# Synchronizing Rock Clocks of Earth History

K. F. Kuiper, *et al.*

*Science* **320**, 500 (2008);
DOI: 10.1126/science.1154339



*Science* (print ISSN 0036-8075; online ISSN 1095-9203) is published weekly, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. 

# Synchronizing Rock Clocks of Earth History

K. F. Kuiper,[1,2] A. Deino,[3] F. J. Hilgen,[1] W. Krijgsman,[1] P. R. Renne,[3,4] J. R. Wijbrans[2]

Calibration of the geological time scale is achieved by independent radioisotopic and astronomical dating, but these techniques yield discrepancies of ~1.0% or more, limiting our ability to reconstruct Earth history. To overcome this fundamental setback, we compared astronomical and $^{40}Ar/^{39}Ar$ ages of tephras in marine deposits in Morocco to calibrate the age of Fish Canyon sanidine, the most widely used standard in $^{40}Ar/^{39}Ar$ geochronology. This calibration results in a more precise older age of 28.201 ± 0.046 million years ago (Ma) and reduces the $^{40}Ar/^{39}Ar$ method's absolute uncertainty from ~2.5 to 0.25%. In addition, this calibration provides tight constraints for the astronomical tuning of pre-Neogene successions, resulting in a mutually consistent age of ~65.95 Ma for the Cretaceous/Tertiary boundary.

Accurate and precise measurement of geological time is a prerequisite for understanding Earth's history. Numerical calibration of the geological time scale (GTS) [for example, GTS2004 (*1*)] is currently based on two independent techniques: astronomical tuning of cyclic sedimentary sequences, which provides a very accurate and high-resolution age model for the youngest Neogene part of the time scale, and radioisotopic dating for older time intervals. However, the various techniques often yield statistically different ages when applied to the same stratigraphic horizons (*2*, *3*).

The radioisotopic dating technique most widely applicable to the late Cenozoic is the $^{40}Ar/^{39}Ar$ method. With careful attention to experimental design, it is possible to achieve analytical precision of 0.2% or better; however, the absolute accuracy of the technique is limited to ~2.5% (*4*, *5*), mainly because of uncertainties in the ages of standards and radioactive decay rates (*6*).

Several attempts have been made to improve the technique's accuracy by calibrating the $^{40}Ar/^{39}Ar$ dating method to the astronomical method. However, these attempts were limited by uncertainties in identifying the location of magnetostratigraphic boundaries and their correlation to the astronomical polarity time scale (*7*), assumptions regarding constancy of sedimentation rates (*7*), complications associated with the use of geochronometers such as biotite (recoil, open-system alteration) and plagioclase (excess argon) (*8*), problems associated with multigrain sanidine experiments (masking complexities in age distributions) (*3*), or uncertainties in astronomical time control (*3*, *9*).

We avoid these drawbacks by applying the single-crystal $^{40}Ar/^{39}Ar$ dating method to sanidine phenocrysts extracted from numerous silicic tephra layers intercalated in an astronomically tuned open marine succession from the Messinian Melilla Basin in Morocco. This basinal succession grades laterally into a marginal carbonate complex; the coarse-grained tephra are derived from the nearby Gourougou volcanic complex (*10*, *11*). The astronomical tuning of the basinal precession–related marl-diatomite cycles is accomplished indirectly, because the sedimentary cycles lack the expression of characteristic details related to precession amplitude and precession-obliquity interference that are common in Mediterranean sapropel sequences (*12*). Selected planktonic foraminiferal bioevents known to be synchronous throughout the Mediterranean have been identified in the Melilla sections and are correlated to well-tuned Mediterranean reference sections (Fig. 1) (*11*) that form the core of the standard Neogene time scale (*12*, *13*). The number of sedimentary cycles at Melilla between these biostratigraphic markers is consistent with the number found in these reference sections (*11*, *12*). This indirect approach allows astronomical dating of each tephra layer (Fig. 1).

Uncertainties in the astronomical ages of the radioisotopically dated tephra horizons are contingent on (i) the applied astronomical solutions, including values for tidal dissipation and dynamical ellipticity; (ii) errors in interpolation resulting from the assumption of a constant sedimentation rate between two astronomically tuned calibration points [in this case, cycles are precession tuned and errors are therefore much less than 21 thousand years (ky)]; and (iii) the lag between the orbital forcing and sedimentary expression (we assume that the lag is zero). No exact error can be calculated, but taking these uncertainties into account and provided that the tuning and correlation itself is correct, we estimate that the uncertainty in the astronomical ages for the volcanic ash layers is ±10 ky.

[1]Faculty of Geosciences, Department of Earth Sciences, Utrecht University, Budapestlaan 4, 3584 CD Utrecht, Netherlands. [2]Faculty of Earth and Life Sciences, Institute of Earth Sciences, Vrije Universiteit Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, Netherlands. [3]Berkeley Geochronology Center, 2455 Ridge Road, Berkeley, CA 94709, USA. [4]Department of Earth and Planetary Science, University of California, Berkeley, CA 94720, USA.

**Table 1.** Recalculated ages of K-T boundary and early Paleocene geomagnetic polarity-reversal boundaries, in Ma. The $^{40}Ar/^{39}Ar$ ages of (*36*–*38*) are recalculated relative to the astronomically calibrated age of FCs (28.201 ± 0.046 Ma). An age of 28.02 Ma for FCs (*4*) is adopted in GTS2004. Reversal ages in GTS2004 are based on age calibration by spline fit of selected calibration points, including the K-T boundary with an age of 65.5 Ma. Recalculated radioisotopic ages are given with full error estimate. Details on the revised astronomical tuning are given in Fig. 4. The astronomical ages for the reversal boundaries and K-T boundary are calculated by counting the number of precession cycles from the nearest 100-ky eccentricity maximum/minimum. The age is then calculated by adding or subtracting this number multiplied with the 21-ky precession period to or from the age of the nearest eccentricity maximum or minimum. The astronomical error includes, under the assumption of a correct correlation to the 100-ky eccentricity maximum or minimum, the uncertainty in the 405-ky eccentricity cycle in astronomical solution (±40 ky) [figure 25 in (*35*)] and an additional error of ±15 ky for the uncertainty in the exact position of reversal boundaries. Chron, time interval between polarity reversals of Earth's magnetic field.

| Chron / Boundary | GTS2004 (*1*) | Westerhold *et al.* (*39*) Option 1 | Westerhold *et al.* (*39*) Option 2 | Dinarès-Turell *et al.* (*33*) | Swisher *et al.* (*36*, *37*) | Izett *et al.* (*38*) | Revised tuning (this study)‖ |
|---|---|---|---|---|---|---|---|
| Reversal C28n (o) | 64.128 | 64.028 ± 0.013 | 64.385 ± 0.013 | 64.460 | 64.6 | | 64.698 ± 0.055 (64.663) |
| Reversal C29n (y) | 64.432 | 64.205 ± 0.014 | 64.572 ± 0.016 | 64.670 | 64.9 | | 64.884 ± 0.055 (64.835) |
| C29n (o) | 65.118 | 64.912 ± 0.015 | 65.282 ± 0.016 | 65.549 | 65.4 | | 65.724 ± 0.055 (65.702) |
| K-T | 65.50 ± 0.30 | 65.280 ± 0.010 | 65.680 ± 0.010 | 65.777 | 65.81 ± 0.14*<br>65.84 ± 0.12†<br>65.99 ± 0.12‡<br>65.84 ± 0.16§ | 65.98 ± 0.10§ | 65.957 ± 0.040 (65.940) |

*Melt rock of Chicxulub crater. †Sanidine of Z coal. ‡Sanidine of IrZ coal. §Haïtian tektites. ‖Bracketed ages tuned to Va03_R7 (*44*).

The $^{40}Ar/^{39}Ar$ dating of the Melilla tephra was performed in parallel at the Berkeley Geochronology Center (BGC) and the Vrije Universiteit Amsterdam (VU) (*14*). In general, $^{40}Ar/^{39}Ar$ ages measured in both laboratories are equivalent within 2σ analytical error (table S1), thus confirming a lack of significant interlaboratory bias at this level of confidence. These results can be converted to an astronomically calibrated age for Fish Canyon sanidine (FCs) by treating the Melilla sanidines as astronomically dated standards and FCs as the unknown (Fig. 2). After incorporating all known sources of error [analytical errors, uncertainty in the astronomical age, and a decay constant of 5.543 ± 0.020) × $10^{-10}$ $year^{-1}$ (*15*)], the intercomparison yielded an age of 28.198 ± 0.044 million years ago (Ma). This approach involves the $^{40}K$ total decay constant, but is insensitive to the value used or its uncertainty. A compilation of the underlying activity data and data updated with new values for other constants led Min *et al.* (*5*) to determine a value of (5.463 ± 0.214) × $10^{-10}$ $year^{-1}$ and showed the conventionally accepted error to be overly optimistic by an order of magnitude. Nonetheless, from this substantially less accurate (but more realistic) value we calculate an indistinguishable age (with negligibly increased uncertainty) of 28.201 ± 0.046 Ma for FCs. We propose that this result should be the age and uncertainty for FCs, rather than the widely used age of 28.02 ± 0.56 Ma (*4*). Our age is 0.65% older than the previous one, although given the larger uncertainty of the earlier value the two ages are statistically indistinguishable.

Comparison of our result with the U/Pb zircon age for the Fish Canyon Tuff is meaningless because of its complex crystallization history, lengthy residence time of zircon, and/or age bias due to Pb loss [for example, see (*16*–*18*)]. Comparison of conventional $^{40}Ar/^{39}Ar$ and U/Pb ages for diverse rock types over more than 3 billion years of geological time demonstrates a systematic offset, in which the U/Pb ages are older by 0 to 1% than the $^{40}Ar/^{39}Ar$ ages for the same rocks (*19*), although scatter in the offset suggests that some of the differences may result from interlaboratory biases or geological complexities. Mundil *et al.* (*20*) presented U/Pb (zircon) and $^{40}Ar/^{39}Ar$ ages for a suite of volcanic rocks between 130 Ma and 2.1 Ga; these results are likely free of detectable bias due to geological complexities (for example, magma residence time of the zircons, differential closure temperatures, or excess $^{40}Ar$) or interlaboratory

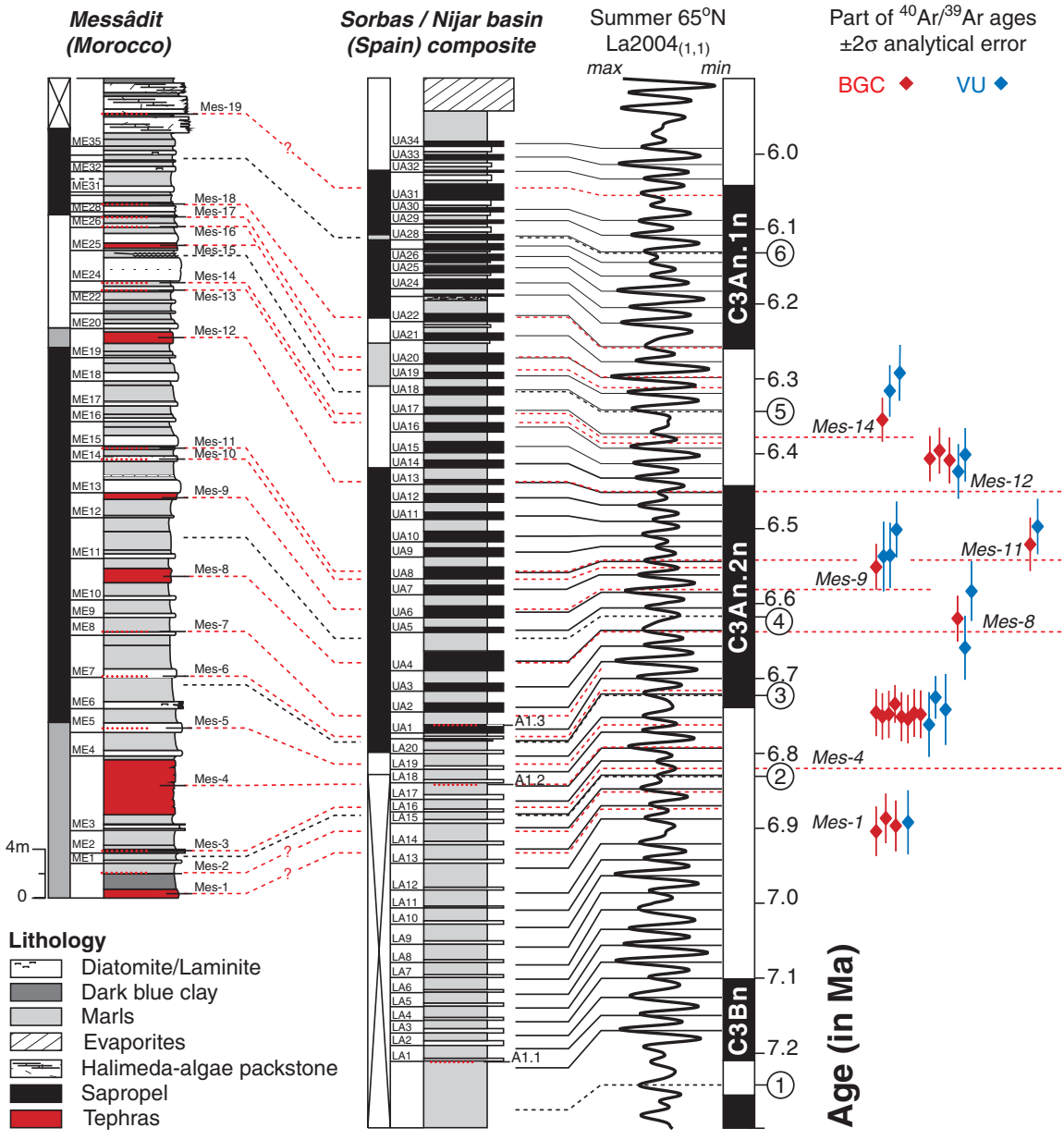



**Fig. 1.** Astronomical calibration of Messinian Messâdit section in the Melilla-Nador Basin and $^{40}Ar/^{39}Ar$ ages of intercalated tephra. The cycles are tuned to the La2004$_{(1,1)}$ solution (*35*). The main biostratigraphic marker events registered within the studied sections and used for high-resolution correlations are (1) *Globorotalia miotumida* group first regular occurrence (FRO), (2) *G. nicolae* first common occurrence (FCO), (3) *G. nicolae* last occurrence (LO), (4) *G. obesa* FCO, (5) *Neogloboquadrina acostaensis* sinistral/dextral coiling change, and (6) *N. acostaensis* first sinistral influx (*11*, *12*, *43*). The phase relation of the sedimentary cycles to orbital parameters is determined using the exact position of bioevents and characteristic planktonic foraminiferal faunal changes associated with the sedimentary cyclicity in the pre-evaporite Messinian Sorbas basin (*43*). Homogeneous marls in the Moroccan sections correspond to sapropels in Sorbas and other Mediterranean sections (*11*). Astronomical ages for the tephras are derived by linear interpolation between two astronomically tuned points (that is, three-quarters of the height from the base of the homogeneous interval in each cycle is correlated to the insolation maximum). Weighted mean $^{40}Ar/^{39}Ar$ ages of tephra intercalated in the Messâdit section and analyzed in BGC and VU are shown, calculated relative to an age of 28.02 Ma for FCs (*4*) (table S1). The 2σ error bars include only analytical uncertainties of samples and standards.

errors, and yielded an age of 28.28 ± 0.06 Ma for FCs (*21*). Thus, our astronomically tuned FCs age of 28.201 Ma is consistent at the 95% confidence level with normalization of the $^{40}Ar/^{39}Ar$ to the U/Pb system.

