs_{16.4\pm0.1}Wo_{1.5\pm0.2}$, n=13), and plagioclase ($An_{12.4\pm0.3}$; n=10).

Classification: Ordinary chondrite (H5, S3, W2)
Specimens: 22.7 g including a thin section at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12365 (NWA 12365)
(Northwest Africa)
Purchased: April 2018
Classification: Carbonaceous chondrite (CO3)
History: Bought in April 2018 from a mineral dealer in Laayoune, Morocco.
Petrography: (A. Bischoff, *IfP*) Chondrules, chondrule fragments, and CAIs are embedded in a fine-grained brownish matrix, which has an abundance of about 20-30 vol%. The majority of chondrules belong to chemical type I and the mean apparent chondrule size is about 200 µm. The sample is strongly weathered.
Geochemistry: (K. Klemm; A. Bischoff, *IfP*) Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{8.9\pm9.8}$ ($Fa_{0.7\text{-}28.6}$); n=21. Random measurements of low-Ca pyroxene grains revealed $Fs_{7.2\pm13.3}Wo_{1.3\pm1.1}$ ($Fs_{0.7\text{-}39.9}Wo_{0.5\text{-}4.2}$); n=15.
Classification: CO3 chondrite based on small chondrule size, chondrule-matrix ratio, texture, and mineral chemistry.

Northwest Africa 12366 (NWA 12366)
(Northwest Africa)
Purchased: April 2018
Classification: Carbonaceous chondrite (CO3)
History: Bought in April 2018 from a dealer in Zagora, Morocco.
Petrography: (A. Bischoff, *IfP*) Chondrules, chondrule fragments, and CAIs are embedded in a fine-grained brownish matrix, which has an abundance of about 20-30 vol%. The majority of chondrules contain Fe-poor olivine and low-Ca pyroxene and the mean apparent chondrule size is about 200 µm.
Geochemistry: (K. Klemm; A. Bischoff, *IfP*) Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{11.9\pm14.0}$ ($Fa_{0.4\text{-}49.4}$); n=14. Random measurements of low-Ca pyroxene grains revealed $Fs_{2.3\pm1.3}Wo_{1.7\pm1.5}$ ($Fs_{1.1\text{-}5.7}Wo_{0.3\text{-}5.1}$); n=12.
Classification: CO3 chondrite based on small chondrule size, chondrule-matrix ratio, texture, and mineral chemistry.

Northwest Africa 12367 (NWA 12367)
(Northwest Africa)
Purchased: April 2018
Classification: Carbonaceous chondrite (CO3)
History: Bought in April 2018 from a dealer in Zagora, Morocco.

Petrography: (A. Bischoff, *IfP*) Chondrules, chondrule fragments, and CAIs are embedded in a fine-grained brownish matrix, which has an abundance of about 20-30 vol%. The majority of chondrules belong to chemical type I and the mean apparent chondrule size is about 200 µm.
Geochemistry: (K. Klemm; A. Bischoff, *IfP*) Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{10.3\pm14.5}$ ($Fa_{0.7-43.3}$); n=29. Random measurements of low-Ca pyroxene grains revealed $Fs_{6.2\pm12.0}Wo_{1.5\pm1.0}$ ($Fs_{0.6-35.9}Wo_{0.5-4.3}$); n=15.
Classification: CO3 chondrite based on small chondrule size, chondrule-matrix ratio, texture, and mineral chemistry.

Northwest Africa 12368 (NWA 12368)
(Northwest Africa)
Purchased: 2018
Classification: Lunar meteorite (feldspathic breccia)
History: Found in the spring of 2017 in the Moroccan Sahara and purchased in Temara by A. *Aaronson* on July 23, 2018.
Physical characteristics: Single complete stone, no fusion crust; saw cut reveals a fragmental breccia with scattered white feldspathic and mafic clasts set in a dark-gray groundmass.
Petrography: (C. Agee, *UNM*) This meteorite consists primarily of fragmental pyroxene, olivine, feldspathic and mafic clasts, and shock melt. Ubiquitous Fe-Ti-Cr-Al oxides are present, rare kamacite was detected. There appears to be 2 or 3 distinct populations of pyroxenes and olivines, suggesting that this is a polymict breccia.
Geochemistry: (C. Agee, *UNM*) olivine $Fa_{53.3\pm11.8}$, Fe/Mn=96±7, n=7; fayalite $Fa_{91.8\pm2.9}$, Fe/Mn=91±8, n=3; pigeonite $Fs_{26.0\pm1.3}Wo_{6.4\pm1.3}$, Fe/Mn=51±3, n=7; subcalcic augite $Fs_{38.3\pm3.2}Wo_{24.2\pm4.3}$, Fe/Mn=57±3, n=2; ferro-augite $Fs_{63.9\pm4.3}Wo_{30.4\pm7.6}$, Fe/Mn=92±21, n=2; plagioclase $An_{95.5\pm1.4}$, n=6; Shock melt (20 _m defocused electron beam, proxy for bulk meteorite composition): SiO_2=44.6±1.5, TiO_2=0.18±0.13, Al_2O_3=28.8±4.2, Cr_2O_3=0.11±0.14, MgO=4.1±1.8, FeO=4.2±2.1, MnO=0.07±0.03, CaO=16.8±1.9, NiO=0.02±0.02, Na_2O=0.54±0.14, K_2O=0.06±0.04 (all wt%), n=3.
Classification: Lunar feldspathic breccia
Specimens: 20.6 g including a probe mount on deposit at *UNM*,
Adam *Aaronson* holds the main mass.

Northwest Africa 12369 (NWA 12369)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H5)
History: Found in the Moroccan western Sahara in May 2018, purchased in Temara by A. *Aaronson* on August 14, 2018.

Physical characteristics: Single stone, no fusion crust, saw cut reveals numerous closely packed chondrules in a brown matrix.
Petrography: (C. Agee, *UNM*) This meteorite has many porphyritic chondrules, abundant Fe-metal, and plagioclase up to 25 μm in size.
Geochemistry: (C. Agee, *UNM*) olivine $Fa_{18.2\pm0.2}$, Fe/Mn=37±2, n=30; low-Ca pyroxene $Fs_{16.0\pm0.1}Wo_{1.5\pm0.1}$, Fe/Mn=21±1, n=11.
Classification: Ordinary chondrite H5
Specimens: 25 g including a probe mount on deposit at *UNM*,
Adam *Aaronson* holds the main mass.

Northwest Africa 12381 (NWA 12381)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L~6)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 21.7 g dark-brown fragment
Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poorly defined, but partly metal-rimmed chondrules (0.5-2 mm) and metal specks
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.85
Classification: Ordinary chondrite (L~6, W2)
Specimens: 4.4 g on deposit at *Kiel*, Ben Levi Karsten (Hamburg) holds the main mass, and 3.1 g with *Bart*.

Northwest Africa 12382 (NWA 12382)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H~5)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 29.0 g brown fragment
Petrography: (R. Bartoschewitz, *Bart*) Brown stained, recrystallized matrix with well-defined chondrules (av. 0.5 mm)
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.70
Classification: Ordinary chondrite (H~5, W4)
Specimens: 5.9 g on deposit at *Kiel*, Joseph Kaiser (Hamburg) holds the main mass, and 3.9 g with *Bart*.

Northwest Africa 12383 (NWA 12383)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H~5)

History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 209.65 g dark brown fragment
Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with recognizable chondrules(av. 0.5 mm) and metal specks
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.13
Classification: Ordinary chondrite (H~5, W2)
Specimens: 22.0 g on deposit at *Kiel*, W. Kalisch (Berlin) holds the main mass, and 17 g with *Bart*.

Northwest Africa 12385 (NWA 12385)
Morocco
Find: unknown
Classification: Ordinary chondrite (H5)
History: Found in Morocco and purchased by *HMG* from a dealer (Ke Zuokai) in Changsha, China.
Physical characteristics: About 75% of the angular stone is covered by a dull, dark fusion crust. The broken surface shows round chondrules.
Petrography: The thin section shows moderately abundant chondrules set in a fine-grained matrix. The chondrules have no clear boundaries and are cracked. The diameter of chondrules are 0.1 to 2.0 mm. Some chondrules are surrounded by opaque minerals. A few fragments of BO chondrules are visible. The opaque phases include metal, troilite and Fe-oxides are about 20 vol%. Oxidation of metal and troilite distributed as minor rims or fine veins. The weathering grade is W1.
Geochemistry: Silicates are equilibrated. Olivine $Fa_{18.3\pm0.1}$ (PMD= 0.5%); low-Ca pyroxene $Fs_{16.4\pm0.3}Wo_{1.6\pm0.2}En_{82.0\pm0.3}$ (PMD-Fs=2.0%); .
Classification: Ordinary chondrite. H5
Specimens: 3463 g is at *HMG*.

The name Nova 054 replaces the discredited name Mercantour. A description of the meteorite may be found under the former name.
The name Nova 055 replaces the discredited name Castenaso. Information originally submitted for this meteorite may be found under the former name.

Nova 020
(unknown)
Purchased: 2014
Classification: Iron meteorite (IAB-MG)
History: Purportedly found in Licking River, KY, USA. Presented to *UCLA* by P. Allen in 2014.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 65.2, Co = 4.58 (both mg/g), Ga = 89.5, As = 11.5, W = 1.27, Ir = 3.93, Au = 1.444 (all µg/g).
Classification: Iron, IAB main group. Probably paired with Campo del Cielo.
Specimens: Main mass at *UCLA*.

Nova 021

(unknown)
Purchased: 2016
Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Copiapo, Chile. Presented to *UCLA* by D. Ruiz in 2016.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 64.8, Co = 4.56 (both mg/g), Ga = 86.4, As = 10.5, W = 1.22, Ir = 3.39, Au = 1.43 (all µg/g).
Classification: Iron, IAB main group. Probablypaired with Campo del Cielo.
Specimens: Type specimen at *UCLA*.

Nova 022

(unknown)
Purchased: 2013
Classification: Iron meteorite (IAB-MG)

History: Purportedly found in Redding, CA, USA. Presented to *UCLA* by J. Utas in 2013.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 63, Co = 4.58 (both mg/g), Ga = 91.2, As = 11.4, W = 1.26, Ir = 3.55, Au = 1.531 (all µg/g).
Classification: Iron, IAB main group. Probably paired with Campo del Cielo.
Specimens: Type specimen at *UCLA*.

Nova 023

(unknown)
Purchased: 2014
Classification: Iron meteorite (IAB-MG)

History: Purportedly found on a beach, 7 km NNE of Sorso, Sardinia, Italy. Reported to *NMBE* by the finder on 22 Nov 2012. Sample presented to *UCLA* by B. Hofmann in 2014.
Physical characteristics: The surface of the specimen is mostly metal with little rust, with remnants of an earlier rust, so likely the specimen has been cleaned. However the finder reported that he did not clean the sample.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 64.7, Co = 4.64 (both mg/g), Ga = 89.1, As = 10.9, W = 1.29, Ir = 3.47, Au = 1.419 (all µg/g).
Classification: Iron, IAB main group. Probably paired with Campo del Cielo.
Specimens: Type specimen (22 g) and main mass at *NMBE*. INAA sample (2g) at *UCLA*.

Nova 024

(unknown)
Purchased: 2010
Classification: Iron meteorite (IAB-MG)
History: Purportedly found in Tucson, AZ, USA. Presented to *UCLA* by L. *Labenne* in 2010.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 68.1, Co = 4.52 (both mg/g), Ga = 91.2, As = 11.2, W = 1.25, Ir = 3.8, Au = 1.463 (all µg/g).
Classification: Iron, IAB main group. Probably paired with Campo del Cielo.
Specimens: Type specimen at *UCLA*.

Nova 025
(unknown)
Purchased: 2004
Classification: Iron meteorite (IAB-MG)
History: Purportedly found in Blanco, NM, USA. Presented to *UCLA* by R. Jones in 2004.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 67.1, Co = 4.55 (both mg/g), Ga = 92.1, As = 11.1, W = 1.45, Ir = 3.75, Au = 1.482 (all µg/g).
Classification: Iron, IAB main group. Likely paired with Campo del Cielo.
Specimens: 2682 g at *ASU*. INAA sample (1 g) at *UCLA*.

Nova 026
(unknown)
Purchased: 2005
Classification: Iron meteorite (IAB-MG)
History: Purportedly found in Randsburg, CA, USA. Presented to *UCLA* by G. *Hupe* and T. Irving in 2005.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 69.9, Co = 4.54 (both mg/g), Ga = 87.8, As = 10.8, W = 1.19, Ir = 3.65, Au = 1.462 (all µg/g).
Classification: Iron, IAB main group. Probably paired with Campo del Cielo.
Specimens: Type specimen at *UCLA*.

