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THE NORTH-AFRICAN DIAMONDIFEROUS PROVINCE

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Diamonds and the indicative minerals (pyrope, picroilmenite, and chromite) are found on a vast area of submeridional elongation of 300 km of the Reggan district in Algerian Sahara. The Bled-el-Mas ancient valley is in its centre, and here Late Pleistocene alluvials and proluvials are diamondiferous. Diamonds are represented by octahedral, dodecahedral and transitional colorless and yellowish crystals with chromite, graphite and other mineral inclusions. Among the pyropes the knorringite containing varieties of diamond association is found. As an intermediate diamond source the Early Cretaceous conglomerates are regarded, while their primary source has not yet been established.

The first diamond in North Africa was found by Ranou while sampling heavy concentrate in the west part of the Hoggar Shield. It was reported to be a roundish crystal about 40 mg associating with zircon, amphibole, martite, etc. The precise sample location however remains uncertain due to the label error. In-Hihau or In-Ziz ouadies are supposed to be the most probable places (Fig. 1). During 1957-58 and 1958-59 field seasons Thebault [1] repeated sampling which turned to be in vain. After the second season 8 diamonds were reported, but 7 of them were proved to be spinels, and one of them found in Tibegim ouady was lost.

In the 60-70's Izarov supervised determined diamond prospecting in different parts of the Hoggar Massive. He succeeded in finding a small (0.36 mm) dodecahedroid diamond, which was tested by X-ray structural analysis at the University of Algerie. This diamond was found in the southerneast part of the Hoggar invicinity of Tiririn in the eluvials of the Late Precambrian conglomerates of the Tiririan group and was associated with typical satellite minerals – pyrope and picroilmenite. Later on pyropes and picroilmenites were proved in different other places of Hoggar, including Silet, In-Hihau, Tiririn, Tegorak, and Tibegim, both in ancient and recent rocks. However, there were no other diamond discoveries.

Gradually the diamond prospecting moved northwest of Reggan. In 1975 Kon'ukhov found here a small colorless diamond chip about 2.1 mg in a sample of the Infra-Cambrian "green series". Another dodecahedric diamond about 40 mg was met in a 10-litre sample in the Quaternary. In the same 1975-76 season the pyrope aureole was established in the Quaternary which later traced all along the S-N Reggan valley. The subsequent Soviet-Algerian prospecting efforts resulted in establishing diamonds and indicating minerals in the Quaternary rocks on quite an extensive area, about 300 km long, from Tanesruft and Ahnet in the south up to El-Xebain in the north, and Aulef in the east (Fig. 2).

The Dzhebel placer of the ancient Bled-el-Mas valley is located in the central part of this region in the midst between the Reggan and Ahnet depressions. This area is underlied by the Precambrian basement and Paleozoic platform cover, transgressed by Mesozoic-Cenozoic continental succession. The Archean and Proterozoic crystalline rocks outcropping in the Hoggar Uplift are about 3.5 km deep under the cover. The oldest outcropping rocks are the so-called Infra-Cambrian strata about 2,500 m thick which are supposed to be Upper Proterozoic of Riphean.

Arenites, sandy shales, and conglomerates with gravels of schists, granites, and quartzites, interbedding with quartzose sandstones are typical of this group. It is supposed to be stratigraphically correlative with the "Purple Ahnet series" of the northern Hoggar and the Tiririan series of East Hoggar, which contained one of the first found diamonds and satellite minerals.

The Paleozoic succession transgressing the Infra-Cambrian is composed of a thick terrigenic-carbonaceous terrane slightly inclined to the west. And it is totally devoid of diamonds and satellite-minerals.