Further confirmation of consistency between the $^{40}Ar/^{39}Ar$ and U/Pb systems based on the proposed revised $^{40}Ar/^{39}Ar$ age of FCs comes from comparison of U/Pb and $^{40}Ar/^{39}Ar$ ages of chondritic meteorites, such as Acapulco (*22*) and Allende. A ~0.8 to 1% bias between the most accurate $^{40}Ar/^{39}Ar$ (*23*, *24*) and U/Pb (*25*, *26*) ages has classically been interpreted as evidence for slow cooling after partial melting at 4555.1 ± 1.3 Ma (Acapulco) and formation at 4566.6 ± 1.7 Ma (Allende), as determined by U/Pb dating. With the revised age for the FCs, the K/Ar and U/Pb systems approach concordancy and instead suggest that the parent body of these meteorites cooled rapidly after formation, as suggested by (U+Th)/He (*27*) and I/Xe (*28*, *29*) studies.

The astronomically calibrated FCs age thus eliminates the documented offset of the conventionally calibrated $^{40}Ar/^{39}Ar$ and U/Pb dating systems in many volcanic rocks. It also has implications for ages of geomagnetic polarity reversals over the past 3 million years (My). Numerous studies in the past two decades have demonstrated apparent consistency between the $^{40}Ar/^{39}Ar$ method and the astronomical dating approach in both sedimentary and volcanic settings, starting from a younger age for FCs or other standards (table S3). This implies that the new FCs age is not consistent with many of these results. For example, recalculating some $^{40}Ar/^{39}Ar$ dates for the Matuyama-Bruhnes reversal relative to our age for FCs yields radioisotopic ages older than the astronomical age [table S3 and references in (*14*)]. However, the most recent and comprehensive $^{40}Ar/^{39}Ar$ data (*30*), which suggested that the transition may have been diachronous, are in agreement with our intercalibration.

An important application of the astronomically calibrated $^{40}Ar/^{39}Ar$ method is to provide constraints for the astronomical tuning of pre-Neogene sequences. The prime, first-order target for tuning these older sequences is the 405-ky earth-orbital eccentricity cycle (*31*, *32*). Our method reduces the absolute uncertainty from ~2.5% (or ~1600 ky at 65 Ma) to potentially <0.25% (or <165 ky at 65 Ma), because the uncertainties in absolute amounts of radiogenic $^{40}Ar$ and $^{40}K$ in the primary standard and the branching ratio of the $^{40}K$ decay constant are circumvented using the astronomical age of the Melilla sanidines as the basis for calculating the $^{40}Ar/^{39}Ar$ age. The use of equation 5 of (*4*) enables calculation of the age of an unknown based on an age for the standard determined by means other than the K-Ar system, and requires only knowledge of the total $^{40}K$ decay constant (that is, not the branching ratio). [Full equations are provided in (*14*)].

We demonstrate the improved age resolution by examining the GTS2004 age of 65.5 Ma for the Cretaceous/Tertiary (K-T) boundary, which marks one of the most important biotic crises in Earth history. The K-T boundary section at Zumaia, Spain, which magnetostratigraphically covers the interval from the younger part of polarity interval C29r well into C26r, has been astronomically tuned and the boundary has been assigned an age of 65.777 Ma (*33*). The astronomical age of (*33*) is uncertain for two reasons: (i) the use of the potentially unstable very-long-period 2.4-My eccentricity cycle as the starting point for the tuning; and (ii) the matching of basic marl/limestone cycle packages [the E-cycles of (*33*)] to successive 100-ky eccentricity minima in the target curve, which is less certain (and stable) than the 405-ky eccentricity minima (fig. S2).

According to (*33*), the 405-ky cycle is not expressed, or only very weakly present at Zumaia. Nevertheless, this cycle can be identified on photographs, in the field, and in the lithologic log of Zumaia of (*33*) through differences in the thickness and expression of marls intercalated between 100-ky limestone beds (Fig. 3 and fig. S3). Details of the cycle pattern confirm the phase relations between the sedimentary cycles and eccentricity as inferred by (*33*). Small-scale precession-related cycles are less well developed in the limestone beds of eccentricity-related cycles, indicating that these beds indeed correspond to eccentricity minima be-

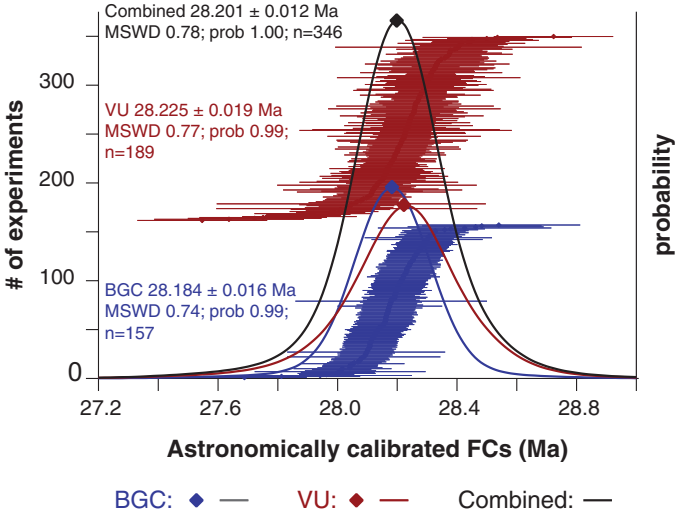



**Fig. 2.** Astronomically calibrated FCs age. The $^{40}Ar/^{39}Ar$ ages of the ash layers are converted to an astronomically calibrated age for FCs by using the Melilla sanidines as astronomically dated standards and the FCs as the unknown. Instead of doing this exercise for each tephra horizon separately, we included all reliably (both isotopic and astronomical) dated tephra to prevent an a priori bias to one of the astronomically dated tephra. However, the calibrated age is an inverse-variance weighted mean age; thus, tephra mes4, with the highest number of replicate analyses and the most precise data, dominates the final outcome. We include only the single-crystal fusion data (displayed here with 1σ analytical error), and ages with $P > 0.1$. Incremental heating experiments on selected sanidine fractions confirm the thermally undisturbed nature of the samples (*14*). We calculate an astronomically calibrated FCs age for each experiment propagating only analytical uncertainties. The weighted mean FCs age and standard analytical error for BGC and VU data are displayed separately and as a combined-age probability diagram. The 28.201 ± 0.012 Ma age for FCs is converted to an intercalibration factor of $R^{FCs}_{astro}$ of 4.3644 ± 0.0018 for a $T_{astro}$ at 6.500 Ma. This translates to 28.201 ± 0.046 Ma, including decay-constant uncertainties and the uncertainty in the astronomical ages of ±10 ky.

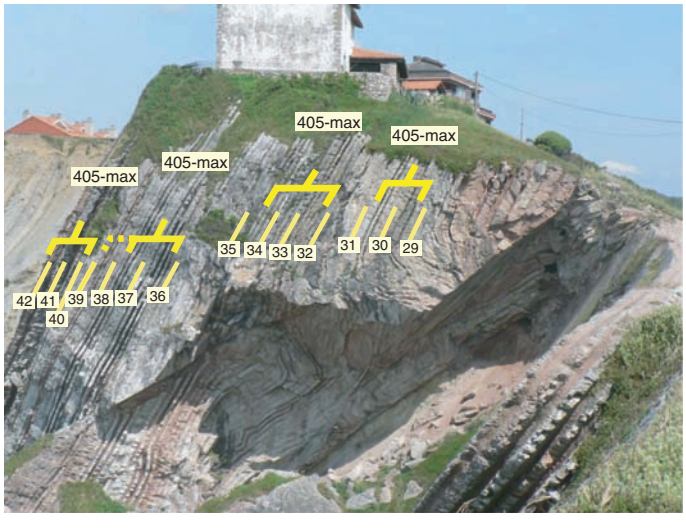



**Fig. 3.** Photo of the upper part of the Zumaia section below the San Telmo chapel. Both the 100-ky limestone beds 29 to 42 of (*33*) and the large-scale clusters of precession-related basic cycles that mark successive 405-ky eccentricity maxima are indicated (see also figs. S3, a to c). The phase relation with eccentricity is unambiguous: The marly intervals in between the 405- and 100-ky limestone beds often reveal distinct precession-related cycles, which is consistent with eccentricity maxima because eccentricity determines precessional amplitude. Eccentricity minima are marked by weakly developed precession-related cycles and are dominated by limestone beds.

cause eccentricity modulates the precession signal's amplitude.

The K-T boundary at Zumaia lies at the base of a prominent limestone-dominated interval that corresponds to a 405-ky eccentricity minimum. Successive 405-ky minima have ages of ~65.2, ~65.6, ~66.0, and ~66.4 Ma; thus, the challenge is to identify the correlative minimum. The error in the astronomical solution is on the order of 40 ky at 65 Ma [(*34*) and figure 25 in (*35*)]. To pinpoint this minimum, we recalculated published $^{40}Ar/^{39}Ar$ ages for the K-T boundary interval with our astronomical FCs age of 28.201 Ma.

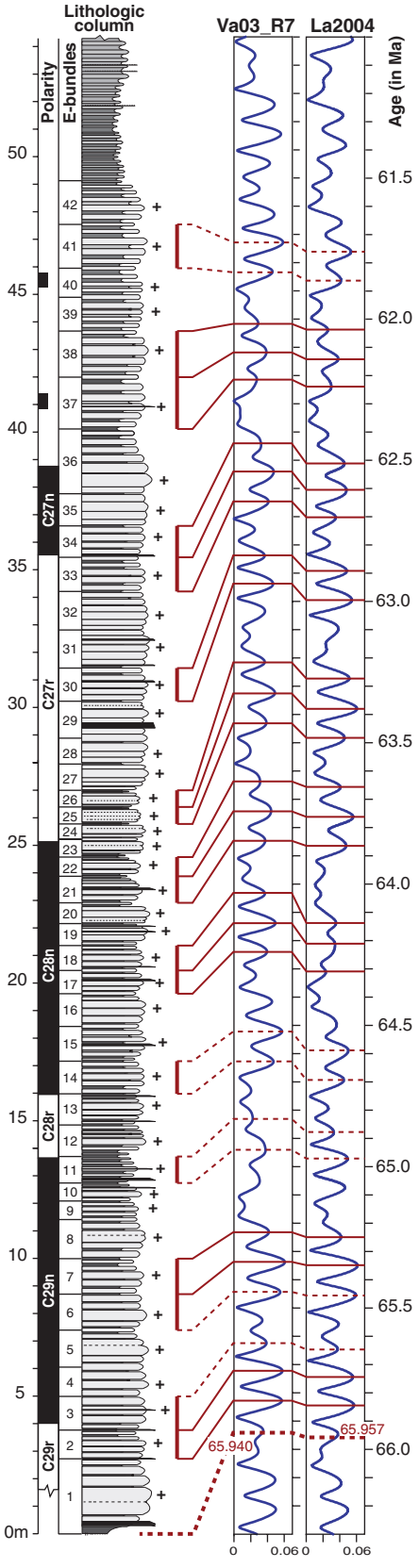



**Fig. 4.** Tuning of the K-T boundary section at Zumaia. Modified tuning of the Zumaia section following (*33*) that is consistent with the proposed intercalibration and takes the expression of the 405-ky eccentricity cycle into account. Close inspection of the lithologic log suggests that cycle bundles 1 to 14 should be tuned one 100-ky eccentricity minimum older than in (*33*) if the Va03_R7 solution is used for the tuning (note that the differences with the La2004 solution are larger). Crosses to the right of the lithological column mark midpoints of limestone-dominated parts of the 100-ky cycle that correlate with 100-ky eccentricity minima. The boundaries between the 100-ky cycles represent midpoints of the more marly intervals. Solid lines mark correlation lines in intervals in which the identification of the ~100- and 405-ky cycles is rather straightforward; dashed lines mark correlation lines in intervals in which the identification of the 405-ky cycle is less clear but supported by the number of ~100-ky and precession-related cycles. A conservative estimate of the absolute uncertainty in the 405-ky cycle around 65 Ma is ±40 ky (*35*). The estimated uncertainty of ~165 ky in the astronomically calibrated $^{40}Ar/^{39}Ar$ method at the K-T boundary gives a combined estimate of ±200 ky. This is sufficient to pinpoint the correct 405-ky maximum, because the astronomically calibrated $^{40}Ar/^{39}Ar$ ages (Table 1 and table S4) for the K-T boundary correspond closely to a 405-ky eccentricity minimum, leaving no space for tuning the K-T boundary interval one 405-ky eccentricity minimum older (K-T ~66.4 Ma) or younger (K-T ~65.6 Ma). Starting from the eccentricity tuning, the astronomical age of the K-T boundary arrives at 65.957 or 65.940 Ma for the La2004 and Va03_R7 solutions, respectively, using the average precession period (21 ky) at that time and the number of precession-related cycles (2.5) below cycle 2b, the oldest tuned 100-ky eccentricity minimum.