Nova 027
(unknown)
Purchased: 2005
Classification: Iron meteorite (IAB-MG)
History: Purportedly found in Arispe, Baja California, Mexico. Presented to *UCLA* by P. Utas in 2005.

Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 65.6, Co = 4.54 (both mg/g), Ga = 90.9, As = 11.3, W = 1.37, Ir = 3.54, Au = 1.465 (all µg/g).
Classification: Iron, IAB main group. Probably paired with Campo del Cielo.
Specimens: Type specimen at *UCLA*.

Nova 028
(unknown)
Purchased: 2004
Classification: Iron meteorite (IAB-MG)
History: Purportedly found in Utah, USA.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data (average of two samples), Ni = 67.9, Co = 4.5 (both mg/g), Ga = 91.6, As = 11.1, W = 1.26, Ir = 3.92, Au = 1.492 (all µg/g).
Classification: Iron, IAB main group
Specimens: Type specimen at *ASU*.

Ouargla 001 31°06', 5°11'
Ouargla, Algeria
Purchased: before 2001
Classification: Ordinary chondrite (H3)
Petrography: Low-Ca pyroxene exhibits polysynthetic twinning. Chondrules are sharply defined but lack glassy mesostases. Many metal grains are elongated and ragged; some contain small silciate grain fragments. Some metal grains contain small, irregular troilite grains. The rock appears to have been shocked and annealed.
Classification: H3 (estimated subtype 3.7).

Note: this name replaces provisional name NWA 736

Ozerki 52°48.084'N, 38°10.268'E
Lipetskaya oblast', Russia
Confirmed fall: 21 June 2018
Classification: Ordinary chondrite (L6)
History: The first meteorite fragments were recovered based on analysis of the fireball observed over the Lipetskaya oblast' in Russia on June 21, 2018, at 01:16:20 UT. The fireball was widely observed from many places in Russia, including Moscow. The scientists from *UrFU*, *UHelsinki*, and the Finnish Fireball Network formed a consortium enabling quick prediction and the actual discovery of the meteorite. Collection of the observational data and trajectory analysis were done by Esko Lyytinen, Maria Gritsevich, Nikolai Kruglikov, and Mikhail Larionov. The derived parameters, characterizing the trajectory were clearly

indicative of a number of meteorite fragments landing on the ground. Using these results, a comprehensive model of the strewn field providing the expected locations of fragments was done by Jarmo Moilanen. The area of the meteorite shower was predicted to be on the line Ozerki – Zlobino - Druzhba, Stanovlyansky district, northwest of Yelets town, Lipetskaya oblast'. The modeling assumed about 100 meteorites (excepting the main body) with total mass ~7 kg. With the support of these data, a meteorite recovery campaign was initiated by Victor I. Grokhovsky. Five samples of the meteorite (1176 g) were recovered during the *UrFU* meteorite expedition-2018 (23-27 June 2018; Pastukhovich A.Yu., Yakovlev G.A., Petrova E.V. and volunteer Usenkov A.V.) in the Lipetskaya oblast'. The first sample was found 25 June 2018 by G.A. Yakovlev (59.85 g). The *UrFU* finds were near Ozerki village. During the next few weeks, more meteorite samples (>5500 g) were recovered by institutional groups (*Vernad* - GEOKHI RAS, IA RAS, IDG RAS) and private collectors in the area Ozerki – Zlobino. The total mass and number of stones may increase due to additional finds.

Physical characteristics: The meteorites have roughly rounded shapes, covered by dark fusion crust; the interior is light colored and contains visible opaque shock veins. The samples are fresh, but halos of Fe-hydroxides were already present around metal grains. Some samples contain impact melt.

Petrography: (V.V. Sharygin, *SIGM* and *UrFU*, and D.A. Zamyatin, *RAS-UB* and *UrFU*): Petrographic observation of a polished section shows very rare chondrules in a coarse recrystallized matrix. Most chondrules are very poorly defined and their apparent sizes vary from 200 μm to 1 mm. Only the largest chondrules (up to 4 mm) are clearly delineated. The PO, POP and BO chondrules are most common and mainly consist of olivine, plagioclase, low-Ca pyroxene ± chromite and blebs of troilite and FeNi-metal. Other textural types of chondrules were not observed. Olivine, low-Ca-pyroxene, plagioclase, FeNi-metal and troilite are the main minerals in the matrix. Clinopyroxene, chromite, chlorapatite and merrillite (100-300 μm) occur locally in the matrix. Plagioclase grains are larger than 50-100 μm. Shock features include undulatory extinction, irregular and planar fractures (three directions) in olivine and the presence of opaque shock veins. The presence of impact melt suggests shock stage S5. Grains of FeNi metal (up to 1 mm) are represented by both individual phases (kamacite, taenite or plessite) and their intergrowths (kamacite + taenite, kamacite + plessite + tetrataenite, kamacite + tetrataenite + pentlandite) ± troilite. Grains of troilite (100-500 μm) are spongy, fine-grained aggregates of micrometer-sized individuals (<5 μm). Some pentlandite grains occur in such aggregates, especially on contacts with FeNi-metal. Opaque shock veins (up to 100 μm in thick) are not very abundant and contain metal-sulfide intergrowths in fine-grained low-Ca pyroxene matrix. The thickness of fusion crust is up to 600 μm. It is highly vesicular and zoned in texture: the outmost zone is a cryptocrystalline aggregate of skeletal crystals of zoned olivine and magnetite (up to 5 μm) and glass (44-47 wt.% SiO_2); the inner zone is represented by larger skeletal crystals of newly formed olivine + glass + minor magnetite. Both zones contain rounded relics of initial olivine and chromite and newly formed Ni-

rich metal-sulfide globules (10-20 μm). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.8 (analyst Yakovlev G.A.).
Geochemistry: SEM-EDS-WDS (V. V. Sharygin, *SIGM* and *UrFU*) and EMPA-WDS (D.A. Zamyatin, *RAS-UB* and *UrFU*). Olivine $Fa_{25.6\pm0.3}$ (N=51), low-Ca pyroxene $Fs_{21.4\pm0.2}Wo_{1.6\pm0.3}$ (N=44), plagioclase $Ab_{83.5}An_{10.5}Or_{6.0}$ (N=35), Cr-bearing clinopyroxene $En_{45.8}Fs_{9.0}Wo_{45.2}$ (Cr_2O_3 – 0.8-1.0 wt.%, N=6), chromite $Crt_{82.8}Spl_{12.1}$ (N=17), chlorapatite, merrillite, FeNi-metals, troilite and pentlandite. Chlorapatite contains F (up to 0.5 wt.%); Cl – 5.5, Na_2O – 0.5 wt.% (N=11). Merrillite is poor in FeO (0.3-0.7 wt.%, N=8). Composition of metal (in wt.%): kamacite (N=32) – Fe 93.2±1.4, Ni – 5.89±1.44, Co – 0.92±0.13; taenite (N=20) – Fe 68.6±5.1, Ni 31.0±5.1, Co 0.36±0.09; tetrataenite (N=3) – Fe 48.5, Ni 51.2, Co 0.16. Composition of sulfides (in wt.%): pentlandite (N=10, in association with troilite) – Fe 50.6±0.8, Ni 15.4±1.0, Co 0.15±0.02, Cu 0.61±0.26, S 33.6±0.3; heazlewoodite (N=10, from fusion crust) – Fe 2.62±0.46, Ni 71.4±0.8, Co 0.11±0.01, Cu 0.37±0.09, S 25.6±0.5.
Classification: Ordinary chondrite. L6, S5, W0.
Specimens: *UrFU* - 798.6 g (3 samples: 550.4, 188.3, 59.9 g); *Vernad* - 603 g (3 samples); *SIGM* - 31.7 g fragment; *RAS-UB* - 15 g fragment; *UHelsinki* - 15 g fragment.

Parauapebas 6°3.373’S, 49°53.347’W
Para, Brazil
Probable fall: 2013 Dec 09
Classification: Ordinary chondrite (H4-5)
History: (D. Cunha, D. Atencio, A.L.R. Moutinho) On 9 December 2013, about 7:00 p.m. local time, a meteorite fell in the city of Parauapebas, located in the eastern part of Pará State, Brazil. A witness reported seeing the bolide traveling from NE to SW direction. A stone hit the roof of a house with a loud noise that was heard by the resident Mrs. Maria. She claims that a meteorite fragment hit and injured her right shoulder but her son says that she was hit only by roof debris. Her son, I. S. Lima, collected the stone on the roof. The stone broke in two pieces during the impact. One piece is lost but the other remaining 62 g piece was kept by Mrs. Maria for some years and then donated to the Institute of Geosciences, *USP*. Another 210.3 g oriented mass was observed to fall by other city residents while they were in front of their house. Meire C. Rosa, her husband Paulo T. Nunes, her mother Rosa C. Santos and neighbors heard loud thunder and a noise when the stone penetrated the wooden beam of their house, embedding itself in the ground. Meire immediately collected the stone and noticed it was still warm. In early 2018, she contacted Andre L.R. Moutinho, who was already part of the classification team of the 62 g fragment. The 210.3 g stone was purchased by Andre L. R. Moutinho.
Physical characteristics: The 210.3 g mass is almost fully crusted, and measures 5.7 × 5.3 × 4.2 cm, and shows orientation features such as nose-cone shape and roll-over lips. A small portion of secondary crust is also present. The 62 g fragment

measuring 4.8 × 3.5 × 2.6 cm shows the gray interior with two distinct lithologies: type-4 clast with an abundance of chondrules showing sharply defined edges; and type-5 clast, in which the edges of the chondrules are beginning to merge with the surrounding groundmass. Shock melt veins indicate it is a breccia.
Petrography: (C.V.N. Villaça and M.E. Zucolotto, *MNRJ*/UFRJ; D. Cunha, D. Atencio, IGc/*USP*). Polished thin sections were examined by MEV/EDS and electron microprobe. There are some black shock-induced melt veins, one broader crossing the entire thin section. Olivine, ortho and clinopyroxene were observed with abundant Fe-Ni-metal and sulfide. Mineralogy dominated by forsterite, enstatite, iron, troilite, and tetrataenite. Albite, chromite, diopside, augite, pigeonite, taenite, and merrillite are minor components. Texturally there are at least two lithologies. One exhibits an abundance of chondrules with well-defined margins and no visible plagioclase, consistent with petrologic type 4 chondrites. The other lithology displays chondrules with outlines blurring into the groundmass as evidence of an increasing recrystallization. In at least one clast some small plagioclase of about 20 µm confirmed a type-5 lithology. The presence of shock veins and large olivine with undulatory extinction, fractures and some weakly mosaicism infer a shock state S4
Geochemistry: (A.A. Tosi, Labsonda/UFRJ, A.L.R. Moutinho) Microprobe analysis yields: Type 4 - olivines ($Fa_{19.3\pm0.4}$, PMD = 2.22, n = 30); low-Ca pyroxenes ($Fs_{17.3\pm0.9}Wo_{0.9\pm0.3}$, PMD = 9.16, n= 23); high-Ca pyroxene $Fs_{10.4\pm2.6}Wo_{28.3\pm11.5}$, PMD 29.2, n = 12. Type 5 - olivines ($Fa_{18.9\pm0.4}$ PMD = 1.96, n = 45); low-Ca pyroxenes ($Fs_{16.9\pm0.6}$ $Wo_{1.6\pm0.9}$, PMD = 5.44, n = 19); high-Ca pyroxene $Fs_{15.1\pm2.5}Wo_{16.0\pm2.5}$, PMD 22.7 n = 7). Metal: iron (Ni = 6.15±0.32 wt.%, Co = 0.42±0.02 wt.%, n = 9), tetrataenite (Ni = 52.9±2.3 wt.%, Co = 0.09±0.08 wt.%, n = 3), taenite (Ni = 37.1 wt.%, Co = 0.12 wt.%, n = 1), troilite (Ni = 0.11±0.11 wt.%, n = 9) and chromite (Cr/(Cr+Al) = 0.928±0.003, n = 3). Cathodoluminescence also gives results comparable to breccia H4-5. (D. Atencio, D. Cunha, A. L. R. Moutinho, Laboratório de Microscopia Eletrônica/IGc/*USP*) SEM/EDS analysis yields: olivines ($Fa_{19.6\pm1.1}$,PMD=9.9,n=6); low-Ca pyroxenes ($Fs_{16.6\pm0.7}Wo_{0.0\pm0.0}$, PMD=3.43, n=15). plagioclase ($Ab_{83.0\pm2.0}An_{12.2\pm1.3}Or_{4.8\pm0.8}$, n=5). Metal: tetrataenite (Ni = 49.16 ± 2.75 wt.%, n = 3), troilite (Fe = 61.49 ± 1.66 wt.%, S = 37.46 ± 1.02 wt.%, n = 10) and chromite (Cr/(Cr+Al) = 0.85, n = 2)
Classification: It is a genomict breccia with the clasts and matrix from the same compositional group but different petrologic types, H4-5, S4, W0
Specimens: IGc/*USP*: 34.8 g, *MNRJ*: 4 g; Andre L. R. Moutinho: 210.3 g main mass and 13.08 g slice.