The Mesozoic formation uncomformably transgresses the Paleozoic. This is a thick succession of continental lagoon and marine sediments. The Triassic–Early Jurassic continental section is usually regarded as the "Intermediate Continental". The next stage of continental sedimentation occurred in the Pliocene-Holocene, which resulted in Plioviofranciene 10–20 m thick areal cover of gravelites, sands, and sandy shales

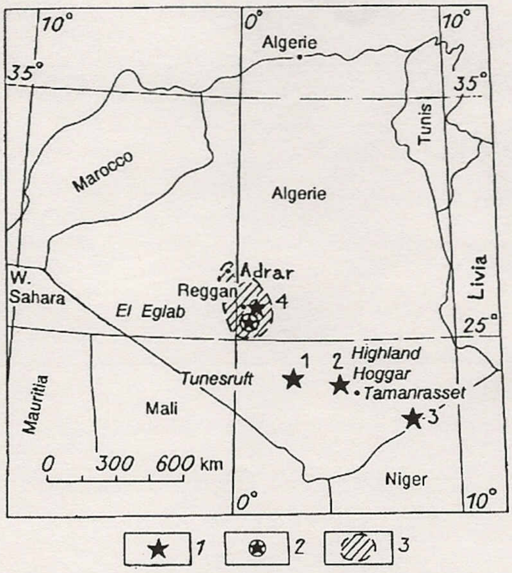

Fig. 1. North Africa diamond localities. ***1*** **— localities of diamond finding (1 — J. Ranon, 1954; 2 — J. Thebault, 1958; 3 — V. Izarov, 1969; 4 — J. Kon'ukhov, 1975);** ***2*** **— Dzhebel placer of the Bled-el-Mas valley;** ***3*** **— diamondiferous area.**

of the fluvio-lacustrine alluvial facies on the vast territory between Erg-Shesh and Hoggar. These rocks often contain pyropes, picroilmenites, and chromites.

The Bled-el-Mas valley, prominent for famous numerous diamond occurrences in the Reggan district (including the Dzhebel placer), starts at the southern escarp of the Tilikelt Plato underlain by the Lower Cretaceous sandstones and conglomerates. It is easily traced under the recent eolian sands in the submeridional direction for 90 km southward with a sharp curve in its middle part (Fig. 2). The valley is 2–4 km wide in its upper part and 8–9 km wide in its southern lower part. In some places the valley is bifurcated by the cuesta-type Paleozoic outcrops. The recent smooth surface of the valley is of deflation nature and it is mainly due to the finegrained eolian sands, transgressing the alluvials. This background is complicated by low river terraces, ouadies, sebhs, and proluvial cones.

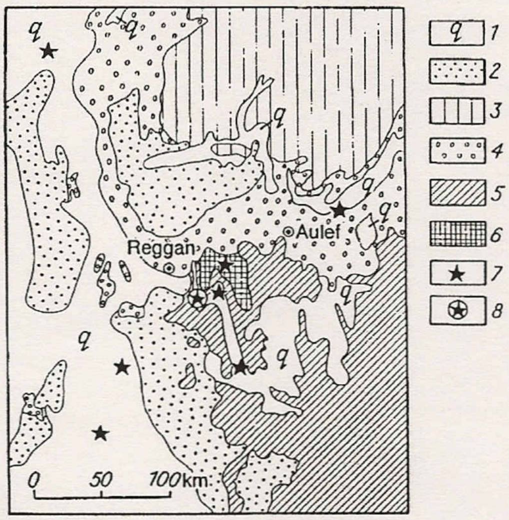

Fig. 2. Regional geology of the Reggan district. ***1*** **— Quaternary eolian sands,** ***2*** **— Plioviofrancienian sediments,** ***3*** **— Early Cretaceous,** ***4*** **— Late Jurassic—Early Cretaceous gravels and conglomerates,** ***5*** **— Paleozoic,** ***6*** **— Infra-Cambrian,** ***7*** **— diamond findings,** ***8*** **— Dzhebel placer.**

The bottom of the valley is composed of 1.5–15-m-thick alluvial-proluvial complex subdivided into two rhythms. The lower one fills the deepest parts of the valley and occurs mainly in its western marginal part. Usually it transgresses the weathering crust of the Devonian redstones up to 0.5–2.0 m thick. The final shape of the valley is supposed to have been acquired during the last Middle Holocenic mild climatic stage. In the Late Neolite a new expances of the desert resulted in river extinction and its substitution by the deflation bath with smoothed landscape and high differences not exceeding 2–3 m. The eolian sandy surface carries shallow (1.0–1.5 m) recent ouadies, arising and renovating during rare rain periods (one in 10–20 years). Ergs and isolated dunes are small (0.5–5.0 m wide and up to 100 m high) and have general northeastern orientation.