Single-crystal sanidine $^{40}Ar/^{39}Ar$ dates on tephra horizons are available for the same magnetostratigraphic interval in continental sections in Montana (*36*). Haïtian K-T boundary tektites and Chixulub crater melt rock have also been dated by the $^{40}Ar/^{39}Ar$ technique (*37*, *38*). These ages recalculated relative to our FCs age of 28.201 Ma range from 65.8 to 66.0 Ma (Table 1 and table S4). We regard the single-crystal sanidine ages of 65.84 Ma [of Z coal (*36*)] and especially 65.99 Ma [of IrZ coal (*36*)] as the best estimates. These ages are considerably greater than the ages reported in GTS2004, which are based on sea-floor anomaly profiles numerically calibrated by means of a limited number of isotopically dated tie points, including the K-T boundary at 65.5 Ma, using an age of 28.02 Ma for FCs. This approach pins the K-T boundary down to the 405-ky eccentricity minimum around 66.0 Ma. Using this calibration as the starting point, the Zumaia section of (*33*) was retuned, taking the newly recognized 405-ky cycle into account (Figs. 3, 4). The resultant astronomical ages for the K-T boundary and magnetic reversal boundaries are in good agreement with the revised $^{40}Ar/^{39}Ar$ ages (Table 1).

In principle, the revised astronomical age of ~65.95 Ma for the K-T boundary can be shifted upward or downward by one 405-ky eccentricity cycle, resulting in ages of either ~65.56 or ~66.4 Ma (for example, see fig. S4). However, the astronomically recalibrated $^{40}Ar/^{39}Ar$ ages allow us to exclude these ages for the K-T boundary (Table 1 and table S4). Westerhold *et al.* (*39*) similarly linked the K-T boundary to a 405-ky eccentricity minimum using Fe and magnetic susceptibility records of Ocean Drilling Program cores from the Pacific and Atlantic Ocean and including the Zumaia section in their astrochronological framework. Their preferred tuning options result in ages of 65.28 Ma (option 1) or 65.68 Ma (option 2) for the K-T boundary. A third option (66.08 Ma) was added for consistency with our astronomically calibrated age for FCs, but this option is less favored, because it results in a relatively old age of 56.33 Ma for the Paleocene/Eocene boundary, an age that is difficult to reconcile with existing, though limited, radioisotopic constraints, even when recalculated against our astronomical FCs age. However, our Zumaia tuning results in one extra 405-ky cycle compared with (*39*) for the interval between the K-T boundary and the top of the normal polarity interval of C28n. Such differences must be resolved before a tuned Paleocene time scale can be finalized. Nevertheless, our intercalibration firmly links the K-T boundary to the 405-ky eccentricity minimum around 66 Ma.

An age of ~66.0 Ma for the K-T boundary was previously incorporated in the polarity time scale of Cande and Kent (*40*). However, this seemingly identical age was interpreted to be a spurious result from the chemical preparation of volcanic ashes

found intercalated in coal beds. Redating of the sanidine in these ash beds (using an age of 27.83 Ma for the FCs) led to a revised age of ~65.0 Ma for the K-T boundary, which was adopted in (*41*). The same single-crystal sanidine dates now provide an age of ~65.95 Ma, relative to our FCs age of 28.201 Ma.

We argue that our astronomically calibrated FCs age of 28.201 Ma should be incorporated in the next standard GTS to recalculate all other $^{40}Ar/^{39}Ar$ ages after it is confirmed by independent (intercalibration) studies. Only in this way is a mutually consistent age calibration of the GTS assured. Moreover, our integrated approach may lead to a stable time scale with unprecedented accuracy, precision, and resolution that will not be forced to undergo any further substantial revisions.

**References and notes**


1. F. M. Gradstein, J. G. Ogg, A. G. Smith, *A Geologic Time Scale 2004* (Cambridge Univ. Press, Cambridge, 2004).
2. P. R. Renne, D. B. Karner, K. R. Ludwig, *Science* **282**, 1840 (1998).
3. K. F. Kuiper, F. J. Hilgen, J. Steenbrink, J. R. Wijbrans, *Earth Planet. Sci. Lett.* **222**, 583 (2004).
4. P. R. Renne *et al*., *Chem. Geol.* **145**, 117 (1998).
5. K. W. Min, R. Mundil, P. R. Renne, K. R. Ludwig, *Geochim. Cosmochim. Acta* **64**, 73 (2000).
6. All errors are stated at the 2σ level, unless stated otherwise.
7. P. R. Renne *et al*., *Geology* **22**, 783 (1994).
8. F. J. Hilgen, W. Krijgsman, J. R. Wijbrans, *Geophys. Res. Lett.* **24**, 2043 (1997).
9. J. Steenbrink, N. Van Vugt, F. J. Hilgen, J. R. Wijbrans, J. E. Meulenkamp, *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **152**, 283 (1999).
10. S. Roger *et al*., *Earth Planet. Sci. Lett.* **179**, 101 (2000).
11. E. Van Assen, K. F. Kuiper, N. Barhoun, W. Krijgsman, F. J. Sierro, *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **238**, 15 (2006).
12. W. Krijgsman, F. J. Hilgen, I. Raffi, F. J. Sierro, D. S. Wilson, *Nature* **400**, 652 (1999).
13. L. J. Lourens, F. J. Hilgen, J. Laskar, N. J. Shackleton, D. Wilson, in *The Geological Time Scale 2004*, F. M. Gradstein, J. G. Ogg, A. G. Smith, Eds. (Cambridge Univ. Press, Cambridge, 2004), pp. 409–440.
14. Materials and methods are available as supporting material on *Science* Online.
15. R. H. Steiger, E. Jäger, *Earth Planet. Sci. Lett.* **36**, 359 (1977).
16. J. I. Simon, P. R. Renne, R. Mundil, *Earth Planet. Sci. Lett.* **266**, 182 (2008).
17. O. Bachmann *et al*., *Chem. Geol.* **236**, 134 (2007).
18. M. D. Schmitz, S. A. Bowring, *Geochim. Cosmochim. Acta* **65**, 2571 (2001).
19. B. Schoene, J. L. Crowley, D. J. Condon, M. D. Schmitz, S. A. Bowring, *Geochim. Cosmochim. Acta* **70**, 426 (2006).
20. R. Mundil, P. R. Renne, K. K. Min, K. R. Ludwig, *Eos Transactions American Geophysical Union Meeting Supplement* **87**, Abstract V21A (2006).
21. J. Y. Kwon, K. W. Min, P. J. Bickel, P. R. Renne, *Math. Geol.* **34**, 457 (2002).
22. Acapulco has chondritic chemistry but lacks chondrules owing to early high-temperature metamorphism (*42*).
23. P. R. Renne, *Earth Planet. Sci. Lett.* **175**, 13 (2000).
24. E. K. Jessberger, B. Dominik, T. Staudacher, G. F. Herzog, *Icarus* **42**, 380 (1980).
25. Y. Amelin, V. Pravdivtseva, *Meteorit. Planet. Sci.* **40**, A16 (2005).
26. A. Bouvier, J. Blichert-Toft, F. Moynier, J. D. Vervoort, F. Albarede, *Geochim. Cosmochim. Acta* **71**, 1583 (2007).
27. K. Min, K. A. Farley, P. R. Renne, K. Marti, *Earth Planet. Sci. Lett.* **209**, 323 (2003).
28. R. H. Nichols, C. M. Hohenberg, K. Kehm, Y. Kim, K. Marti, *Geochim. Cosmochim. Acta* **58**, 2553 (1994).
29. T. D. Swindle, *Meteorit. Planet. Sci.* **33**, 1147 (1998).
30. R. S. Coe, B. S. Singer, M. S. Pringle, X. X. Zhao, *Earth Planet. Sci. Lett.* **222**, 667 (2004).
31. L. J. Lourens *et al*., *Nature* **435**, 1083 (2005).
32. H. Pälike *et al*., *Science* **314**, 1894 (2006).
33. J. Dinarès-Turell *et al*., *Earth Planet. Sci. Lett.* **216**, 483 (2003).
34. H. Pälike, J. Laskar, N. J. Shackleton, *Geology* **32**, 929 (2004).
35. J. Laskar *et al*., *Astron. Astrophys.* **428**, 261 (2004).
36. C. C. Swisher, L. Dingus, R. F. Butler, *Can. J. Earth Sci.* **30**, 1981 (1993).
37. C. C. Swisher III *et al*., *Science* **257**, 954 (1992).
38. G. A. Izett, G. B. Dalrymple, L. W. Snee, *Science* **252**, 1539 (1991).
39. T. Westerhold *et al*., *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **257**, 377 (2008).
40. S. C. Cande, D. V. Kent, *J. Geophys. Res.* **97**, 13917 (1992).
41. W. A. Berggren, D. V. Kent, C. C. Swisher, M.-P. Aubry, *Geochronology, Time Scales and Global Stratigraphic Correlation, SEPM Special Publication* **54**, 129 (1995).
42. T. J. McCoy *et al*., *Geochim. Cosmochim. Acta* **60**, 2681 (1996).
43. F. J. Sierro, F. J. Hilgen, W. Krijgsman, J. A. Flores, *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **168**, 141 (2001).
44. F. Varadi, B. Runnegar, M. Ghil, *Astrophys. J.* **592**, 620 (2003).


45. The project was funded by grants 750.198.02 and 814.01.004 of the Netherlands Organisation for Scientific Research to K.K., and supported by NSF grant EAR-9903078 to P.R. and A.D. P.R. and A.D.'s work was also supported by the Ann and Gordon Getty Foundation. Mineral separation facilities at VU were provided by Roel van Elsas.


**Supporting Online Material**

www.sciencemag.org/cgi/content/full/320/5875/500/DC1
Materials and Methods
SOM Text
Figs. S1 to S4
Tables S1 to S4
References


18 December 2007; accepted 6 March 2008
10.1126/science.1154339




# REPORTS

# Sign Change of Poisson's Ratio for Carbon Nanotube Sheets


**Lee J. Hall,[1] Vitor R. Coluci,[2] Douglas S. Galvão,[2] Mikhail E. Kozlov,[1] Mei Zhang,[1]* Sócrates O. Dantas,[3] Ray H. Baughman[1]†**



Most materials shrink laterally like a rubber band when stretched, so their Poisson's ratios are positive. Likewise, most materials contract in all directions when hydrostatically compressed and decrease density when stretched, so they have positive linear compressibilities. We found that the in-plane Poisson's ratio of carbon nanotube sheets (buckypaper) can be tuned from positive to negative by mixing single-walled and multiwalled nanotubes. Density-normalized sheet toughness, strength, and modulus were substantially increased by this mixing. A simple model predicts the sign and magnitude of Poisson's ratio for buckypaper from the relative ease of nanofiber bending and stretch, and explains why the Poisson's ratios of ordinary writing paper are positive and much larger. Theory also explains why the negative in-plane Poisson's ratio is associated with a large positive Poisson's ratio for the sheet thickness, and predicts that hydrostatic compression can produce biaxial sheet expansion. This tunability of Poisson's ratio can be exploited in the design of sheet-derived composites, artificial muscles, gaskets, and chemical and mechanical sensors.


When stretched, most materials contract in both lateral dimensions to decrease stretch-induced volume change. The ratio of percent lateral contraction to percent applied tensile elongation is the Poisson's ratio. Some rubbers have Poisson's ratios of about 0.5 for both lateral directions, so their volume does not appreciably change upon stretching. In very rare materials the sum of Poisson's ratios for lateral dimension changes exceeds unity, so they increase density when stretched and, inversely, expand in at least one direction when hydrostatically compressed (*1*). If a lateral dimension expands during stretching, the associated Poisson's ratio is negative and the material is called auxetic (*2*). Recent interest in this counterintuitive behavior originated from pioneering discoveries that partially collapsed foams and honeycombs (*2*, *3*), fibrillar polymers (*4*), and polymer composites (*5*) can be auxetic.

Poisson's ratio was unknowingly used 2000 years ago in the empirical selection of cork for wine bottle stoppers. Cork stoppers have a near-zero Poisson's ratio for radial directions when subjected to orthogonal uniaxial stress (*6*). A positive Poisson's ratio makes a stopper difficult to insert but easy to remove, and the reverse occurs for a negative Poisson's ratio.

Carbon nanotube sheets (buckypaper) were fabricated (*7*, *8*) by filtration of aqueous dispersions of single-walled nanotubes (SWNTs) (*9*) and multiwalled carbon nanotubes (MWNTs) (*10*) produced by chemical vapor deposition, a technique reminiscent of ancient methods for making writing paper by drying a fiber slurry. The SWNTs are seamless cylinders of graphite

# Supporting Online Material for

## Synchronizing Rock Clocks of Earth History

K. F. Kuiper, A. Deino, F. J. Hilgen, W. Krijgsman, P. R. Renne, J. R. Wijbrans

Published 25 April 2008, *Science* **320**, 500 (2008)

DOI: 10.1126/science.1154339

**This PDF file includes:**

**Supporting Online Material**

The supporting online material includes:

- Material and Methods with details on data treatment both at BGC and the VU.
- All relevant analytical information (tables S1, S2, fig. S1).
- Age and error equations for astronomically calibrated standard.
- $^{40}Ar/^{39}Ar$ ages for the Matuyama- Bruhnes geomagnetic polarity reversal (table S3).
- Details of revised astronomical tuning of the K-T boundary (figs. S2-4).
- Comments on existing controversy of the relation between Chixculub impact crater and K-T boundary event.
- Details on $^{40}Ar/^{39}Ar$ data of the K-T boundary (table S4).
- References.