Qira 001 37°34’22.01"N, 80°23’33.46"E
Xinjiang, China
Find: 2012
Classification: Ordinary chondrite (H~5)

History: (R. Bartoschewitz, *Bart*) Discovered by Bi Chunlin in the desert in Hotan county/Xinjiang in 2012 and was purchased by Wang Ziyao, who donated it to R. Bartoschewitz.
Physical characteristics: (R. Bartoschewitz, *Bart*) Red-brown 8.03 g stone with adhering desert sand.
Petrography: (R. Bartoschewitz, *Bart*) Red-brown stainted recrystallized matrix with nearly complete recrystallized chondrules (av. ~1.0 mm). Metal and sulfide completely oxidiezed, vugs partly filled with gypsum.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.59
Classification: Ordinary chondrite (H~5, W5)
Specimens: 1.70 g on deposit at *Kiel*, main mass of 5.8 g with *Bart*.

Rabt Sbayta 010 24.135944, -14.763139
Rio de Oro, Western Sahara
Find: 2017 Dec 8
Classification: Martian meteorite (basaltic breccia)
History: Found on 12/08/2017 by Zaid Oualguirah in the same area as NWA 7034. Purchased by Jean Redelsperger from Mohamed Elguirah in Zagora, Morocco, in 2018.
Physical characteristics: Three identical appearing pieces 4.8 g, 0.7 g, and 0.6 g, two pieces preserve patches of original glassy fusion crust, the remaining exterior surfaces have a shiny black luster. Saw cut reveals a breccia with numerous dark and light colored fragmental crystals and polycrystalline lithologies, scattered spherules and spherical objects, set in a dark gray, fine-grained groundmass, some opaques visible.
Petrography: (C. Agee, *UNM*) Microprobe examination of the polished deposit sample shows a polymict breccia with fragmental feldspar and pyroxene grains, set in a very fine-grained groundmass composed of feldspar, pyroxene, oxides, and phosphates.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{36.0\pm10.0}Wo_{5.0\pm2.3}$, Fe/Mn=36±4, n=10; high-Ca pyroxene $Fs_{23.5\pm2.9}Wo_{40.3\pm6.5}$, Fe/Mn=32±1, n=2; plagioclase $Ab_{58.4\pm6.5}An_{38.5\pm8.0}Or_{3.2\pm1.6}$, n=12.
Classification: Martian (basaltic breccia). Paired with NWA 7034 pairing group
Specimens: 1.3 g including a probe mount on deposit at *UNM* Jean Redelsperger holds the main mass.

Ramlat as Sahmah 530 (RaS 530) 20°34.104’N, 55°43.342’E
Al Wusta, Oman
Find: 20 Apr 2014
Classification: Ureilite
History: The meteorite was found on 20 April 2014 during a field trip in the Oman desert.

Physical characteristics: Brownish individual lacking any fusion crust.
Petrography: The meteorite is dominantly composed of <1 mm sized olivine grains, sometimes poikilitically enclosing augite crystals. Olivine shows abundant reduced rims; the meteorite contains flaky graphite and Cr-bearing sulfides. Cracks are often found to be filled with barite likely due to intense terrestrial weathering.
Geochemistry: Reduced rims in olivine: $Fa_{1.4\text{-}4.5}$; olivine contains 0.28±0.03 wt% Cr_2O_3 and 0.22±0.02 wt% CaO; augite contains 1.58±0.03 wt% Cr_2O_3 and 3.37±0.03 wt% Al_2O_3
Classification: Ureilite, augite-bearing

Ramlat Fasad 057 19°0.580'N, 53°20.587'E
Zufar, Oman
Find: 31.01.16
Classification: Martian meteorite (Shergottite)
History: A single fragment was found during a search for meteorites.
Physical characteristics: Pale/greyish brown to greenish brown, platy fragment, 3x4x0.7 cm, without fusion crust. Wind-ablation on small sides.
Petrography: (Felix Mechelke, *Bern*, B. Hofmann, *NMBE*) The meteorite consists of pigeonite and augite (together 48 vol%, typical length 0.5-1 mm), olivine (35 vol.%, typical size 0.6 mm) and plagioclase completely transformed to maskelynite (11 vol.%, typical size 0.3x0.7 mm). Accessories (6 vol%) comprise pyrrhotite and spinel. Weathering effects: Minor replacement of silicates by terrestrial calcite along fractures, staining of silicates with iron hydroxides near surface.
Geochemistry: (Felix Mechelke, *Bern*, B. Hofmann, *NMBE*) Olivine rim compositions are $Fa_{40.8\pm3.5}$ (N = 43). Dark brown, partially altered cores are $Fa_{35.1\pm1.9}$ (N = 21). Pigeonite compositions are $Fs_{29.8\pm3.1}$ (N = 44, range 27.3-43.4), $Wo_{8.8\pm1.7}$ (range 6.3-13.6), mean FeO/MnO = 28.0±1.4; augite compositions are $Fs_{23.1\pm2.8}$ (range 20.1-29.2, N = 8) $Wo_{31.0\pm5.3}$ (range 20.3-36.4). Maskelynite has $An_{53.0\pm1.5}$ (range 48.5-55.7) $Or_{1.7\pm0.4}$ (range 1.2-2.8, N = 29). Bulk Fe/Mn (XRF) is 35.5±2.7 (N = 5). Oxygen isotopes (R. Greenwood, *OU*): $\delta^{17}O$ 3.031, $\delta^{18}O$ 5.257, $\Delta^{17}O$ 0.297.
Classification: Based on petrography, mineral compositions, bulk Fe/Mn and oxygen isotopes this is a strongly shocked shergottite.
Specimens: All at *NMBE*

Realicó 35°1'S, 64°19'W
La Pampa, Argentina
Find: 1970
Classification: Ordinary chondrite (L5)
History: The meteorite was found around 1970 by a farmer while plowing a rock-free field in the Realicó area, La Pampa Province, Argentina. The only mass, with a weight of 12 kg approximately, was kept at the farm. This find was little known until 2015, when an amateur astronomer (J.C. Spagnotto, Observatorio El Catalejo

de Santa Rosa, La Pampa, Argentina) learned about the meteorite. Spagnotto sent a sample to ICATE and the stone was identified as a chondrite.
Petrography: The stone is highly altered. Different types of chondrules are visible: BO, RP and POP with apparent diameter ranging from 600 microns to 1.5 mm. The shock features record by crystals such as: undulatory extinction, planar fractures, melt pockets and the presence of polycrystalline troilite indicate a state of shock S3 or S4. A strong degree of oxidation of metal suggest an alteration stage W3.
Geochemistry: Mineral composition: EMP analyses, Olivine, $Fa_{25.4\pm0.5}$ (n=51); pyroxene, $Fs_{21.1\pm0.5}Wo_{1.2\pm0.2}$ (n=28).
Classification: Ordinary chondrite (L5).
Specimens: Type specimen of 47.5 g is on deposit at the *MLP* and three thin sections are on deposit at ICATE, Argentina. The main mass remains at the farm.

Reckling Peak 14003 (RKP 14003) 76°12.744'S, 158°32.205'E
Antarctica
Find: 2014 Nov 10
Classification: Ordinary chondrite (H3)
Petrography: The section shows sharply defined chondrules (~0.4 mm in average) with some glassy mesostasis. Metal abundance is ~13 vol%. The section appears to be brecciated.
Geochemistry: Olivine composition is $Fa_{0.4\text{-}36.4}$; low-Ca pyroxene is $Fs_{15.5\text{-}40.6}Wo_{0.3\text{-}2.7}$.

Reckling Peak 14005 (RKP 14005) 76°15.954'S, 158°07.073'E
Antarctica
Find: 2014 Nov 16
Classification: Carbonaceous chondrite (CM2)
Petrography: The section consists of relatively small chondrules (~16 vol %, ~<100 μm to ~1.6 mm in diameter, the average size of chondrule is ~300 μm) and matrix (~84 vol%). Single hibonite crystal is observed in matrix. Fe-Ni metal is very rare (<0.1 vol%). The section has abundant hydrated materials, mainly serpentine. The matrix occurs as fine-grained rims surrounding chondrules.
Geochemistry: Olivine is $Fa_{0.4\text{-}57.5}$; low-Ca pyroxene is $Fs_{1.0\text{-}3.7}Wo_{0.9\text{-}3.4}$.

Reckling Peak 14006 (RKP 14006) 76°16.344'S, 158°08.727'E
Antarctica
Find: 2014 Nov 16
Classification: Ordinary chondrite (H3)
Petrography: The section shows sharply defined chondrules (~70 vol%, average size of ~0.3 mm) with glassy mesostasis. Metal abundance is ~10 vol%.
Geochemistry: Olivine is $Fa_{0.5\text{-}39.9}$; low-Ca pyroxene is $Fs_{4.1\text{-}42.7}Wo_{0.1\text{-}5.3}$.

Renchen 48°35’17.9988’’N, 8°0’00.00’’E
Baden-Wurttemberg, Germany
Confirmed fall: 10 July 2018
Classification: Ordinary chondrite (L5-6)

History: (Pavel Spurný, *CzAS*). A -13.4 maximum absolute magnitude bolide was observed by many of eyewitnesses, mainly over western Germany, eastern France, Belgium, Netherlands, Luxembourg, and Switzerland, and recorded photographically and photoelectrically by instruments of the Czech and German parts of the European Fireball Network on July 10, 2018, at 21:29:49-53 UT. Based on these instrumental data, precise results on atmospheric trajectory, heliocentric orbit and fragmentation history were quickly determined. From this analysis (done at *CzAS*), it was evident that this event terminated with a multiple meteorite fall in Baden-Württemberg, close to the Rhine river. The impact area for a possible range of meteorite masses was thus modeled and sent to a German colleague (Dieter *Heinlein*) shortly after the fall. As a result, all of the meteorites were found in the predicted location for a given mass during dedicated searches.

Physical characteristics: (D. *Heinlein*). A total mass of 999 g was recovered within the predicted fall site. The first meteorite (12 g) was discovered two weeks after the fall. The largest meteorite fragment had a mass of 955 g and was found in a field. close to a small impact pit. Two of the meteorites (5 and 6 g) were caught by a hail net covering a fruit plantation.

Petrography: (M. Patzek and A. Bischoff, *IfP*): Based on the study of the thin sections, Renchen is brecciated. Highly recrystallized fragments (type 6) coexist with areas showing a chondritic texture (type 5) and fragments of impact melt. Olivine shows weak mosaicism indicating shock stage S4. Opaque phases include metals (kamacite, taenite), troilite, and chromite. Other accessory phases include Cl-apatite and merrillite. Several shock veins cross the meteorite.

Geochemistry: (M. Patzek and A. Bischoff, *IfP*): The mean composition of olivine is $Fa_{26.0\pm0.5}$ with a compositional range of $Fa_{24.6\text{-}27.1}$ (n=59). The low-Ca pyroxene has a mean composition of $Fs_{21.9\pm0.4}Wo_{1.4\pm0.3}$ (n= 21), varying between $Fs_{21.1\text{-}22.6.}$ Mean plagioclase is $An_{9.8\pm0.6}Or_{3.9\pm2.6}$ (n= 10; range $An_{8.6\text{-}10.7}$). O-isotopes (A. Pack; *UGött*): The mean oxygen isotope composition of two analyzed fragments is: $\delta^{17}O = 3.63‰$, $\delta^{18}O = 4.74‰$, $\Delta^{17}O = 1.12‰$ (relative to a reference line with a slope of 0.5305). The data are consistent with those of other L chondrites.

Classification: L chondrite breccia (L5-6, S4, W0)

Specimens: Type Specimens: 20.9 g, *IfP*; the main masses are with the finders.