The detrital material, characteristic of the terrace and valley floor deposits, is composed of gravels (50–60 %) of medium and high roundness. The fragments of the Plioviofranciene silica-quartzose rock are rounded best of all (III–IV classes). Local sandstones, argillites, dolerites, and silicified wood are less rounded.

All these rocks, starting from the Lower Cretaceous, contain indicative minerals – pyrope, picroilmenite and chromite, pyrope sufficiently prevailing. It is composed of fairly rounded (III, IV classes) grains of red, lilac and violet color 0.4–1.55 mm in diameter. Most of them are low medium-chromium varieties with 55–60 % of the pyrope component. Sometimes the high-chromium, low-calcic garnets of the diamond assemblage, containing up to 17 % of the knorringite component among them are met.

Diamonds are constantly assayed in the lower terrace and valley floor deposits. Actually the whole alluvial-proluvial succession is diamondiferous, but the biggest stones occur in the lower sedimentation cycle. The productive basal horizon up to 2 m thick is composed of sandy gravels and is poorly cemented by clay and ferric oxides.

Morphologically the diamonds of the Bled-el-Mas valley are represented by octahedral, combined and dodecahedral crystals in 35 : 50 : 15 ratio [2]. Cubic crystals have not encountered. About 70 % of found diamonds are fragments. Colorless and yellowish stones prevail (~ 90 %), but bluish and lemone-yellow are also met. About 40 % of diamonds contain inclusions, mainly graphitic. Other inclusion minerals are sulphides, chromite, chromdiopside, garnet, etc.

The Bled-el-Mas valley diamonds reveal features specific of the marine-shores environs and intermediate reservoir. They have rounded tops, blunt and dull (sometimes totally polished) edges. Primary and secondary surfaces are shagreen. Some crystals reveal rather corroded surfaces with hummock-and-hollow or rolling relief. Sometimes etching canals filled with ferric oxides are observed; they transect several edges. Some diamonds are typical of greenish-brown and brown pigmentation spots suggesting their ancient age and passing secondary reservoir high temperature environs. Fresh chips are rare and they are found only in about 20 % of the grains. These features combined with data on abundant pyropes encountered in Lower Cretaceous continental deposits allow these layers to be envisaged as the source of the Bled-el-Mas valley diamonds.

The whole rock samples of the basal Lower Cretaceous conglomerates yield no diamonds. But they always reveal high pyrope content (up to 15–25 grains in each sample), and on the surface of the Tidikelt Plateau in the Tigfermas ouady in one of the samples there has been found a small (0.15 mm) diamond chip. Pyropes in Lower Cretaceous are established on a vast area between Adrar and Aulex and further eastward. Their amount decreases northward. Maximum concentrations are fixed in basal layers. Most of pyrope grains are small (0.3–1.0 mm) and are of red or violet color. All of them reveal pronounced mechanical reworking (class III–IV) – they have smooth even, sometimes polished, surfaces typical of the beach-submarine environments. Almost all grains are hypergenically corroded, starting from slight corrosion and up to cuboid forms.

Their composition in Lower Cretaceous and Quaternary, according to Sobolev, is the same. However their FeO (5.8–11.0 %) and Cr_2O_3 (0.8–8.5 %) content, varies sufficiently, the low- and medium-chromium varieties (2–5 % Cr_2O_3) obviously prevailing. Almost all pyropes belong to the lerzolite paragenesis, though there are met also some of the dunite-harzburgite paragenesis and some of them correspond to the diamond association (8.23 % Cr_2O_3 and 5.93 % CaO). Such pyropes are distributed unevenly, and it might be supposed that on the periphery of the Lower Cretaceous area another diamondiferous manifestations are fairly possible.