## Material and Methods

Volcanic levels intercalated in cyclic sedimentary sequences of marl and diatomites were sampled during joint field campaigns. Mineral separations and $^{40}Ar/^{39}Ar$ analyses were performed independently both at the Vrije Universiteit Amsterdam (VU) and the Berkeley Geochronology Center (BGC). All samples were irradiated in the OSU TRIGA reactor CLICIT facility in several batches ranging from 7-20 hours irradiation time. At BGC single crystals of sanidine were either fused or incrementally heated. J-values are calculated by a planar regression over the irradiations discs. At the VU single crystals of sanidine were fused. J values are calculated by a 2nd order polynomial regression over the vial height. The neutron flux monitor FCs of 28.02 ± 0.28 Ma (*S1*) is used in all irradiations apart from VU37, which used 85G003 of 28.34 ± 0.28 Ma (*S1*). Residuals calculated for J-values are on the order of 0.1% both at BGC and the VU, in practice a slightly higher uncertainty (± 0.2-0.3% 1σ uncertainty in J) is arbitrarily used in the age calculations. Decay constants of (*S2*) are used in age calculations. Corrections factors for neutron interference reactions are $2.65 \pm 0.022 \times 10^{-4}$ for $(^{36}Ar/^{37}Ar)_{Ca}$, $6.95 \pm 0.092 \times 10^{-4}$ for $(^{39}Ar/^{37}Ar)_{Ca}$, $1.22 \pm 0.0027 \times 10^{-2}$ for $(^{38}Ar/^{39}Ar)_{K}$ and $7.3 \pm 0.92 \times 10^{-4}$ for $(^{40}Ar/^{39}Ar)_{K}$ at BGC and $2.64 \pm 0.017 \times 10^{-4}$ for $(^{36}Ar/^{37}Ar)_{Ca}$, $6.73 \pm 0.037 \times 10^{-4}$ for $(^{39}Ar/^{37}Ar)_{Ca}$, $1.211 \pm 0.003 \times 10^{-2}$ for $(^{38}Ar/^{39}Ar)_{K}$ and $8.6 \pm 0.7 \times 10^{-4}$ for $(^{40}Ar/^{39}Ar)_{K}$ at the VU (1 sigma errors). Note that all VU data have been recalculated with BGC correction factors resulting in negligible an age difference of 0.007% or less.

### *Irradiation and flux monitor procedures at BGC*

Samples were irradiated in the OSU TRIGA reactor CLICIT facility in three different irradiation batches: BGC269 in a 14h irradiation and BGC252 and BGC257 in a 20h irradiation. BGC monitors the horizontal flux gradient over 190mm diameter and 2-3 mm thick aluminum discs (*S1*). All irradiations use FCs.

At BGC J-values are calculated by a planar regression over the disc. After rigorous cleaning of the data set (i.e. omission of all data with $^{40}Ar^*$ yields < 98%, $^{39}Ar < 0.05 \times 10^{-14}$, Ca/K > 1, followed by omission of data outside 2 standard deviations) weighted mean J values for each hole containing FCs are used for this regression. If standards (and thus also samples) are measured during different periods, J values are calculated for each period and only combined when they are statistically equivalent. Residuals calculated for the standard positions from these regressions are on the order of 0.1%, in practice a slightly higher uncertainty (± 0.2% 1σ uncertainty in J) is arbitrarily used in the age calculations.

### *Irradiations and flux monitor procedures at VU*

Samples were irradiated in the OSU Triga reactor CLICIT facility in three different irradiation batches all for 7 hours (VU37, VU41 and VU42). The vertical neutron gradient flux is monitored by irradiating samples and standards in ~80mm long vials. The horizontal flux gradient in the 6mm ID vials is ignored. Irradiation VU37 uses Taylor

Creek Rhyolite sanidine (TCs) and irradiations VU41 and VU42 use FCs as neutron flux monitor.

J-values are calculated using a weighted 2nd order polynomial regression. Cleaning of the dataset is less rigorous than at BGC, but $^{40}Ar^*$ yields for FCs and TCs are in general higher than 97%. Radiogenic $^{40}Ar$ yields lower than 90%, and Ca/K > 1 are omitted. When MSWD > student's T statistic outliers are omitted until MSWD < student's T (at 95% confidence level). Then weighted mean J values and standard errors for each position in the vial are used in the weighted 2nd order polynomial regression. Residuals are on the order of 0.1 %, but in practice a slightly higher uncertainty (0.2-0.3% 1σ uncertainty in J) is arbitrarily used in the age calculations.

### *$^{40}Ar/^{39}Ar$ analytical procedures at BGC*

Samples and standards are melted using a focused $CO_2$ laser to extract trapped argon from the crystals. Gasses are exposed to a -130ºC cold trap to remove $H_2O$ and to SAES getters to remove reactive compounds. Samples, standards, blanks and air aliquots are measured during a fixed period of 1800 seconds in ~13 scans. Baseline is measured at masses 35.6 and 36.4 at the beginning and end of an analysis. A series of air measurements (n = 4-8) is typically performed at the beginning and end of a series run (after bake out and before sample change). Further single air pipettes are analyzed every ~10 unknowns. Depending on their behavior blanks are measured every one or two unknowns. $^{40}Ar/^{39}Ar$ dating procedures at BGC are described in detail elsewhere (*S1*).

### *$^{40}Ar/^{39}Ar$ analytical procedures at VU*

Samples are melted with a 20W continuous wave argon ion laser. Samples and standards are preheated with a defocused laser beam at ~1.8W to remove contaminating volatiles before melting. Gasses are exposed to SAES getters during 300 seconds, followed by measurement of the argon isotopes on a MAP 215-50 mass spectrometer. The mass spectrometer is operated with a modified version of the standard MAP software that allows data collection for argon using a Johnston's SEM collector. Measurements are performed in 10-12 scans in a peak jumping mode from m/e 40 to m/e 35.5 in half mass intervals. Baselines in each scan consist of typically 4-6 integration cycles, $^{37}Ar$ and $^{38}Ar$ peaks consist of 8-12 integration cycles and $^{40}Ar$, $^{39}Ar$ and $^{36}Ar$ of 12-16 integration cycles per scan. The mean value of each integration cycle is stored in a raw data file together with the number of scans and the time elapsed since the inlet of the gas into the mass spectrometer. System blanks are generally measured every 3 or 4 steps. The total system blanks are in the range of 1-10 $\times 10^{-17}$ moles for mass 40, 1-5 $\times 10^{-18}$ moles for mass 39, 38 and 36 and 1-3 $\times 10^{-17}$ moles for mass 37. Mass discrimination (1.002-1.0100 per atomic mass unit) was monitored by frequent analysis of $^{40}Ar/^{38}Ar$ reference gas or $^{40}Ar/^{36}Ar$ air pipette aliquots. Further details on $^{40}Ar/^{39}Ar$ dating procedures at VU are described in detail elsewhere (*S3, S4*).

***Data reduction, age calculation and error propagation***

$^{40}Ar/^{39}Ar$ ages are calculated with decay constants of Steiger and Jäger (*S2*) and an age of 28.02 Ma for FCs and 28.34 Ma for TCs (*S1*). At the VU the in-house developed ArArCALC program is used for reduction of the raw $^{40}Ar/^{39}Ar$ data. Details on procedures and algorithms can be found in Koppers (*S5*). At BGC the in-house developed argon data acquisition and data reduction program "Mass Spec" (by A. Deino) is used for data reduction. In both BGC and VU regression lines are calculated, in general by exponential fitting of $^{40}Ar$ and $^{39}Ar$ and linear fits for $^{38}Ar$, $^{37}Ar$ and $^{36}Ar$. Blank correction is done by either a (linear or smoothing) trend through a series of blanks or by bracketing blanks (using linear interpolation). Mass discrimination factors are generally based on linear interpolation.

All analytical information is given in the supplementary tables S1, S2. Ages are calculated with $1\sigma$ analytical error (i.e. only the error in the $^{40}Ar^{*}/^{39}Ar_K$ ratio of the sample is included) and $\pm 1\sigma$(J) including the error in the $^{40}Ar^{*}/^{39}Ar_K$ ratio of the standard as well.

***Outlier detection***

Approaches in detections of outliers between BGC and VU differ at some points. At BGC data yielding either "low" radiogenic $^{40}Ar^{*}$ (i.e. <97% for unknowns and <98% for FCs), Ca/K ratios > 1 and/or small amounts of $^{39}Ar$ ($<0.05 \times 10^{-14}$ moles) are immediately discarded. Outliers in the remaining data set are first visually assessed and extreme outliers (i.e. >1 Ma younger/older than expected age) are rejected. Next, a 1.5 nMad criteria is used for rejection of outliers, which appeared to be a very efficient semi-quantitative way to recognize outliers.

At the VU data yielding either Ca/K ratios > 1 and/or small amounts of $^{39}Ar$ ($<0.05 \times 10^{-14}$ moles) are also immediately discarded, but criteria for low radiogenic $^{40}Ar^{*}$ yields are less rigorous (i.e. data with $^{40}Ar^{*}$ < 85% are excluded). "Extreme" outliers (> 1 Ma from expected age) are then omitted. For the remaining data the 1.5 nMad outlier criteria is applied.

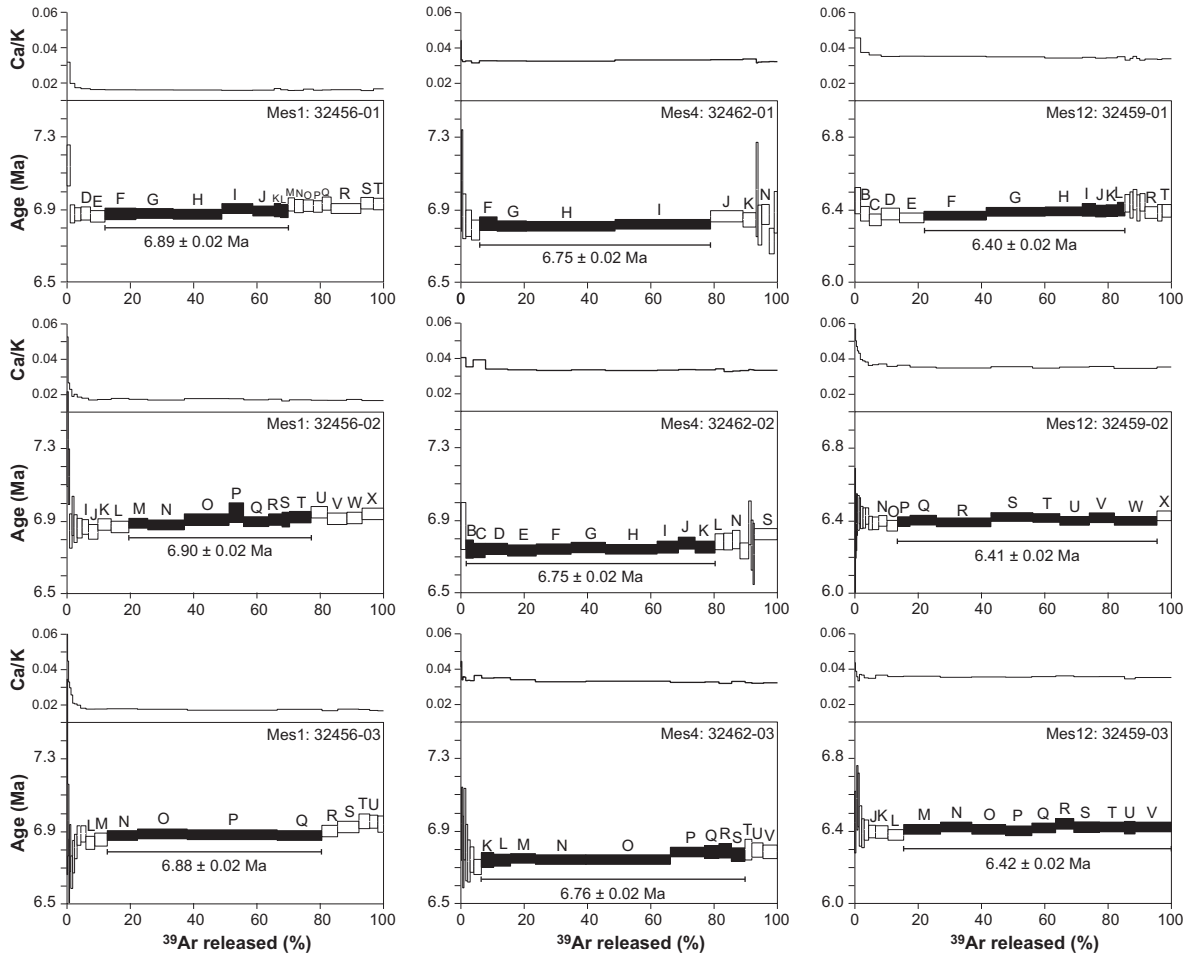



**Figure S1. Incremental heating spectra.**

Incremental heating experiments were performed at BGC on single sanidine crystals of three samples Mes1, Mes4 and Mes12. Analytical data of steps containing less than 2% of the total $^{39}Ar$ are listed in the table S2, but are never included in the plateau age. An age plateau is located on basis of MSWD with probability cut-off at 0.95 and the two outermost steps from each side of the plateau must not be significantly different than the weighted mean plateau age at 1.4σ (tolerance limit of 1.4). Radiogenic $^{40}Ar$ yields are high (>97% for all steps yielding >2% $^{39}Ar_K$) and Ca/K ratios are constant. The samples do not show complex thermal histories and this implies that total fusions instead op incremental heating experiments are justified (fig. S1). Age spectra are shown with 2 sigma error bars.