Sahara 98063
Sahara
Find: 1998
Classification: Ordinary chondrite (H3)

History: Sample was found 1998 by the *Labenne*-group. The coordinates are unknown.
Petrography: The sample is an unequilibrated chondrite, with chondrules of about 500 µm. Metal abundance is about 10 vol%.
Geochemistry: Olivine compositions are $Fa_{6.7.-0-26.3}$ (mean $Fa_{19.6\pm4.3}$, n=21), pyroxene compositions are $Fs_{2.1-17.5}Wo_{0.2-5.4}$ (mean $Fs_{12.3\pm5.7}Wo_{1.3\pm1.2}$, n=20).
Classification: H3 chondrite based on the high metal abundance and many silicate analyses in the H-group field.

San Juan de Allende 26.94°N, 105.30°W
Chihuahua, Mexico
Find: 1995 Aug
Classification: Ordinary chondrite (L3)
History: An approximately 200 g single invidual was found by Ruben Jurado, sold to Edwin *Thompson*, with portions donated to *Cascadia* in 2004 and 2008.
Petrography: Well-defined chondrules, some glass-bearing, with an average diameter of 0.77±0.34 mm (N=59), are present in a chondrite with an estimated metal content of 3.5 area%.
Geochemistry: Chondrules contain unequilibrated olivine ($Fa_{22.1\pm7.5}$, N=99) and low-Ca pyroxene ($Wo_{0.9\pm0.8}Fs_{11.6\pm8.2}$, N=52). A subset of olivine point analyses, obtained with longer count times for better minor element data, gives a Cr_2O_3 content of 0.08±0.08 wt% (N=13).
Classification: L3 chondrite based on mean chondrule size, metal abundance, olivine and pyroxene compositions. Subtype estimated as 3.4-3.6, based on olivine Fa content and Cr_2O_3 content (latter suggests ~3.2).
Specimens: Type sample at *Cascadia* consists of four pieces totaling to 20.2 g as well as a polished thin section. A 113 g main mass specimen is held by a person wishing to remain anonymous.

San Juan 085 (SJ 085) 25°22’29.4"S, 69°48’55.3"W
Antofagasta, Chile
Find: 2017 Nov
Classification: Carbonaceous chondrite (CK6)
Physical characteristics: Dark stone. Cut surface reveals an homogeneous dark-gray interior.
Petrography: (J. Gattacceca, *CEREGE*) Recrystallized chondrite with poorly defined large chondrules. Silicates are olivine, Ca-pyroxene, and plagioclase (average size >50 µm). No orthopyroxene was observed. Abundant sulfides (including pentlandite) and magnetite. No metal was observed.
Geochemistry: Olivine $Fa_{33.2\pm0.4}$, NiO 0.48±0.06 wt% (N=4). Ca-pyroxene $Fs_{12.7\pm0.0}Wo_{47\pm0.2}$ (N=2). Plagioclase $An_{31.9}Ab_{64.1}Or_{4.0}$ (N=1). Magnetite contains 3.7 wt% Cr_2O_3.
Classification: Carbonaceous chondrite (CK6)

Specimens: Type specimen at *CEREGE*. Main mass with *ARTMET*.

San Juan 086 (SJ 086) 25°37’55’’S, 69°46’16’’W
Antofagasta, Chile
Find: November 9, 2017
Classification: Ordinary chondrite (L6, melt breccia)
History: The meteorite was found in 2017 during a field trip in the Atacama desert.
Physical characteristics: Dark brownish individual without fusion crust.
Petrography: The meteorite is composed of regions displaying chondritic textures with relict chondrules and mean plagioclase size about 60 μm, and large melt regions characterized by recrystallized shock melt containing characteristic FeNi metal and sulfide globules. Chondritic portions are crosscut by shock melt veins.

San Juan 089 (SJ 089) 25°26.488’S, 69°53.232’W
Antofagasta, Chile
Find: 18 Jan 2017
Classification: Ordinary chondrite (H5)
History: Charles and Nick Lucas used low-grade magnets attached to poles, while walking north-south lines about 5 mapart in the area where the meteorite was found, which is a relatively flat area with a 2 to 3 degree down slope to the north.
Physical characteristics: Dark-brown weathering patina covers entire exterior. Patches of beige caliche occur on top of the patina on one side of the samples
Petrography: The overall texture is fairly well integrated in thin section, although chondrules are readily identifiable. Chondrule mesostases are fine grained and include devitrified glass. Numerous chromite-plagioclase regions and several grains of metallic copper are present. BSE imaging shows that olivine and low-calcium pyroxene grains are coarse and equilibrated. Both chondrule mesostases and chromite-plagioclase objects extend into feldspathic veins which invade surrounding ferromagnesian. Feldspathic mesostases experienced segregation of sodic, potassic, and calcic components and display different gray levels in BSE images. Tiny chromite grains are concentrated in albitic patches in mesostases. One barred olivine chondrule was examined in detail. It contained a potassium feldspar grain adjacent to a grain with a perthitic intergrowth of albite and orthoclase. In the same chondrule were regions of chromite-albitic plagioclase intergrowths and small patches of calcic feldspathic glass.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Olivine ($Fa_{19.9\pm0.5}$, N=34) and low-Ca pyroxene ($Fs_{17.8\pm0.7}Wo_{1.3\pm0.2}$, N=27) grains are equilibrated. Feldspathic material occurs in three roughly defined compositions (sodic $Ab_{79.8}An_{15.0}Or_{5.2}$, N=13; calcic $Ab_{26.4}An_{73.2}Or_{0.4}$, N=4; potassic $Ab_{10.6}An_{4.2}Or_{85.2}$, N=5).
Classification: H5 based on chemistry and texture.
Specimens: *Cascadia* holds 17.3 g in three pieces, in addition to one polished thin section and a mounted butt.

San Juan 100 (SJ 100) 25°29.875’S, 69°44.639’W
Antofagasta, Chile
Find: 14 Feb 2018
Classification: Ureilite

Physical characteristics: Sawn surface shows a dark interior with scattered graphite flakes. Stone low weathered.

Petrography: Thin section shows typical ureilitic texture with interlocked olivine (40 vol%) and pyroxene (60 vol%) grains of 0.8-3 mm in size. Common graphite aggregates up to 1 mm are observed.

Geochemistry: Olivine cores in the range $Fa_{11.4\text{-}13.1}$ (mean $Fa_{11.9\pm0.5}$, N=18), with FeO/MnO=21.6±3.2 and Cr_2O_3=0.68±0.07. Pyroxene in the range $Fs_{10.0\text{-}11.6}$ (mean $Fs_{10.6\pm0.5}Wo_{4.4\pm0.3}$, N=20).

San Pedro de Urabá 8°16’44.39"N, 76°22’41.67"W
Antioquia, Colombia
Confirmed fall: 16 Feb 2017
Classification: Ordinary chondrite (L6)

History: At 5:30 pm local time on 16 February 2017, a large fireball with sonic booms was observed in northern Colombia. A meteorite subsequently impacted near Mr. Orlando Cuevas on the edge of a soccer field in San Pedro de Urabá, Turbo district, Antioquia State, Colombia. The event was widely reported in the local media, e.g., www.minuto30.com/fotos-en-zona-rural-de-turbo-aseguran-que-cayo-un-meteorito/340813/, which shows a picture of the 3768 g stone from the soccer field. Two other stones are known to have fallen, one much larger than the one that was collected in the soccer field, but their whereabouts are unknown. Michael Farmer acquired the 3768 g stone from Mr. Cuevas.

Physical characteristics: Single regmaglypted stone covered with matte black fusion crust. Interior is a light greenish-gray and friable. Cut surface shows poorly defined chondrules and even distribution of small metal/troilite grains. Only a single thin shock vein is visible.

Petrography: (L. Garvie, ASU) SEM observation of a polished mount shows scattered poorly defined chondrules (BO, RP, and PO) largely integrated with the matrix. All silicates heavily fractured. Feldspar grains typically >50 μm, with many around 100 to 200 μm. Troilite anhedral and dominantly single crystal to 400 μm. Rare anhedral Ca-Na-Mg phosphates to 60 μm. Chromite to 600 μm is anhedral to subhedral and heavily fractured. Three Fe-Ni metal types present: kamacite, dominantly single crystal (to 0.5 mm) with a frosty etch and weakly defined Neumann bands; tetrataenite, rare, commonly contiguous to kamacite; and, equant Ni-zoned grains with Ni-rich rims and dark-etched cores, some showing kamacite spindles. Native Cu is rare and occurs as <10 micron grains at kamacite/troilite boundary. Scattered and rare melt pockets to 60 μm.

Geochemistry: Olivine $Fa_{25.1\pm0.3}$, FeO/MnO=47.6±1.8, n=9; low Ca pyroxene $Fs_{21.4\pm1.2}Wo_{1.5\pm0.2}$, FeO/MnO=28.4±1.3, n=10; Feldspars $Or_{13.4\pm0.3}Ab_{67.3\pm67.3\pm0.5}$, n=3 and $Or_{5.4\pm0.1}Ab_{84.4\pm0.02}$, n=2.
Classification: Ordinary chondrite L6, S3, W0
Specimens: 32 g at *ASU*. Main mass with *MFarmer*.

Sauceda de la Borda 22°49’15.73"N, 102°31’28.99"W
Zacatecas, Mexico
Find: October, 2016
Classification: Iron meteorite (IAB-MG)
History: Found October, 2016, by Mr. Alejandro Cortes while he was clearing brush along a dirt road about 2 km southwest of Sauceda de la Borda. About 1/4 of the stone was sticking out of the ground. Purchased by Michael Farmer from the finder in December 2016.
Physical characteristics: A relatively unweathered and beautifully regmaglypted 41 kg stone, measuring approximately 37 × 19 × 18 cm. A 17 × 12 cm cut and etched slice shows a well-developed Widmanstätten pattern and an abundance of graphite/troilite nodules, one 8 × 2 cm. A well-developed heat-affected zone is present around the whole of the slice. Layered fusion crust and beads of ablated material are present within some of the regmaglypts.
Petrography: (L. Garvie, ASU) A 13 × 10 cm slice demonstrates a variable structure typical of many group IAB octahedrites, with half of the section rich in decomposed cohenite and the other half showing a well-developed coarse octahedral structure with few inclusions - the two structural types are separated by an elongated graphite/troilite nodule. Etched sections display a coarse Widmanstätten pattern with short but bulky kamacite lamellae, typically 2 mm wide. Kamacite shows two generations of Neumann bands: the first are strongly developed, whereas the second are partially annealed and decorated with sub-μm sized precipitates. Taenite/plessite occupies ~4 areal%, most commonly as ribbons and wedge-shaped blocks separating kamacite lamellae. Plessite shows dominantly pearlitic, comb, and net structures. Decomposed cohenite is present in abundance as smoothly rounded elongated grains (to 4 cm), within and following kamacite lamellae, enveloping schreibersite grains, and around graphite/troilite nodules. In a polished mount, all of the cohenite is decomposed to graphite and ferrite. Schreibersite occurs in three forms: as large grains (to 8 mm) with enveloping decomposed cohenite and surrounded by swathing kamacite; as grain boundary veinlets; and as rhabdites and sub-micron precipitates. The troilite/graphite nodules are entirely mantled by a structurally complex rim (<5 mm thick) of troilite, graphite, schreibersite, and decomposed cohenite. Deep emerald green crystals, possibly krinovite or kosmochlor, occur in several of the graphite nodules.
Geochemistry: (J.T. Wasson, *UCLA*), INAA, Ni = 69.9 and Co = 4.76 (both mg/g), Ga = 77.4, As = 15.3, Ir = 2.14, and Au = 1.59 (all μg/g).

Classification: Found only a few km from the iron Zacatecas (1792), though Sauceda de la Borda is structurally and chemically distinct. It is a member of the IAB main group and there are no other Mexican irons that are chemically similar.
Specimens: 1.2 kg at *ASU*. The rest with *MFarmer*.

Sayh al Uhaymir 605 (SaU 605) 20°32’37.51"N, 56°40’35.98"E
Al Wusta, Oman
Find: 2014 Nov 5
Classification: Ordinary chondrite (L4)
Physical characteristics: Single crusted stone
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed and well-defined chondrules. Opaque are FeNi metal and troilite.
Geochemistry: Olivine $Fa_{24.2\pm1.1}$, PMD 3.9% (N=8), range $Fa_{22.8-26.1}$. Orthopyroxene $Fs_{16.2\pm6.5}Wo_{1.0\pm0.8}$, Fs PMD 34%, range $Fs_{4.8-24.0}$ (N=10).
Classification: L4. Olivine is not completely equilibrated but the Fa PMD is below 5%, indicating a type 4.
Specimens: Type specimen at *CEREGE*. Main mass with anonymous finder.