According to the available data, diamonds of the Algerian Sahara differ from diamonds of the adjacent territories. In placers of Guinea and Sierra Leone diamonds are sufficiently bigger and of higher quality, dodecahedric forms being dominant. On the another hand, minor diamonds in Ghana are typical of prevalence of platy octahedrals and cubic forms, that are not yet met in Algeria [3]. Taking into consideration sufficient distance from the reported diamond provinces, a conclusion might be done that new diamondiferous area are an autonomous province. In analogy with the South-African, Central-African, East-African and West-African provinces, it is proposed to name the North-African province. Its larger part including the primary sources, appears to be poorly understand.

The provenance of the primary sources of the diamonds turns to be a question of highest priority and concern. Taking into account Clifford's rule [4] it is to be remembered that the basement at the Sahara Plate

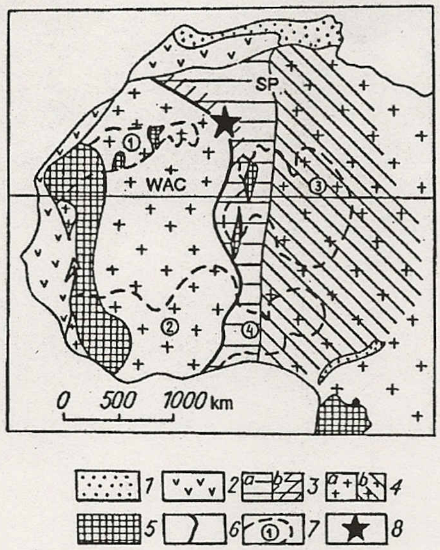

Fig. 3. Structural setting of the North-African diamond province [7]. ***1*** **— Alpides;** ***2*** **— Herzinides;** ***3–7*** **— African Platform and its basement:** ***3*** **— Pan-African basement (*a* — 650-550 Ma; *b* — rejuvenated in the Herzinian episode);** ***4*** **— Eburnean basement (*a* — 2,000–1,750 Ma; *b* — rejuvenated in the Faruzian epoch);** ***5*** **— Archean basement (3,000–2,600 Ma, granulites);** ***6*** **— the West-African cratons (WAC) and the Sahara Plate (SP) boundaries;** ***7*** **— shields: 1 — Regibat, 2 — Gvineisko-Liberian, 3 — Hoggar, 4 — Nigerian;** ***8*** **— Reggan diamond prospect.**

is Farusian (Fig. 3), which, according to Kennedy [5] is an event terminated by consolidation about 600 Ma. It is contemporaneous with the Pan-African event, or, more precisely, to its earlier stage of 650–600 Ma age. From this point of view the envisaged area might be compared with the Damara area of South Africa, which is a typical nondiamondiferous area. More over, Cabi showed that the Farusians in the northern part on their boundary with the West-African Craton underwent the Herzinian rejuvenation. On the other hand, the whole West-African Craton, including its eastern boundary was stable all along the last 2,000–1,700 Ma.

Under such structural settings according to the Clifford's rule the northeastern part of the West-African Plate, which is adjacent to the Regibat Shield, must be regarded as the most promising area for diamondiferous kimberlites. But two additional circumstances are to be considered. The first is that the Sahara Plate in the Pan-African zone contains an ancient submeridional block 450 km long, the In-Uzzel granulite block. It incorporates ancient basic and ultrabasic rocks of Eburnean age and is supposed to be stable during the last 2,000 Ma (the so-called Suggarides after Kennedy). On the other hand, the possibility of lamproitic diamond primary sources cannot be neglected. In Western Australia, lamproites occur in the Late Proterozoic folded zone, enveloping the ancient craton [6]. Such possibility cannot be excluded in the North-African province, since picroilmenites associating with diamonds reveal high alumina content, which is in contrast with kimberlitic picroilmenites.

Thus, further prospecting for diamond primary sources in the North-African province should be based mainly on the heavy concentrate sampling proven to be highly efficient on different continents for kimberlitic and lamproitic diamond deposits exploring.

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