**Table S1: Summary of $^{40}Ar/^{39}Ar$ and astronomical ages in the Melilla-Nador Basin.**
Weighted mean ages with 1σ analytical errors, including analytical uncertainty in *J*, are given for each irradiation. Data are reported using sanidine from the Fish Canyon Tuff (FCs) as a dating standard with a reference age of 28.02 Ma and/or sanidine from the Taylor Creek Rhyolite (TCRs) of 28.34 Ma (*S1*) and decay constants used by convention since 1977 (*S2*). Full analytical data and summary calculations for individual irradiation experiments are available in Table S2. Astronomical ages are given in bold. Published $^{40}Ar/^{39}Ar$ ages of previous studies on the same tephras (*S6-S8*) are listed for completeness, but are not included in the intercalibration.

| Lab ID | Irradiation | Age (Ma) | ± 1σ (J) | Prob. | n |
|---|---|---|---|---|---|
| **Mes1 >6.84 Ma** | | | | | |
| 32474 | BGC252A | 6.904 | 0.016 | 0.64 | 8/8 |
| 32480 | BGC252A | 6.887 | 0.016 | 0.91 | 8/8 |
| 32486 | BGC252A | 6.897 | 0.017 | 0.75 | 6/7 |
| 01M0165 | VU37 | 6.892 | 0.021 | 0.30 | 8/8 |
| 32456-01 | BGC252PR-C | 6.893* | 0.023 | 0.60 | 7/20 |
| 32456-02 | BGC252PR-C | 6.901* | 0.023 | 0.22 | 8/24 |
| 32456-03 | BGC252PR-C | 6.880* | 0.024 | 0.99 | 4/22 |
| **Mes4 = 6.791 Ma** | | | | | |
| 22009 | BGC269A | 6.746 | 0.016 | 0.15 | 9/13 |
| 22029 | BGC269B | 6.751 | 0.016 | 0.92 | 11/11 |
| 22050 | BGC269C | 6.748 | 0.016 | 0.56 | 12/12 |
| 22071 | BGC269D | 6.734 | 0.013 | 0.92 | 17/17 |
| 22083 | BGC269E | 6.751 | 0.016 | 0.99 | 7/16 |
| 32470 | BGC252A | 6.754 | 0.016 | 0.43 | 8/8 |
| 32476 | BGC252A | 6.746 | 0.016 | 0.54 | 8/8 |
| 32482 | BGC252A | 6.748 | 0.016 | 0.37 | 9/9 |
| 01M0170/191 | VU37 | 6.762 | 0.022 | 0.00 | 4/4 |
| 01M0379 | VU41 | 6.725 | 0.014 | 0.90 | 9/10 |
| 02M0267 | VU42 | 6.742 | 0.024 | 0.72 | 10/10 |
| 32462-01 | BGC252PR-C | 6.753* | 0.023 | 0.85 | 4/16 |
| 32462-02 | BGC252PR-C | 6.746* | 0.023 | 0.89 | 10/19 |
| 32462-03 | BGC252PR-C | 6.758* | 0.023 | 0.09 | 9/22 |
| *V2 (S6)* | | 6.72 | 0.02 | | 10/10 |
| *V2 (S6)* | | 6.76 | 0.02 | | 10/10 |
| *Me-5 (S8)* | | 6.73* | 0.02 | | 3/3 |
| **Mes6 = 6.716 Ma** | | | | | |
| 01M0171 | VU37 | 6.679 | 0.024 | 0.09 | 6/6 |
| **Mes8 = 6.638 Ma** | | | | | |
| 32529 | BGC257PR-C | 6.620 | 0.015 | 0.65 | 13/15 |
| 01M0192 | VU37 | 6.659 | 0.021 | 0.17 | 5/6 |
| 02M0268 | VU42 | 6.584 | 0.020 | 1.00 | 10/10 |
| *Me-13 (S8)* | | 6.54 | 0.04 | | 10/10 |
| **Mes 9 = 6.581 Ma** | | | | | |
| 32533 | BGC257PR-C | 6.552 | 0.015 | 0.07 | 12/16 |
| 00M0239/245/246 | VU37 | 6.537 | 0.023 | 0.75 | 3/3 |
| 01M0167 | VU37 | 6.536 | 0.022 | 0.72 | 5/5 |
| 02M0270 | VU42 | 6.502 | 0.019 | 0.97 | 9/10 |
| *Me-16 (S8)* | | 6.46 | 0.03 | | 10/10 |

| | | | | | |
|---|---|---|---|---|---|
| **Mes10 = 6.552 Ma** | | | | | |
| 02M0272 | VU42 | 6.508 | 0.021 | 0.67 | 6/9 |
| **Mes11 = 6.542 Ma** | | | | | |
| 32531 | BGC257PR-C | 6.521 | 0.018 | 0.17 | 17/30 |
| 00M0160 | VU37 | 6.498 | 0.018 | 0.68 | 4/5 |
| **Mes12 = 6.452 Ma** | | | | | |
| 32472 | BGC252A | 6.407 | 0.015 | 0.68 | 8/8 |
| 32478 | BGC252A | 6.396 | 0.015 | 1.00 | 7/8 |
| 32484 | BGC252A | 6.409 | 0.015 | 0.90 | 7/8 |
| 00M0172/248/168 | VU37 | 6.402 | 0.018 | 0.36 | 6/8 |
| 02M0273 | VU42 | 6.424 | 0.018 | 0.98 | 9/10 |
| 32459-01 | BGC252PR-C | 6.396* | 0.022 | 0.68 | 7/20 |
| 32459-02 | BGC252PR-C | 6.408* | 0.021 | 0.64 | 8/24 |
| 32459-03 | BGC252PR-C | 6.419* | 0.021 | 0.86 | 10/22 |
| **Mes14 = 6.378 Ma** | | | | | |
| 32523 | BGC257PR-C | 6.355 | 0.015 | 0.88 | 11/14 |
| 01M0166 | VU37 | 6.317 | 0.017 | 0.00 | 8/8 |
| 02M0275 | VU42 | 6.293 | 0.019 | 0.51 | 9/10 |
| **Mes15 = 6.336 Ma** | | | | | |
| 02M0277 | VU42 | 6.267 | 0.019 | 1.00 | 8/8 |
| **Mes16 = 6.312 Ma** | | | | | |
| 02M0279 | VU42 | 6.264 | 0.017 | 0.92 | 10/10 |
| **Mes17 = 6.298 Ma** | | | | | |
| 00M0237/238 | VU37 | 6.231 | 0.022 | 0.60 | 3/3 |
| 00M0236 | VU37 | 6.207 | 0.027 | --- | 1/1 |
| 02M0280 | VU42 | 6.247 | 0.018 | 0.96 | 10/10 |
| **Mes18 = 6.259 Ma** | | | | | |
| 02M0302 | VU42 | 6.220 | 0.018 | 0.77 | 9/10 |
| **Ifo1 = 6.452 Ma** | | | | | |
| 02M0304 | VU42 | 6.411 | 0.016 | 0.99 | 8/10 |
| **Ifo2 = 6.442 Ma** | | | | | |
| 02M0303 | VU42 | 6.417 | 0.016 | 0.99 | 8/10 |
| **Ifo3 = 6.325 Ma** | | | | | |
| 32535 | BGC257PR-C | 6.275 | 0.014 | 0.01 | 15/16 |
| 01M0110 | VU37 | 6.276 | 0.018 | 0.00 | 8/8 |
| 02M0307 | VU42 | 6.289 | 0.016 | 0.37 | 10/10 |
| **Ifo4 = 6.280 Ma** | | | | | |
| 32537 | BGC257PR-C | 6.238 | 0.014 | 0.05 | 13/17 |
| 01M0113/193 | VU37 | 6.242 | 0.018 | 0.12 | 6/7 |
| 02M0308 | VU42 | 6.279 | 0.018 | 0.29 | 10/10 |
| **Ifo5 = 6.269 Ma** | | | | | |
| 32539 | BGC257PR-C | 6.241 | 0.014 | 0.60 | 13/17 |
| 01M0112 | VU37 | 6.229 | 0.018 | 0.84 | 6/6 |
| 02M0309 | VU42 | 6.204 | 0.017 | 0.99 | 10/10 |
| *Ro-3 (S7)* | | 6.20 | 0.02 | | 7/11 |
| **Iza = 6.794 Ma** | | | | | |
| 00M0153/01M0190 | VU37 | 6.730 | 0.017 | 0.68 | 6/11 |

*weighted mean plateau ages.

**Table S2: Analytical $^{40}Ar/^{39}Ar$ data (pages 9-20).**

Full analytical data and summary calculations for individual irradiation experiments with 1σ errors. Ages with 1σ analytical errors, including analytical uncertainty in *J*, are given for each experiment. Data are reported using sanidine from the Fish Canyon Tuff (FCs) as a dating standard with a reference age of 28.02 Ma and/or sanidine from the Taylor Creek Rhyolite (TCRs) of 28.34 Ma (*S1*) and decay constants used by convention since 1977 (*S2*).