Sayh al Uhaymir 606 (SaU 606) 20°20.555’N, 56°49.427’E
Al Wusta, Oman
Find: 12.02.17
Classification: Ordinary chondrite (H5)
History: A complete, fresh-looking individual was found during a search for meteorites on February 12, 2017. The area (to a distance of 1-2 km) was searched again in February 2018 but no paired meteorites were found.
Physical characteristics: Complete individual fully covered with black, slightly crackled fusion crust. Bulk density based on a shape model is 3.43 g/cm3.
Petrography: (Å. Rosén, *Bern*, E. Gnos, *MHNGE*, B. Hofmann, *NMBE*) The meteorite shows a brecciated chondritic texture with well-preserved chondrules. Minor and accessory minerals include chromite, ilmenite and native copper. Typical grain size of plagioclase is 10-20 μm. Mean chondrule size is 0.47±0.21 mm (n=128). Minor rust staining in silicates close to metal grains. Iron hydroxide rims around metal reach up to 20 μm.
Geochemistry: (Å. Rosén, *Bern* and B. Hofmann, *NMBE*) Olivine compositions are $Fa_{18.1\pm0.3}$ (n=48), pyroxene compositions are $Fs_{16.3\pm0.4}$, $Wo_{0.9\pm0.2}$ (n=29).
Cosmogenic radionuclides: (Å. Rosén, GeMSE): Gamma-spectroscopy performed in April 2017 showed detectable activities of short-lived radionuclides indicating decay during ~5 years. At end of measurement, ^{26}Al was 39.1(+4.2,-3.8), ^{22}Na was 17.9(+2.7,-1.3) and ^{54}Mn was 1.1(+0.3,-0.2) dpm/kg.
Classification: Based on mineral compositions and mean chondrule size this is an equilibrated H5 chondrite. Cosmogenic isotope data indicate a fall around the year 2012.
Specimens: All at *NMBE*

Scarham Creek 34.319, -85.979
Alabama, United States
Find: 2015
Classification: Ordinary chondrite (H3)

History: Chris Whitten found this meteorite on his family's five-acre property near the Scarham Creek, Alabama, in May 2015. He had often searched the property for meteorites for over a decade with no results, however in 2015 a fire burned and cleared some of the wooded area on the property, after which, a new search produced the meteorite find. The sample, when spotted, stood out as different from local rocks and was slightly magnetic. The sample was sent to his aunt, Dana Jenkerson, for identification. KD Meteorites purchased the main mass.

Physical characteristics: Single stone, no fusion crust, weathered exterior.

Petrography: (C. Agee, *UNM*) Microprobe examination shows numerous porphyritic chondrules, most with mesostasis or glass. Much of the metal has been oxidized by terrestrial weathering.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{14.7\pm4.0}$, Fe/Mn=43±14, n=33; low-Ca pyroxene $Fs_{10.8\pm8.8}Wo_{0.9\pm0.5}$, Fe/Mn=26±18, n=8.

Classification: Ordinary chondrite (H3), estimated subtype 3.7-3.9 based on mean Fa content of olivine and the 1-sigma Fa content of olivine.

Specimens: 10.5 g on deposit at *UNM*, Chris Whitten holds 3 grams, KD Meteorites holds the main mass.

Scottsdale 33°42.358'N, 111°56.006'W
Arizona, United States
Find: 1 April 2017
Classification: Ordinary chondrite (LL3)

History: Mr. Todd Dziuk found an unusual looking rock at the edge of a dry wash on 1 April 2017 in a desert area of Scottsdale, Arizona. He noticed that the underside had a rusty appearance and the stone felt slightly heavier than the average rock: power sanding of a corner of the stone revealed numerous bright shiny metallic spots. Extensive searching has not revealed further meteorites.

Physical characteristics: Single 210.8 g stone with broad, shallow regmaglypts. Fusion crust well preserved - light orange stained on the surface in contact with the soil and covered with matte grey fusion crust above the ground. Interior shows tightly packed, well-defined chondrules separated by a dark matrix and scattered metal/troilite grains.

Petrography: SEM observation of a polished mount shows a wide range of chondrule types including PO, PP, BO, RP, POP, and RPT (interleaved radial pyroxene and troilite), with many olivines and pyroxenes zoned. Many chondrules show rims of troilite and more rarely by Fe-Ni metal/troilite. Large range of chondrule sizes with the largest (PO) to 6 × 4 mm, though the majority are <1 mm diameter. Opaques dominated by troilite, with sparse kamacite and high-Ni metal.

Kamacite, to 500 μm, is single crystal. Many grains have well-developed curved Neumann bands. Troilite as polycrystalline grains to 500 μm, some grains with twin lamellae. The troilite rimming chondrules often has a "fizzy" texture. Native copper occurs in structurally complex grains of troilite/kamacite/tetrataenite. Scattered melt pockets to 100 microns. Weathering W1 based on minor oxidation of the metal.
Geochemistry: (L. Garvie, *ASU*) Olivine $Fa_{27.9\pm7.8}$, $Fa_{0.7\text{-}31.3}$, Cr_2O_3=0.06±0.05, range 0.01-0.3 wt%, FeO/MnO=58.3±8.6, CaO=0.12±0.11 wt%, n=29. Low Ca pyroxene $Fs_{15.9\pm10.2}Wo_{1.7\pm2.0}$, FeO/MnO=21.6±6.8. High Ca pyroxene has a wide range of compositions, e.g., $Fs_{9.5}Wo_{30.8}$, $Fs_{15.6}Wo_{41.7}$, $Fs_{20.0}Wo_{44.0}$, and $Fs_{22.6}Wo_{23.9}$.
Classification: LL3 ordinary chondrite, with estimated 3.6 subtype based on Fa range and Cr_2O_3 content.

Sierra Gorda 009 22°30.10’S, 69°08.20’W
Antofagasta, Chile
Find: 2017 Oct 21
Classification: Ungrouped chondrite
History: Three pieces (30 g, 70 g, and 140 g) of one meteorite were found in the the desert by Mr. T. V. Kryachko, Mr. M. E. Nepomiluev, and an anonymous finder.
Physical characteristics: All samples of the meteorite have a brown fusion crust
Petrography: M. A. Ivanova (*Vernad*) Meteorite has chondritic texture and consists of FeNi-metal (22 -25 vol%), chondrules, and their fragments; matrix is absent. Chondrules, up to 2 mm, are PP, BO, POP, SiO_2-bearing and Al-rich with clear bounaries; PP chondrules are dominant; the main minerals are pyroxene, Fe,Ni-metal, olivine and sulfides (troilite and daubreelite), schreibersite; accessory minerals are silica, Mg-chromite, anorthite, spinel, graphite and PGE-metal nuggets.
Geochemistry: Mineral compositions and geochemistry: M. A. Ivanova (*Vernad*), V. V. Kozlov (Oxford Instruments OM & Gatan Inc., Moscow Office) Olivine: $Fa_{0.47\pm0.10}$ (N=74), orthopyroxene: $Fs_{1.42\pm0.39}Wo_{0.88\pm0.63}$ (N=42), (N=42), FeO-rich Opx: $Fs_{9.33\text{-}32.48}Wo_{0.23\text{-}4.74}$; diopside: $Fs_{1.34\pm0.57}Wo_{47.32\pm2.31}$; plagioclase varies in composition: $An_{32.28\text{-}95.04}Ab_{4.96\text{-}65.99}$; mesostasis in chondrules is enriched in K_2O (up to 9.18 wt%) and TiO_2 (up to 6.53 wt%); kamacite contains 5.07 wt% Ni, 0.43 wt% Co, Co/Ni - 0.09, Si and Cr are below detection (<0.03 wt%); taenite: Ni -32.3 wt%, Co - 0.25 wt% ; troilite is enriched in Cr (up to 2.4 wt%); MgO-chromite is almost pure MgO-end member. Oxygen isotopic compositions: (*OU*) $\delta^{17}O$ 3.763, 3.736; $\delta^{18}O$ 6.263, 6.169; $\Delta^{17}O$ 0.506, 0.528 permil.
Classification: ungrouped Fe,Ni-metal-rich chondrite with affinities to "G-chondrites" (GRO 95551 and NWA 5492, Weisberg et al., 2015) in texture and mineral chemistry. Oxygen isotopic compositions are between those of ordinary and enstatite chondrites.
Specimens: 3 pieces of the meteorite (6.3, 16.2, and 18 g), polished and thin sections are deposited in *Vernad*. Anonymous finder, Mt. M. E. Nepomiluev

(ramatahatta2@mail.ru), and Mt. T. V. Kryachko (bredfild@mail.ru) hold the main mass of the meteorite.

Sokoto 13°0.3'N, 5°14.85'E
Sokoto, Nigeria
Confirmed fall: 10 Jan 2008
Classification: Iron meteorite (IIIAB)

History: According to a newspaper report (THISDAY, January 11, 2008), a meteorite fell after a loud explosion and fireball at approximately 10:00 pm local time (2100h UTC) on 10 Jan 2008. The meteorite reportedly destroyed the roof of the house of Malam Bello Mohammed, in Mana Village, South Sokoto Local Government Council (on the outskirts of the city of Sokoto), and was found almost 2 m deep in the ground. The main mass reportedly weighs approximately 30 kg, and was broken into pieces with a hammer. A 240 g specimen was secured by Nigerian resident Eugene Egbe, who provided it to *Twelker*. Other pieces are reportedly with the Geological Survey Laboratory in Kaduna.
Physical characteristics: The meteorite is irregularly shaped, with deep regmaglypts, and a red-brown exterior.
Petrography: (C. Herd, *UAb*) Optical investigation of a ~2 × 3 cm polished and etched surface reveals a well-developed Widmanstatten pattern consistent with a medium octahedrite (0.9±0.2 mm; n=22). No obvious inclusions were noted. Terrestrial alteration has occured along fractures connecting to the exterior.
Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 8.6, Co = 0.51 (both wt%); Ir = 1.7, Ge = 41, As = 16.8, W = 1.1, Re = 0.16, Pt = 6.8, Cu = 158, Au = 1.6 (all μg/g).
Classification: (C. Herd, *UAb*): IIIAB iron, through comparison of bulk composition with data from Wasson and Richardson (2001).
Specimens: Type specimen consisting of one representative slice (21.9 g) at *UAb*. A 240 g mass with *Twelker*.

Stewart Valley 024 (StV 024) 36°14.991'N, 116°10.319'W
Nevada, USA
Find: 2017 Jan 07
Classification: Ordinary chondrite (H3)

Petrography: Chondrules are very sharply defined, but none appear to contain isotropic glassy mesostases, suggesting a high type-3 classification. Chondrule types include, PO, PP, POP, BO, RP and C. Olivine grains exhibit sharp optical extinction, indicative of shock stage S1. However, some of the troilite grains are polycrystalline, suggesting the rock was shocked and then annealed. Consistent with this is the occurrence of small irregular troilite grains within some grains of metallic Fe-Ni, probably a feature formed by localized shock melting. There are no observable crystalline plagioclase grains. More than 95% of the metal and troilite grains have been transformed into limonite and goethite by terrestrial weathering.

Sueilila 002 24.732°N, 14.319°W
Rio de Oro, Western Sahara
Find: 2014 May 25
Classification: Martian meteorite (Shergottite)

History: (H. Chennaoui-Aoudjehane, *FSAC*) A party of four experienced meteorite hunters (A. Bouferra, Z. Balli, A. Oubedda and M. Ouicha) had camped at a place on their way back from Sbayta to Boujdour in southern Morocco on May 24, 2014, and the next day searched there for meteorites. Mr. Zaid Balli found a 1467 g, mostly buried rock which appeared different from the background desert soil, but without fusion crust and somewhat weathered. Although following its excavation this specimen did not seem promising, they decided to search for more material anyway, and found several identical pieces within a few meters of the first stone. A sample sent to *UWS* was soon confirmed to be a shergottite. On October 17, 2014 Dr. H. Chennaoui-Aoudjehane (accompanied by M. Aoudjehane, A. Bouragaa and A. Bouferra) traveled to the find site to collect information on the coordinates. Independently, other metorite hunters visited the site during June and July, and found additional pieces. One 560 g stone was purchased by Darryl Pitt in August 2014 and a 124 g stone was purchased by Steve Arnold in October 2014.

Physical characteristics: (A. Irving, *UWS* and A. Bouragaa) The buried portion of the largest (1467 g) stone was coated by pale brown clay, but the small area that was exposed is brown with dark phenocrysts visible. The cut interiors of both the 560 g and 124 g stones have a mottled brown appearance with larger, deep brown phenocrysts. All stones have a weathering rind up to several millimeters thick.

Petrography: (A. Irving and S. Kuehner, *UWS*) Porphyritic texture. Euhedral to subhedral, zoned olivine phenocrysts (up to 2.2 mm) are set in a finer grained groundmass composed predominantly of zoned, prismatically-twinned pyroxene and maskelynite with accessory olivine, chromite, ilmenite, Mg-bearing merrillite and pyrrhotite. Olivine phenocrysts contain numerous tiny inclusions of chromite, as well as sparse melt inclusions (now composed of low-Ca pyroxene, silica polymorph, plagioclase, merrillite, pentlandite and glass) surrounded by radial cracks. Cores of olivine grains are orange in thin section, whereas olivine rims, groundmass olivine and groundmass pyroxene are all pale tan in color. Terrestrial weathering effects include orange staining of groundmass opaque minerals and minor thin calcite veinlets.

Geochemistry: Olivine phenocrysts (cores $Fa_{19.1\text{-}20.4}$, N = 3, rims $Fa_{36.9\text{-}39.5}$, N = 2, FeO/MnO = 48-55), groundmass olivine ($Fa_{47.2\text{-}48.7}$, FeO/MnO = 53-57, N = 2), orthopyroxene cores ($Fs_{16.5\text{-}21.7}Wo_{2.2\text{-}3.5}$, FeO/MnO = 25-27, N = 2), pigeonite ($Fs_{32.2\text{-}34.1}Wo_{11.0\text{-}11.5}$, FeO/MnO = 36, N = 3), plagioclase ($An_{60.9\text{-}62.1}Or_{1.4\text{-}1.9}$, N = 3).

Classification: Martian (shergottite, olivine-phyric).

Specimens: 21 g including one polished thin section and one polished slice at *UWB*; 20 g at *FSAC*. The remaining material is held by *DPitt*, Mr. S. Arnold, Mr. A. Bouragaa and Mr. A. Bouferra.

Taltal 001 25°29’19’’S, 70°02’28’’W
Antofagasta, Chile
Find: 2016 Jan 14
Classification: Ordinary chondrite (H3)
History: The meteorite was found in 2016 during a field trip in the Atacama desert.
Physical characteristics: Dark brownish individual without fusion crust.
Petrography: The meteorite shows a chondritic texture with often slightly flattened and loosely packed chondrules (mean diameter about 0.4 mm) in a more fine-grained matrix that contains sulfides and abundant FeNi metal.

Tintigny 49.683786°N, 5.532957°E
Luxembourg, Belgium
Probable fall: Feb. 1971
Classification: HED achondrite (Eucrite, polymict)
History: (S. de Foestraets, S. Liégeois and V. Debaille): In February 1971, Mr. Eudore Schmitz was working in his barn in the village of Tintigny late in the afternoon, when he heard a noise from the roof of the building. Going upstairs, he found a hole in a tile and a black stone on the floor. The school teacher of the children, Albert Rossignon, confirmed it was a meteorite and kept the stone, hoping for further investigation. The teacher later started religious seminary and became a priest. While he kept the meteorite, and showed it from time to time to visitors and children, the story never spread. Schmitz died in 2006. In 2017, after reading a popular article about Belgian expeditions in Antarctica to find meteorites, Priest Rossignon contacted Vinciane Debaille at *ULB*. After several contacts, the Schmitz’s 3 children, Jean-Paul, Joseph and Rita Schmitz, and his widow, Madam Germaine Mathu, donated the meteorite to *RBINS*. Some parts of the meteorite are now missing due to the handling of the stone by various people over the years, but Priest Rossignon confirms that the fusion crust was initially complete with even a piece of the tile stuck on it. Cracks were already visible at that time. The fusion crust is still fresh and shiny with preserved flow lines. The punched tile was recovered from the roof in 2018, as the hole was simply covered by another transparent tile.
Physical characteristics: A single stone partly covered with fresh glassy fusion crust. Light-gray brecciated interior hosts darker (dark-gray to black) clasts.
Petrography: Brecciated ophitic to sub-ophitic texture. Contains low-Ca and high-Ca pyroxene (both with exsolution lamellae), plagioclase, silica polymorph, chromite, troilite, metal. Clasts with melted and variolitic (1 mm) textures are present.
Geochemistry: Low-Ca pyroxenes $Fs_{33.4\text{-}56.5}Wo_{2.6\text{-}9.4}$, average $Fs_{41.5\pm8.5}Wo_{6.3\pm2.8}$ FeO/MnO = 30.6±4.4 (n=6). Ca-pyroxene $Fs_{30.1\text{-}70.0}Wo_{10.9\text{-}38.4}$, average $Fs_{51.4\pm12.3}Wo_{22.2\pm9.3}$ FeO/MnO = 34.7±3.7 (n=8). Average plagioclase

$An_{84.1}Or_{0.5}$ (n=4). Oxygen isotopes (R. Greenwood, *OU*, UK): $\Delta^{17}O$: -0.246±0.003 per mil; $\delta^{18}O$= 3.756±0.041 per mil (n=2).
Classification: Achondrite (eucrite, polymict).
Specimens: Main mass and type specimen at *RBINS*. One polished section at Laboratoire G-TIME (*ULB*).

Troy Dry Lake 34°48.53'N, 116°33.05'W
California, United States
Find: 2017 Apr 7
Classification: Ordinary chondrite (L6)
History: A single 16.3 g stone was found by Mark Bittmann on April 7, 2017, while he was searching for meteorites on a dry lake. Subsequent searches resulted in no additional fragments or other meteorites.
Physical characteristics: Dark-brown, flat shield-shaped fragment with moderately rounded edges, and patches of relict fusion-crust that have developed a desert-polished patina.
Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred. Recrystallized coarse-grained matrix with plagioclase (60um). Interconnected shock melt veins.
Geochemistry: Olivine, $Fa_{24.7\pm0.2}$ (N=26); orthopyroxene, $Fs_{22.3\pm0.2}Wo_{2.7\pm0.2}$(N=25).
Classification: Ordinary Chondrite (L6)
Specimens: 3.5 grams at *UCLA*; main mass with *Verish*.

Turpan 001 42°33'43.03"N, 89°00'36.02"E
Xinjiang, China
Find: 26 Nov 2013
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) The meteorite was discovered by Zijian Wang 45 km SSW of Turpan City in Gaochang District on 26 Nov 2013.
Physical characteristics: (Ziyao Wang) Reddish brown heavy fractured wind eroded irregular rock of 1500 g without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) brown stainted recrystallized matrix with poor defined chondrules (0.6-1.8 mm, av. 0.7 mm).
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.81
Classification: Ordinary chondrite (L~6, W3)
Specimens: 21.9 g on deposit at *Kiel*, Wang Ziyao and Zijian Wang holds the main mass, and 108 g with *Bart*.

Twayla 001 ~26°50.2'N, ~9°11.6'W
Saguia el Hamra, Western Sahara
Find, doubtful fall: 2014 Dec
Classification: HED achondrite (Howardite)

History: The family of nomad Lahsen Duine spent the winter of 2014/2015 in the Wad La'waj Talli area, nearly 70 km NE of Bir Lahlou. Short before the end of he year, they were awakened by lightning, followed by a curious whistling noise. In March 2015, the children discovered two black stones on the ground, in the grassy scrub, while they were catching their goats. The stones were discovered within several hundred m of each other. The bigger stone was purchased in Ouarzazate in March 2017.
Physical characteristics: Two nearly complete individuals of 318 and approximately 150 g with glossy black fusion crust. Cut face shows a breccia with fragmental light and darker clasts set in a light-gray groundmass. Some fractures show penetrating fusion curst; no traces of terrestrial fillings are recognizable.
Petrography: (R. Bartoschewitz, *Bart*) Polymict breccia with at least three distinct lithologies: diogenite, eucrite and anorthosite. Ubiquitous iron-nickel metal, Fe-sulfide and chromite present.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Diogenite pyroxene $Fs_{35.0\pm0.7}Wo_{5.2\pm1.4}$, Fe/Mn=27, n=8; chromite CRAL 78.3±1.2, FFM 88.6±3.6. Eucrite pyroxene $Fs_{40.0\pm1.8}Wo_{9.4\pm2.5}$, Fe/Mn=30, n=15; plagioclase $An_{89.7\pm1.5}Or_{0.3\pm0.1}$, n=14; olivine $Fa_{38.5}$, Fe/Mn=34, n=1. Anorthositic clast $An_{93.0\pm0.8}Or_{0.3\pm0.1}$, n=5. Matrix pyroxene $Fs_{35.0\pm3.2}Wo_{5.6\pm0.9}$, Fe/Mn=28, n=9; plagioclase $An_{91.9\pm2.1}Or_{0.3\pm0.1}$, n=2; olivine $Fa_{46.3\pm12.7}$, Fe/Mn=51 , n=2; chromite CRAL 79.4±2.0, FFM 90.4±0.4; kamazite Ni 0.0-2.0, Co 0.2-0.7 wt-%, n=15, troilite.
Classification: HED achondrite (howardite)
Specimens: 20.0 g on deposit at *Kiel*, main mass with Dieter Janek, 21.5 g *Bart*.

Weiya 001 41°43'1.04"N, 94°14'30.94"E
XinJiang, China
Find: 20 Aug 2012
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Wang Ziyao in the Gobi Desert, 12 km SW Weiya and 36 km SE of Yamansu, near Hami city in Xinjiang province on Aug. 20, 2012.
Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Dark, gray-brown, flat stone of 201 g without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) Gray, porous, strongly recrystallized matrix with poorly defined chondrules and irregular metal and sulfide specks up to 0.5 mm.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.83
Classification: Ordinary chondrite (L~6, W4)
Specimens: 21.1 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 23.2 g with *Bart*.

Willcox Playa 011 32°7.0'N, 109°53.3'W
Arizona, United States
Find: 2018 Jan 22
Classification: Ordinary chondrite (L6)
History: A single stone was recovered by Mr. Chris McDoniel while he was searching for an old aircraft crash site. Field ID#: UU180122A
Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (900±100 μm, N=4). Recrystallized coarse-grained matrix with plagioclase (60 μm). Interconnected shock melt veins.
Geochemistry: Olivine, $Fa_{25.1\pm0.2.}$ N=49; orthopyroxene, $Fs_{22.4\pm0.2}Wo_{3.0\pm0.1}$, N=51.
Classification: Ordinary Chondrite (L6)
Specimens: 8.2 grams at *UCLA*; main mass with Robert *Verish*.

Wood River 50°08'N, 106°13'W
Saskatchewan, Canada
Find: Unknown
Classification: Ordinary chondrite (H5)
History: Found many years ago by the owners father along the banks of the Wood River in southern Saskatchewan. The find area is bounded by provincial highways #58 to the west; #363 to the north, #718 to the south and on the east by the Old Wives Lake bird sanctuary. The nearest villages are Coderre and Courval.
Petrography: Chondrules are readily delineated with much recrystallization. Chondrule glass is absent. Weak undulatory extinction visible in the olivine grains.
Geochemistry: Olivine composition determined by two methods: $Fa_{19.3\pm1}$ (by X-ray diffraction, *ROM*) and $Fa_{20.0\pm1.2}$% (EMPA, n=28); $Fs_{16.6\pm0.9}Wo_{1.1\pm0.1}$ (EMPA, n=9). No zoning was visible in olivine or pyroxene grains.

Wuerhe 46°01'01.1''N, 86°16'34.4''E
Xinjiang, China
Find: 2018 July 25
Classification: Ordinary chondrite (L5)
History: Three small meteorites were first found by three anonymous people who were looking for wind-erosed stones of quartz in the desert. These meteorites were confirmed by Pengli Chen. On return back to this area, 10 more pieces were found within 3 days. On September 17-19, 2018, the meteorite hunting team organized by P. Chen searched this area again, and they found 10 other pieces. Counting an additional 3 pieces recovered by anonymous finders, a total of 26 meteorites were collected in this new meteorite strewn field. The total mass is about 6 kg, and the largest piece is 1.3 kg. All of these pieces were completely covered by fusion crust.
Physical characteristics: Two of the meteorites were studied. Black melt veins and pockets can be seen in the exposed surfaces of samples.
Petrography: (Y. Xu, N. Wang and Y. Lin, *IGGCAS*) Microscopic observations of a polished mount reveal a chondritic texture with recrystallized matrix. Chondrules

are readily delineated. It consists mainly of olivine, pyroxene, plagioclase, Fe-Ni metal, and troilite. Plagioclase size is less than 50 μm. Ringwoodite and wadsleyite were found within and close to shock veins and pockets.
Geochemistry: Olivine and pyroxene have homogeneous chemical compositions. Olivine $Fa_{24.6\pm0.9}$ (n=12), orthopyroxene $Fs_{20.7\pm0.8}Wo_{1.6\pm0.2}$ (n=11), plagioclase: An_{11} (n=5)
Classification: L5 (Y Xu, N. Wang and Y. Lin, *IGGCAS*)
Specimens: 2 slices with a total mass of 136 g in *IGGCAS*, 3 pieces with a total mass of ~400 g by P. Chen. Others with anonymous owners.