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{39}$Ar (% of total) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar ($\times 10^{-2}$) | ± 1σ | $^{37}$Ar/$^{39}$Ar ($\times 10^{-2}$) | ± 1σ | $^{36}$Ar/$^{39}$Ar ($\times 10^{-4}$) | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Single crystal incremental heating - BGC** | | | | | | | | | | | | | | | | | | | | |
| **252PR-C:** Mes1 (32456) J = 0.005236 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32456-01A | 9.0 | 3.96E-14 | 0.97 | 0.8880 | 0.0029 | 1.3490 | 0.0056 | 1.6550 | 0.0210 | 4.410 | 0.170 | 0.03243 | 0.00042 | 85.46 | 0.7583 | 0.0061 | 7.149 | 0.058 | 0.062 | %40Ar* <97 |
| 32456-01B | 11.0 | 6.09E-14 | 1.49 | 0.7399 | 0.0017 | 1.2135 | 0.0042 | 1.0412 | 0.0096 | 0.332 | 0.066 | 0.02041 | 0.00019 | 98.79 | 0.7302 | 0.0027 | 6.884 | 0.025 | 0.033 | |
| 32456-01C | 12.0 | 7.99E-14 | 1.96 | 0.7344 | 0.0015 | 1.2149 | 0.0039 | 0.9177 | 0.0095 | 0.153 | 0.044 | 0.01799 | 0.00019 | 99.49 | 0.7299 | 0.0021 | 6.881 | 0.019 | 0.029 | |
| 32456-01D | 13.0 | 1.21E-13 | 2.96 | 0.7340 | 0.0016 | 1.2212 | 0.0031 | 0.8890 | 0.0096 | 0.131 | 0.031 | 0.01742 | 0.00019 | 99.57 | 0.7302 | 0.0019 | 6.884 | 0.018 | 0.028 | |
| 32456-01E | 14.0 | 1.89E-13 | 4.63 | 0.7306 | 0.0015 | 1.2144 | 0.0028 | 0.8639 | 0.0094 | 0.074 | 0.022 | 0.01693 | 0.00018 | 99.80 | 0.7284 | 0.0016 | 6.868 | 0.015 | 0.026 | |
| 32456-01F | 14.5 | 3.96E-13 | 9.66 | 0.7311 | 0.0014 | 1.2106 | 0.0025 | 0.8565 | 0.0057 | 0.039 | 0.011 | 0.01679 | 0.00011 | 99.94 | 0.7300 | 0.0014 | 6.882 | 0.014 | 0.025 | |
| 32456-01G | 14.5 | 4.88E-13 | 11.92 | 0.7310 | 0.0014 | 1.2068 | 0.0028 | 0.8538 | 0.0050 | 0.031 | 0.010 | 0.01673 | 0.00010 | 99.97 | 0.7301 | 0.0014 | 6.883 | 0.013 | 0.025 | |
| 32456-01H | 15.0 | 6.26E-13 | 15.29 | 0.7308 | 0.0013 | 1.2042 | 0.0027 | 0.8513 | 0.0051 | 0.035 | 0.008 | 0.01669 | 0.00010 | 99.96 | 0.7298 | 0.0014 | 6.880 | 0.013 | 0.025 | |
| 32456-01I | 15.0 | 3.99E-13 | 9.73 | 0.7332 | 0.0014 | 1.2110 | 0.0027 | 0.8428 | 0.0057 | 0.005 | 0.012 | 0.01652 | 0.00011 | 100.08 | 0.7330 | 0.0015 | 6.911 | 0.014 | 0.025 | |
| 32456-01J | 15.5 | 2.80E-13 | 6.85 | 0.7330 | 0.0014 | 1.2006 | 0.0026 | 0.8469 | 0.0075 | 0.035 | 0.016 | 0.01660 | 0.00015 | 99.95 | 0.7319 | 0.0015 | 6.900 | 0.014 | 0.025 | |
| 32456-01K | 15.5 | 8.31E-14 | 2.03 | 0.7357 | 0.0016 | 1.2094 | 0.0039 | 0.8934 | 0.0088 | 0.120 | 0.040 | 0.01751 | 0.00017 | 99.62 | 0.7322 | 0.0020 | 6.903 | 0.019 | 0.028 | |
| 32456-01L | 16.0 | 9.48E-14 | 2.31 | 0.7345 | 0.0016 | 1.1990 | 0.0036 | 0.8569 | 0.0077 | 0.089 | 0.034 | 0.01680 | 0.00015 | 99.74 | 0.7319 | 0.0019 | 6.900 | 0.018 | 0.028 | |
| 32456-01M | 16.0 | 8.08E-14 | 1.98 | 0.7365 | 0.0015 | 1.2058 | 0.0036 | 0.8382 | 0.0099 | 0.035 | 0.040 | 0.01643 | 0.00019 | 99.96 | 0.7355 | 0.0020 | 6.934 | 0.018 | 0.028 | |
| 32456-01N | 16.5 | 1.19E-13 | 2.90 | 0.7349 | 0.0016 | 1.1992 | 0.0036 | 0.8410 | 0.0110 | 0.012 | 0.029 | 0.01648 | 0.00021 | 100.05 | 0.7345 | 0.0018 | 6.925 | 0.017 | 0.027 | |
| 32456-01O | 16.5 | 1.30E-13 | 3.19 | 0.7359 | 0.0015 | 1.2041 | 0.0032 | 0.8760 | 0.0100 | 0.034 | 0.028 | 0.01717 | 0.00020 | 99.96 | 0.7348 | 0.0018 | 6.928 | 0.016 | 0.027 | |
| 32456-01P | 17.0 | 1.14E-13 | 2.80 | 0.7367 | 0.0015 | 1.2104 | 0.0033 | 0.8440 | 0.0110 | 0.076 | 0.027 | 0.01653 | 0.00021 | 99.79 | 0.7344 | 0.0018 | 6.924 | 0.016 | 0.027 | |
| 32456-01Q | 18.0 | 1.14E-13 | 2.79 | 0.7389 | 0.0016 | 1.2099 | 0.0040 | 0.8535 | 0.0090 | 0.098 | 0.028 | 0.01673 | 0.00018 | 99.70 | 0.7360 | 0.0018 | 6.939 | 0.017 | 0.027 | |
| 32456-01R | 19.0 | 3.87E-13 | 9.45 | 0.7343 | 0.0014 | 1.2050 | 0.0026 | 0.8601 | 0.0057 | 0.040 | 0.010 | 0.01686 | 0.00011 | 99.94 | 0.7331 | 0.0014 | 6.912 | 0.013 | 0.025 | |
| 32456-01S | 20.0 | 1.60E-13 | 3.92 | 0.7373 | 0.0015 | 1.2082 | 0.0032 | 0.8352 | 0.0093 | 0.026 | 0.025 | 0.01637 | 0.00018 | 99.99 | 0.7365 | 0.0017 | 6.943 | 0.016 | 0.027 | |
| 32456-01T | 24.0 | 1.31E-13 | 3.19 | 0.7363 | 0.0016 | 1.2129 | 0.0034 | 0.8860 | 0.0120 | 0.014 | 0.030 | 0.01736 | 0.00023 | 100.05 | 0.7359 | 0.0018 | 6.937 | 0.017 | 0.027 | |
| **252PR-C:** Mes1 (32456) J = 0.005236 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32456-02A | 2.0 | 3.97E-16 | 0.01 | 6.1250 | 0.0570 | 3.4100 | 0.1100 | 7.5100 | 0.9100 | 188.300 | 9.800 | 0.14700 | 0.01800 | 9.20 | 0.5700 | 0.3000 | 5.3 | 2.8 | 2.793 | %40Ar* <97 |
| 32456-02B | 3.0 | 1.50E-15 | 0.06 | 1.7599 | 0.0084 | 1.5820 | 0.0280 | 3.4300 | 0.2900 | 32.400 | 2.500 | 0.06720 | 0.00570 | 45.80 | 0.8060 | 0.0750 | 7.6 | 0.7 | 0.703 | %40Ar* <97 |
| 32456-02C | 4.0 | 7.70E-15 | 0.29 | 0.8437 | 0.0030 | 1.3640 | 0.0100 | 2.6810 | 0.0810 | 2.220 | 0.460 | 0.05260 | 0.00160 | 92.50 | 0.7800 | 0.0140 | 7.35 | 0.13 | 0.135 | %40Ar* <97 |
| 32456-02D | 5.0 | 1.32E-14 | 0.49 | 0.7663 | 0.0023 | 1.2238 | 0.0073 | 1.3520 | 0.0490 | 0.300 | 0.260 | 0.02651 | 0.00095 | 99.00 | 0.7577 | 0.0080 | 7.143 | 0.076 | 0.079 | |
| 32456-02E | 5.5 | 1.89E-14 | 0.70 | 0.7462 | 0.0018 | 1.2053 | 0.0065 | 1.1670 | 0.0370 | 0.690 | 0.160 | 0.02287 | 0.00073 | 97.39 | 0.7260 | 0.0051 | 6.845 | 0.048 | 0.053 | |
| 32456-02F | 6.0 | 1.85E-14 | 0.69 | 0.7393 | 0.0021 | 1.2266 | 0.0066 | 0.9620 | 0.0380 | 0.140 | 0.180 | 0.01886 | 0.00074 | 99.53 | 0.7351 | 0.0057 | 6.930 | 0.054 | 0.058 | |
| 32456-02G | 6.5 | 2.74E-14 | 1.01 | 0.7559 | 0.0019 | 1.2338 | 0.0057 | 1.0240 | 0.0230 | 0.970 | 0.120 | 0.02007 | 0.00045 | 96.34 | 0.7275 | 0.0040 | 6.859 | 0.038 | 0.043 | %40Ar* <97 |
| 32456-02H | 7.0 | 3.92E-14 | 1.45 | 0.7460 | 0.0016 | 1.2130 | 0.0055 | 0.9420 | 0.0200 | 0.630 | 0.079 | 0.01847 | 0.00039 | 97.61 | 0.7275 | 0.0029 | 6.859 | 0.027 | 0.035 | |
| 32456-02I | 7.5 | 5.73E-14 | 2.12 | 0.7326 | 0.0015 | 1.2097 | 0.0039 | 0.9100 | 0.0190 | 0.147 | 0.054 | 0.01784 | 0.00036 | 99.51 | 0.7283 | 0.0022 | 6.866 | 0.021 | 0.030 | |
| 32456-02J | 8.0 | 7.68E-14 | 2.85 | 0.7315 | 0.0016 | 1.2090 | 0.0039 | 0.8600 | 0.0160 | 0.204 | 0.040 | 0.01685 | 0.00031 | 99.28 | 0.7255 | 0.0020 | 6.840 | 0.019 | 0.028 | |
| 32456-02K | 8.5 | 1.16E-13 | 4.29 | 0.7301 | 0.0016 | 1.2038 | 0.0035 | 0.8730 | 0.0120 | 0.008 | 0.030 | 0.01711 | 0.00023 | 100.07 | 0.7299 | 0.0018 | 6.881 | 0.017 | 0.027 | |
| 32456-02L | 9.0 | 1.51E-13 | 5.59 | 0.7285 | 0.0016 | 1.2215 | 0.0030 | 0.9040 | 0.0100 | 0.002 | 0.025 | 0.01771 | 0.00020 | 100.10 | 0.7285 | 0.0017 | 6.869 | 0.016 | 0.027 | |
| 32456-02M | 9.5 | 1.60E-13 | 5.94 | 0.7305 | 0.0014 | 1.2142 | 0.0033 | 0.8780 | 0.0110 | 0.000 | 0.024 | 0.01721 | 0.00022 | 100.12 | 0.7306 | 0.0016 | 6.888 | 0.015 | 0.026 | |
| 32456-02N | 10.0 | 3.14E-13 | 11.61 | 0.7297 | 0.0014 | 1.2118 | 0.0027 | 0.8575 | 0.0069 | 0.010 | 0.013 | 0.01681 | 0.00014 | 100.06 | 0.7294 | 0.0014 | 6.877 | 0.013 | 0.025 | |
| 32456-02O | 10.5 | 5.35E-13 | 14.05 | 0.7335 | 0.0014 | 1.2146 | 0.0032 | 0.8995 | 0.0098 | 0.025 | 0.012 | 0.01763 | 0.00019 | 100.00 | 0.7328 | 0.0015 | 6.908 | 0.014 | 0.025 | |
| 32456-02P | 11.0 | 4.38E-13 | 4.69 | 0.7367 | 0.0026 | 1.2092 | 0.0076 | 0.8960 | 0.0310 | 0.000 | 0.038 | 0.01756 | 0.00061 | 100.13 | 0.7369 | 0.0029 | 6.948 | 0.027 | 0.034 | |
| 32456-02Q | 11.5 | 2.11E-13 | 7.81 | 0.7322 | 0.0015 | 1.2062 | 0.0029 | 0.8630 | 0.0120 | 0.025 | 0.016 | 0.01692 | 0.00023 | 100.00 | 0.7314 | 0.0015 | 6.896 | 0.014 | 0.026 | |
| 32456-02R | 12.0 | 1.13E-13 | 4.19 | 0.7342 | 0.0016 | 1.2085 | 0.0035 | 0.8809 | 0.0098 | 0.055 | 0.030 | 0.01727 | 0.00019 | 99.88 | 0.7326 | 0.0018 | 6.907 | 0.017 | 0.027 | |
| 32456-02S | 12.5 | 6.50E-14 | 2.41 | 0.7361 | 0.0016 | 1.2105 | 0.0040 | 0.8310 | 0.0140 | 0.115 | 0.052 | 0.01628 | 0.00027 | 99.63 | 0.7327 | 0.0022 | 6.907 | 0.021 | 0.030 | |
| 32456-02T | 14.0 | 1.87E-13 | 6.93 | 0.7355 | 0.0015 | 1.2096 | 0.0029 | 0.8653 | 0.0097 | 0.046 | 0.020 | 0.01696 | 0.00019 | 99.92 | 0.7341 | 0.0016 | 6.921 | 0.015 | 0.026 | |
| 32456-02U | 16.0 | 1.40E-13 | 5.16 | 0.7370 | 0.0015 | 1.2105 | 0.0031 | 0.8500 | 0.0110 | 0.000 | 0.026 | 0.01666 | 0.00021 | 100.12 | 0.7372 | 0.0017 | 6.950 | 0.016 | 0.026 | |
| 32456-02V | 19.0 | 1.62E-13 | 6.01 | 0.7356 | 0.0015 | 1.2083 | 0.0032 | 0.8491 | 0.0097 | 0.073 | 0.022 | 0.01664 | 0.00019 | 99.81 | 0.7334 | 0.0017 | 6.914 | 0.016 | 0.026 | |
| 32456-02W | 22.0 | 1.30E-13 | 4.81 | 0.7337 | 0.0015 | 1.2153 | 0.0032 | 0.8740 | 0.0130 | 0.005 | 0.027 | 0.01714 | 0.00026 | 100.08 | 0.7336 | 0.0017 | 6.916 | 0.016 | 0.027 | |
| 32456-02X | 25.0 | 1.85E-13 | 6.84 | 0.7354 | 0.0015 | 1.2049 | 0.0030 | 0.8430 | 0.0110 | 0.000 | 0.022 | 0.01652 | 0.00021 | 100.21 | 0.7362 | 0.0016 | 6.940 | 0.015 | 0.026 | |
| **252PR-C:** Mes1 (32456) J = 0.005236 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32456-03A | 2.0 | 3.14E-16 | 0.01 | 4.8440 | 0.0840 | 3.5600 | 0.1300 | 5.4000 | 1.6000 | 113.000 | 10.000 | 0.10600 | 0.03100 | 31.00 | 1.5000 | 0.3100 | 14.1 | 2.9 | 2.884 | %40Ar* <97 |
| 32456-03B | 3.0 | 1.45E-15 | 0.05 | 1.1947 | 0.0084 | 1.6810 | 0.0410 | 5.1100 | 0.3200 | 8.500 | 2.300 | 0.10010 | 0.00630 | 79.20 | 0.9460 | 0.0680 | 8.91 | 0.64 | 0.644 | %40Ar* <97 |
| 32456-03C | 4.0 | 4.03E-15 | 0.13 | 0.8585 | 0.0045 | 1.4350 | 0.0180 | 3.1400 | 0.1100 | 3.280 | 0.930 | 0.06160 | 0.00220 | 89.00 | 0.7630 | 0.0280 | 7.20 | 0.27 | 0.266 | %40Ar* <97 |
| 32456-03D | 5.0 | 1.01E-14 | 0.34 | 0.7723 | 0.0028 | 1.2874 | 0.0090 | 2.2830 | 0.0660 | 1.190 | 0.340 | 0.04470 | 0.00130 | 95.70 | 0.7380 | 0.0100 | 6.961 | 0.098 | 0.101 | %40Ar* <97 |
| 32456-03E | 5.5 | 9.65E-15 | 0.32 | 0.7413 | 0.0023 | 1.2072 | 0.0086 | 1.6790 | 0.0500 | 1.130 | 0.300 | 0.03290 | 0.00098 | 95.70 | 0.7086 | 0.0092 | 6.681 | 0.087 | 0.089 | %40Ar* <97 |
| 32456-03F | 6.0 | 1.27E-14 | 0.42 | 0.7369 | 0.0023 | 1.2047 | 0.0085 | 1.5120 | 0.0650 | 0.520 | 0.210 | 0.02960 | 0.00130 | 98.08 | 0.7220 | 0.0067 | 6.807 | 0.063 | 0.066 | |
| 32456-03G | 6.5 | 1.58E-14 | 0.53 | 0.7366 | 0.0022 | 1.2069 | 0.0072 | 1.3040 | 0.0460 | 0.990 | 0.140 | 0.02556 | 0.00089 | 96.18 | 0.7077 | 0.0048 | 6.673 | 0.045 | 0.049 | %40Ar* <97 |
| 32456-03H | 7.0 | 1.75E-14 | 0.58 | 0.7314 | 0.0021 | 1.2214 | 0.0075 | 1.0640 | 0.0260 | 0.490 | 0.140 | 0.02086 | 0.00051 | 98.15 | 0.7171 | 0.0048 | 6.761 | 0.045 | 0.049 | |
| 32456-03I | 7.5 | 2.42E-14 | 0.81 | 0.7343 | 0.0019 | 1.1951 | 0.0052 | 1.0440 | 0.0290 | 0.390 | 0.110 | 0.02047 | 0.00056 | 98.55 | 0.7229 | 0.0037 | 6.816 | 0.035 | 0.041 | |
| 32456-03J | 8.0 | 3.43E-14 | 1.14 | 0.7339 | 0.0016 | 1.2065 | 0.0053 | 1.0070 | 0.0220 | 0.163 | 0.077 | 0.01975 | 0.00043 | 99.46 | 0.7292 | 0.0028 | 6.875 | 0.027 | 0.034 | |
| 32456-03K | 8.5 | 5.00E-14 | 1.67 | 0.7347 | 0.0016 | 1.2146 | 0.0041 | 0.9200 | 0.0150 | 0.145 | 0.057 | 0.01803 | 0.00029 | 99.53 | 0.7305 | 0.0023 | 6.887 | 0.022 | 0.030 | |
| 32456-03L | 9.0 | 8.39E-14 | 2.81 | 0.7297 | 0.0016 | 1.2065 | 0.0038 | 0.8950 | 0.0140 | 0.153 | 0.035 | 0.01755 | 0.00027 | 99.48 | 0.7252 | 0.0019 | 6.837 | 0.018 | 0.028 | |
| 32456-03M | 9.5 | 1.14E-13 | 3.84 | 0.7307 | 0.0016 | 1.2091 | 0.0037 | 0.8990 | 0.0130 | 0.133 | 0.026 | 0.01762 | 0.00026 | 99.57 | 0.7268 | 0.0018 | 6.853 | 0.017 | 0.027 | |
| 32456-03N | 10.0 | 2.88E-13 | 9.64 | 0.7304 | 0.0014 | 1.2242 | 0.0028 | 0.9052 | 0.0093 | 0.033 | 0.011 | 0.01774 | 0.00018 | 99.98 | 0.7295 | 0.0015 | 6.877 | 0.014 | 0.025 | |
| 32456-03O | 11.0 | 4.71E-13 | 15.73 | 0.7307 | 0.0013 | 1.2181 | 0.0026 | 0.8899 | 0.0057 | 0.020 | 0.009 | 0.01744 | 0.00011 | 100.03 | 0.7302 | 0.0014 | 6.884 | 0.013 | 0.025 | |
| 32456-03P | 12.0 | 8.50E-13 | 28.40 | 0.7306 | 0.0014 | 1.2068 | 0.0027 | 0.8634 | 0.0074 | 0.029 | 0.005 | 0.01692 | 0.00015 | 99.99 | 0.7297 | 0.0014 | 6.880 | 0.013 | 0.025 | |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{39}$Ar (% of total) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar ($\times 10^{-2}$) | ± 1σ | $^{37}$Ar/$^{39}$Ar ($\times 10^{-2}$) | ± 1σ | $^{36}$Ar/$^{39}$Ar ($\times 10^{-4}$) | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32456-03Q | 13.0 | 4.23E-13 | 14.13 | 0.7303 | 0.0015 | 1.2114 | 0.0027 | 0.8888 | 0.0077 | 0.026 | 0.010 | 0.01742 | 0.00015 | 100.00 | 0.7296 | 0.0015 | 6.878 | 0.014 | 0.025 | |