Xinjiang 009
Xinjiang, China
Purchased: 2013
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Wang Ziyao from an ornamental stone dealer in Hami/Xinjiang in 2013. He reportet that he got this stone from another ornamental stone dealer, and that it was found in the desert of Xinjiang.
Physical characteristics: (Wang Ziyao) Black-brown stone of 60.3 g with adhering sand grains.
Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (1.0-1.6 mm, av. 1.0 mm)
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.32
Classification: Ordinary chondrite (LL~6, W4)
Specimens: 12.3 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 11 g with *Bart*.

Xinjiang 010
Xinjiang, China
Purchased: 2013
Classification: Ordinary chondrite (LL~6)
History: (Ziyao Wang) Purchased by Wang Ziyao from an ornamental stone dealer in Hami/Xinjiang in 2013. He reportet that he got this stone from another ornamental stone dealer, and that it was found in the desert of Xinjiang.
Physical characteristics: (Wang Ziyao) Black stone of 71.5 g with fusion crust
Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (1.0-1.6 mm, av. 1.0 mm)and irregular metal and sulphide specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.37
Classification: Ordinary chondrite (LL~6, W3)
Specimens: 15.6 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 15 g with *Bart*.

Xinjiang 011
Xinjiang, China
Find: 2014
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Wang Ziyao from Han Yongfeng Urumqi/Xinjiang in 2015. The anonymous finder reported to Han Yongfeng that this meteorite was discovered in the Lop Nur area in 2015.
Physical characteristics: (Wang Ziyao) Brown stone of 89.5 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with poor defined chondrules (0.4-1.5 mm, av. 0.6 mm)
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.70
Classification: Ordinary chondrite (L~6, W4)
Specimens: 18.5 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 14.2 g with *Bart*.

Yangguanzhen 001 39°48’04"N, 94°18’56"E
Gansu, China
Find: 2015
Classification: Ordinary chondrite (LL~6)
History: (R. Bartoschewitz, *Bart*) Discovered by Liu Binghan in the desert near near Aksay/Gansu in 2015 and was purchased by Wang Ziyao, who donated it to R. Bartoschewitz.
Physical characteristics: (R. Bartoschewitz, *Bart*) Brown 8.66 g stone.
Petrography: (R. Bartoschewitz, *Bart*) Brown stainted recrystallized matrix with nearly complete recrystallized chondrules (0.6-1.0 mm)and few metal and sulphide specks, vugs partly filled with gypsum.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.08
Classification: Ordinary chondrite (LL~6, W3)
Specimens: 1.77 g on deposit at *Kiel*, main mass of 6.5 g with *Bart*.

Yucca 045 34°45.894’N, 114°14.101’W
Arizona, United States
Find: 27 Mar 2011
Classification: Ordinary chondrite (H3-6)
History: Found with metal detector 6 inches below the surface in the Yucca DCA by Jim Wooddell March 27, 2011. Entire stone donated to *Cascadia*.
Physical characteristics: Exterior is covered with weathered fusion crust, with large patches of reddish-brown rust.

Petrography: In thin section, two distinct lithologies that appear lighter and darker in plane-polarized light are visible and have irregular and gradational boundaries. The light lithology is coarser grained and contains chondrules with boundaries integrated into their surroundings. Feldspar is variable in size, most slightly below 50 µm in diameter, but with a few larger grains. The dark lithology is dominated by fragmental material containing numerous small cryptocrystalline chondrules; BSE imaging shows that this lithology contains a mix of equilibrated silicates, with a fairly large (~25-35 area %) admixture of type 3 material (both magnesian and iron-rich olivine and pyroxene grains). This lithology also contains occasional coarse feldspar grains (most below 50 µm in diameter), coarse phosphate grains, and numerous chromite-plagioclase assemblages. FeNi carbide with some accompanying magnetite, alumnious low-calcium and high-calcium pyroxenes, and silica polymorph are present in the dark lithology. Along two edges of the section abutting the dark lithology is a small patch of shock melt (opaque in plane-polarized light) containing metal and troilite blebs, and a coarse-grained clast lacking chondrules.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Light lithology olivine ($Fa_{19.6\pm0.6}$, N=7) and low-Ca pyroxene ($Fs_{17.6\pm0.9}Wo_{1.3\pm0.2}$, N=5) are consistent with a type 5 or 6 designation. Dark lithology olivine ($Fa_{17.7\pm9.2}$, N=35) and low-Ca pyroxene ($Fs_{15.4\pm6.5}Wo_{1.2\pm1.0}$, N= 33) compositions reflect the large admixture of type 3 material. Fragments in this lithology include a partial chondrule containing dusty forsteritic olivine grains ($Fa_{0.7\pm4.0}$) and aluminum-rich diopside (6 wt% Al_2O_3) set in anorthitic glass ($An_{92}Or_0$), as well as a fragment of a ferroan chondrule with olivine ($Fa_{34\text{-}51}$) and low-Ca pyroxene ($Fs_{24}Wo_5$) set in a Na-K-rich glass. The coarse-grained clast at the edge of the section consists of equilibrated olivine ($Fa_{19.3\pm0.3}$, N=10), low-Ca pyroxene ($Fs_{16.9\pm0.2}Wo_{1.5\pm0.4}$, N=9), and feldspar ($Ab_{78.2\pm1.4}An_{14.4\pm0.7}Or_{7.4\pm0.8}$, N=2).
Classification: H3-6 finely intermixed genomict breccia. Light lithology is type 5-6 material as implied by medium to coarse feldspar grain sizes and equilibrated olivine and pyroxene; dark lithology contains type 3 material as implied by common presence of magnesian and zoned olivine. Paired with Buck Mountain Wash (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.
Specimens: *Cascadia* holds 38.0 g in two pieces, in addition to one polished thin section and a mounted butt.

Yucca 046 34°46.009’N, 114°14.415’W
Arizona, United States
Find: 12 Oct 2011
Classification: Ordinary chondrite (H3-5)
History: Found by Jim Wooddell on October 23, 2011 while searching with a metal detector. Mr. Wooddell donated the entire stone to *Cascadia* in September, 2013.
Physical characteristics: Brownish weathering patina occurs on exterior surfaces.

Petrography: In thin section, the sample appears to be relatively integrated, with many chondrule fragments and only a few complete chondrules present; distinct lithic clasts typical of a breccia are absent. The material between chondrule fragments is comprised of individual grains and smaller fragments. BSE imaging shows that most of meteorite consists of fragmental material, with an abundance of magnesian and iron-rich olivine and pyroxene grains, many of which show zoning, and which abut equilibrated fragments with typical H-chondrite compositions. Laths of a silica polymorph were observed, as well as several small chromite-plagioclase objects and merrillite grains up to 250µm across. Feldspathic material consists of glass of variable compositions and crystalline plagioclase feldspar grains typically 20-40 µm across; no grains larger than 50 µm across were observed. A single fragment 70 µm across appears to be a typical type 3 matrix lump, found adjacent to a crystalline feldspar grain. Both high- and low-Ca aluminous pyroxenes (up to 6.7 wt% Al) were observed in three chondrule fragments and as single grains, sometimes with anorthitic glass, and sometimes with forsteritic olivine (Fa<5), and spinel. In addition to these small spinel grains, an isolated zoned spinel grain (100 µm across) was observed. Fe-Ni carbide was found, along with magnetite; in one clast magnetite appears to be replacing troilite.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Sample contains a wide range of compositions of olivine ($Fs_{20.1\pm6.0}$, N=51), low-Ca pyroxene ($Fs_{15.6\pm5.3}Wo_{1.2\pm1.0}$, N= 61).
Classification: Metal abundance (9 area%) is consistent with an H chondrite. Although the chemistry and abundance of zoned grains suggests a type 3 designation, the presence of medium-sized crystalline feldspar, coarse phosphate, and chromite-plagioclase objects suggests a higher petrographic type. The thin section studied strongly resembles the "main" lithology found in the Buck Mountain Wash chondrite, suggesting that this is an H3-5 finely intermixed genomict breccia. Paired with Buck Mountain Wash(synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.
Specimens: *Cascadia* holds 9.0 g in two pieces, in addition to a polished thin section and a mounted butt.

Yucca 047 34°49.281’N, 114°16.655’W
Arizona, United States
Find: 24 Nov 2011
Classification: Ordinary chondrite (H3-6)
History: Found with metal detector in the Yucca DCA by Jim Wooddell November 24, 2011. Entire stone donated to *Cascadia*.
Physical characteristics: Exterior is covered with a brownish weathering patina.
Petrography: In thin section, the sample appears to be a relatively integrated mixture of chondrules, chondrule fragments, and indistinct fragments of chondritic clasts. The section appears dark due to the size of small fragments and individual grains that make up material interstitial to chondrules and larger fragments. One discrete lighter colored clast is visible, which lacks discernable chondrules, and

contains coarse grains of feldspar (most slightly below 50 µm in diameter, but a few larger grains). BSE imaging shows that the meteorite contains a mix of equilibrated silicates, with a fairly large (~25-35 area %) admixture of type 3 material (both magnesian and iron-rich olivine and pyroxene grains). Free copper, an FeNi carbide, and magnetite are present, as well three grains of low-Ca pyroxene with relatively high (3.6-5.8 wt% Al_2O_3) alumina content, similar to those reported for Buck Mountain Wash. Small chromite-plagioclase objects are present. Opaques show minor weathering (~5-10% replacement by Fe-hydroxides). Shock effects in olivine are variable from sharp optical extinction to a recrystallized clast, but most olivine grains in the section show undulose extinction with one set of planar fractures, indicating a shock stage of S3.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Host lithology olivine ($Fa_{19.2\pm7.0}$, N=50) and low-Ca pyroxene ($Fs_{13.1\pm5.4}Wo_{0.9\pm0.8}$, N= 47) compositions reflect the large admixture of type 3 material. A clast of higher type material has equilibrated olivine ($Fa_{19.1\pm1.2}$, N=8) and low-Ca pyroxene ($Fs_{17.0\pm0.7}Wo_{1.8\pm1.0}$, N=10) compositions.
Classification: H3-6 finely intermixed genomict breccia. Type 5-6 lithology implied by medium to coarse feldspar grain sizes and equilibrated olivine and pyroxene; type 3 lithology implied by common presence of magnesian and zoned olivine. Paired with Buck Mountain Wash (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.
Specimens: *Cascadia* holds 11.3 g in a single piece, in addition to one polished thin section and a mounted butt.

Yucca 048 34°49.402’N, 114°16.573’W
Arizona, United States
Find: 23 Sep 2012
Classification: Ordinary chondrite (H3-6)
History: Found with metal detector in the Yucca DCA by Troy Ball September 12, 2012. Entire stone donated to *Cascadia*.
Physical characteristics: Exterior is covered with weathered fusion crust, with large patches of reddish-brown rust.
Petrography: In thin section two distinct lithologies that appear lighter and darker in plane-polarized light are visible and have irregular and gradational boundaries. The light lithology is coarser grained and contains chondrules with boundaries integrated into their surroundings. Feldspar is variable in size, most slightly below 50 µm in diameter, but with a few larger grains. The dark lithology is dominated by fragmental material with only 8 complete chondrules visible; BSE imaging shows that this lithology contains a mix of equilibrated silicates, with a fairly large (~25-35 area %) admixture of type 3 material (both magnesian and iron-rich olivine and pyroxene grains). This lithology also contains a large coarse-grained clast with anhedral olivine grains up to 1mm across, a shock melt clast with zoned olivine grains set in a ferromagnesian glass, and a small (~70 µm across) chondrule that contains numerous spinel grains [(Mg0.7Fe0.3)Al2O4] and ilmenite set in a Ca,

Mg, Al-rich glass and surrounded by a shell of Al-rich low-Ca pyroxene. Abundant FeNi carbide with some accompanying magnetite is found only in the dark lithology.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Light lithology olivine ($Fa_{19.3\pm0.8.}$ N=8) and low-Ca pyroxene ($Fs_{16.8\pm0.7}Wo_{1.7\pm0.8}$) are consistent with a type 5 or 6 designation. Dark lithology olivine ($Fa_{17.6\pm9.6}$, N=22) and low-Ca pyroxene ($Fs_{13.9\pm4.8}Wo_{1.4\pm0.7}$, N= 30) compositions reflect the large admixture of type 3 material. The coarse-grained clast in the dark lithology consists of highly equilibrated olivine ($Fa_{19.0\pm0.1}$, N=8), low-Ca pyroxene ($Fs_{16.7\pm0.1}Wo_{1.4\pm0.1}$, N=5), diopside ($Fs_{5.4\pm0.3}Wo_{47.3\pm0.2}$, N=5), and feldspar ($Ab_{70.7\pm3.5}An_{24.2\pm4.5}Or_{5.1\pm1.4}$, N=8).
Classification: H3-6 finely intermixed genomict breccia. Light lithology is type 5-6 material as implied by medium to coarse feldspar grain sizes and equilibrated olivine and pyroxene; dark lithology contains type 3 material as implied by common presence of magnesian and zoned olivine (dark lithology). Paired with Buck Mountain Wash (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.
Specimens: *Cascadia* holds 19.3 g in multiple pieces, in addition to one polished thin section and a mounted butt.

Yucca 049 34°49.033’N, 114°16.238’W
Arizona, United States
Find: 01 May 2014
Classification: Ordinary chondrite (H3-5)
History: Found by Troy Ball on May 1, 2013. The entire stone was donated to *Cascadia* in September, 2013.
Physical characteristics: Stone entirely coated with weathered fusion crust, which varies in color from dark brown to reddish brown. Two small (<1 cm across) patches of crust are missing, revealing a lighter colored reddish-stained interior.
Petrography: In thin section, the sample appears to be relatively integrated, with many chondrule fragments and only a few complete chondrules present; distinct lithic clasts typical of a breccia are absent. The material between chondrule fragments is comprised of individual grains and smaller fragments. BSE imaging shows that most of meteorite consists of fragmental material, with an abundance of magnesian and iron-rich olivine and pyroxene grains, many of which show zoning, and which abut equilibrated fragments with typical H-chondrite compositions. Notable petrographic features include a fragment with zoned Fe-rich low-Ca pyroxene and coarse (up to 80 µm across) equant silica polymorph with veins and a partial rim of olivine; a large (~750 µm across) chromite-plagioclase region that encloses olivine; and an irregular fragment (~200 µm across) that contains elongate chromite-plagioclase pseudomorphs and Ca-pyroxene set in plagioclase. Coarse merrillite (up to 200 µm across) and Fe-Ni carbide was observed
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Sample contains a wide range of compositions of olivine ($Fa_{19.5\pm5.1}$, N=71), low-Ca pyroxene ($Fs_{15.6\pm6.4}Wo_{1.2\pm1.1}$, N= 44). The pyroxene-silica fragment has zoned Fe-rich low-Ca

pyroxene ($Fs_{33.5\pm6.3}Wo_{1.8\pm0.3}$, N=7); the surrounding shell and vein olivine are somewhat higher in iron ($Fs_{26.9\pm5.3}$, N=19) than the host olivine.
Classification: Although the chemistry and abundance of zoned grains suggests a type 3 designation, the presence of medium-sized crystalline feldspar, coarse phosphate, and chromite-plagioclase objects suggests a higher petrographic type. The thin section studied strongly resembles the "main" lithology found in the Buck Mountain Wash chondrite, suggesting that this is an H3-5 finely intermixed genomict breccia. Paired with Buck Mountain Wash (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.
Specimens: *Cascadia* holds the entire type specimen and main mass, which consists of 18.4 g in two pieces, in addition to a polished thin section and a mounted butt

Yucca 050 34°48.036’N, 114°15.346’W
Arizona, United States
Find: 25 Nov 2011
Classification: Ordinary chondrite (H3-5)
History: Found by Wendy Wooddell on November 25, 2011
Physical characteristics: Sample has weathered fusion crust on one side. All other exterior faces are broken surfaces which are medium-brown from weathering, showing numerous small protruding dark bumps, which appear to represent weathered metal grains
Petrography: In thin section, the sample appears to be relatively integrated, with many chondrule fragments and only a few complete chondrules present; distinct lithic clasts typical of a breccia are absent. The material between chondrule fragments is comprised of individual grains and smaller fragments. BSE imaging shows that most of meteorite consists of fragmental material, with about a 10% admixture of magnesian and iron-rich olivine and pyroxene grains, many of which show zoning, and which abut equilibrated fragments with typical H-chondrite compositions. Numerous chromite-plagioclase objects were observed, including a fragment containing chromite-plagioclase pseudomorphs after a lath-shaped phase set in a feldspathic matrix. Throughout the section, feldspathic material consists of glass of variable compositions and crystalline plagioclase feldspar grains typically 20-40 µm across; a few grains up to 70 µm across were observed. Also present are merrillite grains, some up to 250 µm across. Fe-Ni carbide was found, along with ilmenite and magnetite.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Sample contains a range of compositions of olivine ($Fa_{18.7\pm2.2}$, N=31) and low-Ca pyroxene ($Fs_{15.2\pm3.6}Wo_{1.6\pm0.8}$, N= 44).
Classification: Meteorite is an H-chondrite, based on chemistry. Although the chemistry and abundance of zoned grains suggests a type 3 designation, the presence of medium-sized crystalline feldspar, coarse phosphate, and chromite-plagioclase objects suggests a higher petrographic type. The thin section studied strongly resembles the "main" lithology found in the Buck Mountain Wash

chondrite, which is an H3-5 finely intermixed genomict breccia. Paired with Buck Mountain Wash (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.
Specimens: *Cascadia* holds 23.4 g in one piece, in addition to three polished thin sections. Wendy Wooddell retained a 3.8 g end piece.

Yucca 051 34°48.990'N, 114°16.151'W
Arizona, United States
Find: 11 Nov 2011
Classification: Ordinary chondrite (H6)
History: Found 5 cm below the surface by Jim Wooddell on November 11, 2011 while searching with a metal detector. Mr. Wooddell donated the main mass to *Cascadia*.
Physical characteristics: Sample is almost entirely covered with weathered fusion crust. A rusted light-colored interior is visible in two small patches where crust is missing.
Petrography: In thin section, the sample appears to be well integrated and relatively coarse-grained, containing chondrules with boundaries that blend into their surroundings. Crystalline plagioclase feldspar grains are typically 30-40 µm across, although a few grains > 100 µm across were observed. Metallic copper and several chromite-plagioclase objects are present.
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) The major silicate phases are equilibrated, including olivine ($Fa_{19.9\pm0.5}$, N=20), low-Ca pyroxene ($Fs_{17.3\pm0.5}Wo_{1.4\pm0.4}$, N= 16), diopside ($Fs_{6.4\pm2.0}Wo_{46.4\pm1.4}$, N= 5), and plagioclase feldspar ($Ab_{77.7\pm1.7}An_{15.1\pm1.4}Or_{7.2\pm1.1}$, N=8)
Classification: Mineral chemistry indicates an equilibrated H chondrite. A petrographic grade of 6 (near the 5/6 border) is suggested by the sample?s well-integrated texture and the sizes of the plagioclase feldspar grains.
Specimens: *Cascadia* holds 21.7 g in one piece, in addition to a polished thin section. Jim Wooddell holds a 3.8 g end cut and a polished thin section.

Yucca 052 34°45.800'N, 114°14.349'W
Arizona, United States
Find: 27 Mar 2011
Classification: Ordinary chondrite (H3-5)
History: Found with metal detector by Jim Wooddell, March 27, 2011. Cut in 3 pieces. Jim Wooddell retained 1.2 gram slice, with remainder donated to *Cascadia*.
Physical characteristics: Exterior is covered with weathered brown fusion crust.
Petrography: In plane-polarized light, the thin section consists of a main lithology composed mainly of chondrule fragments, two light and two dark clasts, and a clast with a well-defined boundary that contains delineated chondrules in a dark matrix. BSE imaging of the main lithology shows that it contains a mix of equilibrated silicates, with a fairly large (~25-35 area %) admixture of type 3 material (both

magnesian and iron-rich olivine and pyroxene grains). Feldspathic material is mainly glass, although small (less than 20 µm in diameter) feldspar grains are present. This lithology includes grains of silica polymorph, FeNi carbide, aluminous high-Ca pyroxene, chlor-apatite and merrillite. One large chondrule fragment shows signs of aqueous alteration before it was incorporated into the main lithology. This fragment consists of olivine grains that have irregular Fe-rich rims set in a pyroxene-normative glass that has rims and cross-cutting veins of Fe-rich glass. One of the two dark clasts is along the edge of the section and is dark due to the presence of an extensive web of weathering veins. The other dark clast is shock-blackened and contains numerous parallel veins of partially weathered metal and troilite. BSE imaging of the two light clasts shows that they consist of equilibrated silicates. Minerals present include phosphate grains, including a single large (> 300 µm across) grain of merrilite, plagioclase feldspar (less than 20 µm in diameter), and chromite-plagioclase assemblages. BSE imaging of the clast with well-defined chondrules shows that it consists of unequilibrated chondrules (rather than fragments) set in an Fe-rich, fine-grained matrix typical of a type 3 chondrite (hereafter referred to as the type 3 clast).
Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Light clast olivine ($Fa_{18.9\pm1.6}$, N=14) and low-Ca pyroxene ($Fs_{17.4\pm1.0}Wo_{1.1\pm0.7}$, N=10) are consistent with an H chondrite of petrographic type 5. The dark clasts were not analyzed. The main lithology has olivine ($Fa_{17.0\pm6.1}$, N=47) and low-Ca pyroxene ($Fs_{15.4\pm5.0}Wo_{1.4\pm0.9}$, N= 56) compositions suggestive of petrographic type 3, but petrographically resembles the "main lithology" of Buck Mountain Wash, which is a fragmental mixture of equilibrated and type 3 material. The type 3 clast has olivine ($Fa_{18.3\pm8.1}$, N=44) and low-Ca pyroxene ($Fs_{11.5\pm8.1}Wo_{1.1\pm1.1}$, N=35) compositions consistent with a type 3 designation. The large chondrule fragment which appears to have been aqueously altered has olivine grains with cores of $Fa_{16.3\pm2.3}$, N=10, consistent with an H-group precursor. The irregular rims on these grains are $Fa_{43.4\pm3.4}$, N=7.
Classification: H3-5 genomict breccia. Paired with Buck Mountain Wash (synonymous with Yucca 002) on the basis of mineralogy, mineral chemistry, and texture.
Specimens: *Cascadia* holds 19.8 g in two pieces, in addition to one polished thin section and a mounted butt. Jim Wooddell holds a 1.2 g slice.

Yuli 41.3°N, 86.25°E
Xinjiang, China
Find: 2015 Dec
Classification: Iron meteorite (IAB-MG)
History: The anonymous finders stated that the object was found in the neighborhood of Yuli County. The finders are unwilling to release the exact coordinates. The original informal name given to this meteorite was Mulei; this was based on a misunderstanding between the finders and the buyer. This is the name it is cataloged under in several collections.

Petrography: The meteorite is a coarsest octahedrite.
Geochemistry: Composition (based on duplicate INAA): Co, 4.67 mg/g; Ni, 60.9 mg/g; Ga, 92.1 µg/g; Ge, 444 µg/g; As, 11.7 µg/g; W, 1.33 µg/g; Ir 3.78 µg/g; Au, 1.396 µg/g . The meteorite is assigned to IAB-MG.
Classification: The meteorite is assigned to the IAB-MG. The Au and Ni are below and Co somewhat above the IAB-MG range. It could be designated IAB-MG-An, but this feature might also be produced by large sampling errors resulting in an anomalously high kamacite/taenite ratio. Most of the data for Yuli fall in the Campo del Cielo range, but the exceptionally low Ni and Au and somewhat elevated Co differ by too much for this assignment and there is good evidence that it was discovered in China.
Specimens: Type specimen at *PMO*. Main mass at *SSTM*. Only one mass is known.

2. New Dense Collection Areas (DCA)
24 Dense Collection Areas have been approved in 2018.A list of all DCAs can be found at https://www.lpi.usra.edu/meteor/DenseAreas.php.

3. Listing of institutes and collections
An up-to-date index of collections and approved repositories (next to a green check mark) cited in the Meteorite Bulletin can be found here:
https://www.lpi.usra.edu/meteor/MetBullAddresses.php?grp=country

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