| 32456-03R | 14.0 | 1.49E-13 | 4.98 | 0.7327 | 0.0015 | 1.2047 | 0.0035 | 0.8490 | 0.0120 | 0.019 | 0.023 | 0.01665 | 0.00024 | 100.02 | 0.7321 | 0.0017 | 6.902 | 0.016 | 0.026 | |
| 32456-03S | 16.0 | 1.99E-13 | 6.66 | 0.7359 | 0.0014 | 1.2127 | 0.0030 | 0.8945 | 0.0084 | 0.051 | 0.017 | 0.01753 | 0.00017 | 99.90 | 0.7344 | 0.0015 | 6.924 | 0.014 | 0.026 | |
| 32456-03T | 18.0 | 1.02E-13 | 3.42 | 0.7351 | 0.0019 | 1.2027 | 0.0039 | 0.8850 | 0.0130 | 0.000 | 0.033 | 0.01734 | 0.00025 | 100.47 | 0.7378 | 0.0021 | 6.956 | 0.020 | 0.029 | |
| 32456-03U | 21.0 | 7.51E-14 | 2.52 | 0.7370 | 0.0016 | 1.2092 | 0.0041 | 0.8550 | 0.0160 | 0.000 | 0.048 | 0.01676 | 0.00032 | 100.17 | 0.7375 | 0.0021 | 6.953 | 0.020 | 0.029 | |
| 32456-03V | 24.0 | 5.52E-14 | 1.85 | 0.7359 | 0.0016 | 1.2076 | 0.0046 | 0.8460 | 0.0160 | 0.000 | 0.058 | 0.01658 | 0.00031 | 100.11 | 0.7360 | 0.0023 | 6.939 | 0.022 | 0.031 | |
| **252PR-C:** Mes4 (32459) J = 0.005230 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32462-01A | 5.0 | 2.77E-15 | 0.15 | 1.2661 | 0.0046 | 1.2830 | 0.0160 | 2.2540 | 0.0750 | 15.600 | 1.500 | 0.04420 | 0.00150 | 63.70 | 0.8060 | 0.0450 | 7.59 | 0.42 | 0.425 | %40Ar* <97 |
| 32462-01B | 7.0 | 7.57E-15 | 0.41 | 0.7526 | 0.0025 | 1.2110 | 0.0099 | 1.6960 | 0.0430 | 0.340 | 0.500 | 0.03324 | 0.00083 | 98.80 | 0.7430 | 0.0150 | 7.00 | 0.14 | 0.146 | |
| 32462-01C | 9.0 | 1.81E-14 | 0.96 | 0.7311 | 0.0019 | 1.2192 | 0.0068 | 1.6460 | 0.0220 | 0.310 | 0.210 | 0.03226 | 0.00042 | 98.91 | 0.7224 | 0.0065 | 6.803 | 0.061 | 0.064 | |
| 32462-01D | 11.0 | 3.55E-14 | 1.90 | 0.7191 | 0.0016 | 1.2237 | 0.0051 | 1.6650 | 0.0230 | 0.050 | 0.120 | 0.03263 | 0.00045 | 99.99 | 0.7183 | 0.0038 | 6.764 | 0.036 | 0.042 | |
| 32462-01E | 12.0 | 4.65E-14 | 2.47 | 0.7164 | 0.0016 | 1.2044 | 0.0045 | 1.6090 | 0.0150 | 0.091 | 0.080 | 0.03154 | 0.00029 | 99.81 | 0.7143 | 0.0029 | 6.727 | 0.027 | 0.034 | |
| 32462-01F | 13.0 | 1.03E-13 | 5.52 | 0.7194 | 0.0016 | 1.2221 | 0.0032 | 1.6670 | 0.0120 | 0.067 | 0.036 | 0.03266 | 0.00024 | 99.91 | 0.7181 | 0.0019 | 6.762 | 0.018 | 0.027 | |
| 32462-01G | 14.0 | 1.74E-13 | 9.31 | 0.7175 | 0.0014 | 1.2140 | 0.0032 | 1.6640 | 0.0120 | 0.051 | 0.024 | 0.03261 | 0.00023 | 99.98 | 0.7166 | 0.0016 | 6.749 | 0.015 | 0.026 | |
| 32462-01H | 15.0 | 5.24E-13 | 27.95 | 0.7172 | 0.0014 | 1.2137 | 0.0028 | 1.6583 | 0.0078 | 0.047 | 0.009 | 0.03250 | 0.00015 | 99.99 | 0.7164 | 0.0014 | 6.747 | 0.013 | 0.024 | |
| 32462-01I | 16.0 | 5.68E-13 | 30.27 | 0.7181 | 0.0014 | 1.2053 | 0.0029 | 1.6944 | 0.0091 | 0.037 | 0.009 | 0.03321 | 0.00018 | 100.04 | 0.7177 | 0.0014 | 6.758 | 0.013 | 0.024 | |
| 32462-01J | 17.0 | 1.89E-13 | 10.14 | 0.7209 | 0.0015 | 1.2039 | 0.0029 | 1.7015 | 0.0090 | 0.000 | 0.023 | 0.03335 | 0.00018 | 100.29 | 0.7223 | 0.0016 | 6.802 | 0.015 | 0.026 | |
| 32462-01K | 18.0 | 8.00E-14 | 4.28 | 0.7203 | 0.0015 | 1.2019 | 0.0041 | 1.7220 | 0.0130 | 0.025 | 0.053 | 0.03374 | 0.00025 | 100.09 | 0.7203 | 0.0022 | 6.783 | 0.020 | 0.029 | |
| 32462-01L | 19.0 | 8.71E-15 | 0.47 | 0.7221 | 0.0025 | 1.2160 | 0.0094 | 1.6070 | 0.0330 | 0.000 | 0.470 | 0.03150 | 0.00065 | 102.30 | 0.7380 | 0.0140 | 6.950 | 0.130 | 0.136 | |
| 32462-01M | 20.0 | 2.17E-14 | 1.17 | 0.7233 | 0.0020 | 1.2058 | 0.0061 | 1.6320 | 0.0230 | 0.230 | 0.180 | 0.03199 | 0.00044 | 99.25 | 0.7172 | 0.0059 | 6.754 | 0.055 | 0.059 | |
| 32462-01N | 22.0 | 4.61E-14 | 2.47 | 0.7225 | 0.0015 | 1.2050 | 0.0049 | 1.6400 | 0.0210 | 0.000 | 0.079 | 0.03214 | 0.00041 | 100.23 | 0.7235 | 0.0028 | 6.813 | 0.027 | 0.034 | |
| 32462-01O | 24.0 | 2.89E-14 | 1.54 | 0.7182 | 0.0017 | 1.1916 | 0.0056 | 1.6480 | 0.0200 | 0.370 | 0.110 | 0.03229 | 0.00039 | 98.65 | 0.7078 | 0.0038 | 6.666 | 0.036 | 0.041 | |
| 32462-01P | 26.0 | 1.87E-14 | 1.00 | 0.7221 | 0.0021 | 1.2077 | 0.0066 | 1.6450 | 0.0230 | 0.000 | 0.190 | 0.03225 | 0.00045 | 100.46 | 0.7247 | 0.0061 | 6.825 | 0.057 | 0.061 | |
| **252PR-C:** Mes4 (32459) J = 0.005230 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32462-02A | 9.0 | 3.41E-14 | 1.56 | 0.7807 | 0.0059 | 1.3930 | 0.0120 | 2.0570 | 0.0350 | 1.770 | 0.120 | 0.04031 | 0.00069 | 93.51 | 0.7294 | 0.0068 | 6.869 | 0.064 | 0.067 | %40Ar* <97 |
| 32462-02B | 11.0 | 5.11E-14 | 2.28 | 0.7236 | 0.0017 | 1.2237 | 0.0049 | 1.7900 | 0.0190 | 0.288 | 0.071 | 0.03508 | 0.00037 | 99.02 | 0.7158 | 0.0027 | 6.741 | 0.025 | 0.033 | |
| 32462-02C | 12.0 | 8.75E-14 | 3.92 | 0.7217 | 0.0018 | 1.2632 | 0.0040 | 1.9920 | 0.0150 | 0.261 | 0.040 | 0.03904 | 0.00030 | 99.15 | 0.7149 | 0.0022 | 6.733 | 0.020 | 0.029 | |
| 32462-02D | 13.0 | 1.57E-13 | 7.00 | 0.7179 | 0.0015 | 1.2140 | 0.0033 | 1.7250 | 0.0120 | 0.087 | 0.023 | 0.03381 | 0.00024 | 99.84 | 0.7160 | 0.0016 | 6.743 | 0.015 | 0.026 | |
| 32462-02E | 14.0 | 2.05E-13 | 9.16 | 0.7173 | 0.0014 | 1.2155 | 0.0030 | 1.7030 | 0.0110 | 0.096 | 0.020 | 0.03339 | 0.00021 | 99.80 | 0.7151 | 0.0016 | 6.734 | 0.015 | 0.025 | |
| 32462-02F | 14.5 | 2.47E-13 | 10.98 | 0.7171 | 0.0014 | 1.2154 | 0.0029 | 1.6850 | 0.0120 | 0.062 | 0.019 | 0.03302 | 0.00024 | 99.93 | 0.7159 | 0.0015 | 6.742 | 0.014 | 0.025 | |
| 32462-02G | 14.5 | 2.42E-13 | 10.74 | 0.7170 | 0.0014 | 1.2092 | 0.0028 | 1.7030 | 0.0120 | 0.026 | 0.019 | 0.03339 | 0.00024 | 100.08 | 0.7168 | 0.0015 | 6.751 | 0.014 | 0.025 | |
| 32462-02H | 15.0 | 3.69E-13 | 16.40 | 0.7170 | 0.0014 | 1.2061 | 0.0027 | 1.6854 | 0.0086 | 0.063 | 0.013 | 0.03303 | 0.00017 | 99.93 | 0.7157 | 0.0014 | 6.740 | 0.013 | 0.025 | |
| 32462-02I | 15.0 | 1.51E-13 | 6.72 | 0.7178 | 0.0014 | 1.2098 | 0.0031 | 1.6940 | 0.0160 | 0.051 | 0.027 | 0.03321 | 0.00032 | 99.98 | 0.7169 | 0.0017 | 6.752 | 0.016 | 0.026 | |
| 32462-02J | 15.5 | 1.20E-13 | 5.32 | 0.7200 | 0.0015 | 1.2074 | 0.0033 | 1.7100 | 0.0120 | 0.045 | 0.036 | 0.03352 | 0.00024 | 100.01 | 0.7194 | 0.0019 | 6.774 | 0.017 | 0.027 | |
| 32462-02K | 15.5 | 1.42E-13 | 6.32 | 0.7188 | 0.0015 | 1.2156 | 0.0033 | 1.7030 | 0.0120 | 0.083 | 0.027 | 0.03337 | 0.00024 | 99.85 | 0.7170 | 0.0017 | 6.752 | 0.016 | 0.026 | |
| 32462-02L | 16.0 | 6.11E-14 | 2.72 | 0.7220 | 0.0015 | 1.2069 | 0.0043 | 1.7320 | 0.0160 | 0.085 | 0.065 | 0.03396 | 0.00031 | 99.85 | 0.7202 | 0.0024 | 6.782 | 0.023 | 0.031 | |
| 32462-02M | 16.0 | 6.11E-14 | 2.72 | 0.7209 | 0.0015 | 1.1944 | 0.0036 | 1.6520 | 0.0150 | 0.038 | 0.066 | 0.03238 | 0.00029 | 100.03 | 0.7203 | 0.0025 | 6.784 | 0.023 | 0.031 | |
| 32462-02N | 16.5 | 5.30E-14 | 2.36 | 0.7219 | 0.0015 | 1.1993 | 0.0044 | 1.6700 | 0.0180 | 0.036 | 0.074 | 0.03272 | 0.00036 | 100.04 | 0.7214 | 0.0027 | 6.794 | 0.025 | 0.033 | |
| 32462-02O | 16.5 | 6.16E-14 | 2.74 | 0.7205 | 0.0015 | 1.1980 | 0.0039 | 1.6820 | 0.0180 | 0.214 | 0.060 | 0.03297 | 0.00036 | 99.31 | 0.7148 | 0.0023 | 6.732 | 0.022 | 0.030 | |
| 32462-02P | 17.0 | 1.70E-14 | 0.76 | 0.7291 | 0.0019 | 1.1982 | 0.0073 | 1.7130 | 0.0240 | 0.000 | 0.200 | 0.03358 | 0.00047 | 100.39 | 0.7312 | 0.0064 | 6.886 | 0.060 | 0.063 | |
| 32462-02Q | 18.0 | 1.35E-14 | 0.60 | 0.7201 | 0.0021 | 1.1747 | 0.0094 | 1.7090 | 0.0250 | 0.090 | 0.240 | 0.03349 | 0.00049 | 99.80 | 0.7182 | 0.0074 | 6.763 | 0.069 | 0.072 | |
| 32462-02R | 19.0 | 1.14E-14 | 0.50 | 0.7202 | 0.0024 | 1.1903 | 0.0079 | 1.6960 | 0.0410 | 0.260 | 0.290 | 0.03323 | 0.00080 | 99.10 | 0.7131 | 0.0091 | 6.715 | 0.085 | 0.088 | |
| 32462-02S | 24.0 | 1.62E-13 | 7.21 | 0.7252 | 0.0015 | 1.2012 | 0.0033 | 1.6890 | 0.0110 | 0.040 | 0.023 | 0.03311 | 0.00022 | 100.02 | 0.7247 | 0.0017 | 6.824 | 0.016 | 0.026 | |
| **252PR-C:** Mes4 (32459) J = 0.005230 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32462-03A | 2.0 | 4.47E-16 | 0.02 | 15.7000 | 0.1500 | 2.6980 | 0.0780 | 2.1000 | 1.0000 | 517.000 | 13.000 | 0.04100 | 0.02000 | 2.70 | 0.4300 | 0.3800 | 4.0 | 3.5 | 3.539 | %40Ar* <97 |
| 32462-03B | 3.0 | 1.64E-15 | 0.07 | 1.4904 | 0.0077 | 1.4280 | 0.0250 | 3.9400 | 0.3300 | 22.800 | 1.900 | 0.07720 | 0.00640 | 55.00 | 0.8200 | 0.0580 | 7.72 | 0.55 | 0.548 | %40Ar* <97 |
| 32462-03C | 4.0 | 3.90E-15 | 0.17 | 0.8588 | 0.0033 | 1.2770 | 0.0150 | 2.2500 | 0.1100 | 2.910 | 0.810 | 0.04420 | 0.00210 | 90.20 | 0.7740 | 0.0250 | 7.29 | 0.23 | 0.232 | %40Ar* <97 |
| 32462-03D | 5.0 | 8.60E-15 | 0.38 | 0.7534 | 0.0029 | 1.1980 | 0.0100 | 1.7260 | 0.0580 | 0.560 | 0.350 | 0.03380 | 0.00110 | 98.00 | 0.7370 | 0.0110 | 6.94 | 0.10 | 0.105 | |
| 32462-03E | 5.5 | 9.70E-15 | 0.43 | 0.7374 | 0.0024 | 1.2102 | 0.0085 | 1.8110 | 0.0690 | 0.600 | 0.340 | 0.03550 | 0.00140 | 97.80 | 0.7200 | 0.0110 | 6.784 | 0.099 | 0.101 | |
| 32462-03F | 6.0 | 1.03E-14 | 0.46 | 0.7402 | 0.0024 | 1.1985 | 0.0089 | 1.8010 | 0.0680 | 0.150 | 0.340 | 0.03530 | 0.00130 | 99.60 | 0.7370 | 0.0110 | 6.937 | 0.099 | 0.101 | |
| 32462-03G | 6.5 | 1.38E-14 | 0.60 | 0.7264 | 0.0023 | 1.1893 | 0.0085 | 1.7070 | 0.0580 | 0.240 | 0.260 | 0.03340 | 0.00110 | 99.20 | 0.7200 | 0.0082 | 6.781 | 0.077 | 0.080 | |
| 32462-03H | 7.0 | 1.82E-14 | 0.80 | 0.7228 | 0.0021 | 1.2156 | 0.0055 | 1.7090 | 0.0430 | 0.280 | 0.190 | 0.03350 | 0.00085 | 99.04 | 0.7151 | 0.0062 | 6.734 | 0.058 | 0.061 | |
| 32462-03I | 7.5 | 2.90E-14 | 1.27 | 0.7219 | 0.0018 | 1.2198 | 0.0058 | 1.7010 | 0.0340 | 0.220 | 0.110 | 0.03333 | 0.00067 | 99.29 | 0.7160 | 0.0037 | 6.743 | 0.035 | 0.040 | |
| 32462-03J | 8.0 | 5.38E-14 | 2.37 | 0.7175 | 0.0014 | 1.2135 | 0.0042 | 1.8500 | 0.0230 | 0.225 | 0.057 | 0.03626 | 0.00044 | 99.29 | 0.7116 | 0.0022 | 6.702 | 0.021 | 0.029 | |
| 32462-03K | 8.5 | 8.78E-14 | 3.85 | 0.7200 | 0.0017 | 1.2224 | 0.0035 | 1.7790 | 0.0210 | 0.173 | 0.038 | 0.03486 | 0.00041 | 99.49 | 0.7157 | 0.0021 | 6.740 | 0.019 | 0.028 | |
| 32462-03L | 9.0 | 1.19E-13 | 5.24 | 0.7187 | 0.0015 | 1.2227 | 0.0036 | 1.7850 | 0.0150 | 0.131 | 0.027 | 0.03498 | 0.00029 | 99.67 | 0.7156 | 0.0018 | 6.739 | 0.017 | 0.026 | |
| 32462-03M | 9.5 | 1.79E-13 | 7.88 | 0.7187 | 0.0014 | 1.2223 | 0.0030 | 1.7280 | 0.0120 | 0.092 | 0.018 | 0.03388 | 0.00024 | 99.82 | 0.7167 | 0.0015 | 6.749 | 0.014 | 0.025 | |
| 32462-03N | 10.0 | 3.62E-13 | 15.92 | 0.7184 | 0.0014 | 1.2085 | 0.0026 | 1.6700 | 0.0120 | 0.104 | 0.010 | 0.03274 | 0.00024 | 99.76 | 0.7160 | 0.0014 | 6.743 | 0.013 | 0.024 | |
| 32462-03O | 11.0 | 6.07E-13 | 26.70 | 0.7169 | 0.0013 | 1.2027 | 0.0029 | 1.6850 | 0.0110 | 0.055 | 0.007 | 0.03302 | 0.00021 | 99.97 | 0.7160 | 0.0013 | 6.743 | 0.013 | 0.024 | |
| 32462-03P | 12.0 | 2.48E-13 | 10.92 | 0.7204 | 0.0014 | 1.1996 | 0.0027 | 1.6530 | 0.0140 | 0.022 | 0.017 | 0.03240 | 0.00027 | 100.10 | 0.7204 | 0.0015 | 6.784 | 0.014 | 0.025 | |
| 32462-03Q | 13.0 | 1.01E-13 | 4.43 | 0.7194 | 0.0015 | 1.2040 | 0.0030 | 1.6640 | 0.0170 | 0.000 | 0.041 | 0.03262 | 0.00033 | 100.24 | 0.7204 | 0.0019 | 6.784 | 0.018 | 0.027 | |
| 32462-03R | 14.0 | 9.18E-14 | 4.04 | 0.7216 | 0.0016 | 1.2056 | 0.0041 | 1.6210 | 0.0250 | 0.040 | 0.045 | 0.03178 | 0.00050 | 100.02 | 0.7210 | 0.0021 | 6.790 | 0.020 | 0.029 | |
| 32462-03S | 16.0 | 9.71E-14 | 4.26 | 0.7204 | 0.0016 | 1.2132 | 0.0035 | 1.6780 | 0.0240 | 0.076 | 0.043 | 0.03289 | 0.00047 | 99.88 | 0.7188 | 0.0021 | 6.770 | 0.019 | 0.028 | |
| 32462-03T | 18.0 | 4.76E-14 | 2.09 | 0.7192 | 0.0015 | 1.1909 | 0.0045 | 1.6430 | 0.0190 | 0.000 | 0.084 | 0.03220 | 0.00036 | 100.45 | 0.7217 | 0.0030 | 6.797 | 0.028 | 0.035 | |
| 32462-03U | 21.0 | 8.40E-14 | 3.70 | 0.7219 | 0.0016 | 1.2119 | 0.0036 | 1.6280 | 0.0280 | 0.034 | 0.047 | 0.03190 | 0.00054 | 100.05 | 0.7215 | 0.0021 | 6.795 | 0.020 | 0.029 | |
| 32462-03V | 24.0 | 1.01E-13 | 4.42 | 0.7212 | 0.0017 | 1.2006 | 0.0039 | 1.6390 | 0.0170 | 0.045 | 0.035 | 0.03212 | 0.00034 | 100.00 | 0.7206 | 0.0020 | 6.786 | 0.019 | 0.028 | |

| Lab ID# | Laser Power (W) | $^{39}Ar$ (moles) | $^{39}Ar$ (% of total) | $^{40}Ar/^{39}Ar$ | ± 1σ | $^{38}Ar/^{39}Ar$ ($\times 10^{-2}$) | ± 1σ | $^{37}Ar/^{39}Ar$ ($\times 10^{-2}$) | ± 1σ | $^{36}Ar/^{39}Ar$ ($\times 10^{-4}$) | ± 1σ | Ca/K | ± 1σ | $^{40}Ar^{*}$ (%) | $^{40}Ar^{*}/^{39}Ar_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **252PR-C:** Mes12 (32459) J = 0.005248 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32459-01A | 9.0 | 6.29E-14 | 1.85 | 0.7406 | 0.0025 | 1.2821 | 0.0050 | 2.3450 | 0.0190 | 1.987 | 0.091 | 0.04596 | 0.00038 | 92.32 | 0.6830 | 0.0038 | 6.456 | 0.036 | 0.041 | %40Ar* <97 |
| 32459-01B | 11.0 | 9.22E-14 | 2.68 | 0.6794 | 0.0016 | 1.2252 | 0.0034 | 1.9260 | 0.0120 | 0.159 | 0.044 | 0.03776 | 0.00023 | 99.54 | 0.6755 | 0.0021 | 6.385 | 0.020 | 0.028 | |
| 32459-01C | 12.0 | 1.31E-13 | 3.80 | 0.6747 | 0.0015 | 1.2196 | 0.0030 | 1.8530 | 0.0120 | 0.121 | 0.030 | 0.03632 | 0.00024 | 99.69 | 0.6719 | 0.0017 | 6.351 | 0.016 | 0.025 | |
| 32459-01D | 13.0 | 1.98E-13 | 5.76 | 0.6775 | 0.0014 | 1.2115 | 0.0032 | 1.8107 | 0.0097 | 0.099 | 0.022 | 0.03549 | 0.00019 | 99.78 | 0.6754 | 0.0016 | 6.383 | 0.015 | 0.024 | |
| 32459-01E | 14.0 | 2.70E-13 | 7.84 | 0.6753 | 0.0013 | 1.2114 | 0.0028 | 1.8172 | 0.0089 | 0.099 | 0.016 | 0.03562 | 0.00017 | 99.78 | 0.6731 | 0.0014 | 6.362 | 0.013 | 0.023 | |
| 32459-01F | 14.5 | 6.73E-13 | 19.54 | 0.6762 | 0.0013 | 1.2071 | 0.0029 | 1.8160 | 0.0110 | 0.084 | 0.007 | 0.03559 | 0.00022 | 99.85 | 0.6744 | 0.0014 | 6.374 | 0.013 | 0.023 | |
| 32459-01G | 14.5 | 6.40E-13 | 18.56 | 0.6769 | 0.0013 | 1.2052 | 0.0027 | 1.7990 | 0.0073 | 0.039 | 0.008 | 0.03526 | 0.00014 | 100.04 | 0.6765 | 0.0013 | 6.394 | 0.012 | 0.023 | |
| 32459-01H | 15.0 | 4.08E-13 | 11.88 | 0.6774 | 0.0013 | 1.2025 | 0.0025 | 1.7651 | 0.0062 | 0.040 | 0.011 | 0.03460 | 0.00012 | 100.04 | 0.6770 | 0.0014 | 6.398 | 0.013 | 0.023 | |
| 32459-01I | 15.0 | 1.40E-13 | 4.10 | 0.6796 | 0.0016 | 1.2008 | 0.0044 | 1.7860 | 0.0140 | 0.084 | 0.028 | 0.03501 | 0.00027 | 99.84 | 0.6778 | 0.0018 | 6.406 | 0.017 | 0.026 | |
| 32459-01J | 15.5 | 1.18E-13 | 3.42 | 0.6806 | 0.0015 | 1.2138 | 0.0032 | 1.7630 | 0.0140 | 0.139 | 0.028 | 0.03456 | 0.00027 | 99.61 | 0.6772 | 0.0017 | 6.400 | 0.016 | 0.025 | |
| 32459-01K | 15.5 | 1.20E-13 | 3.48 | 0.6791 | 0.0014 | 1.2129 | 0.0029 | 1.7710 | 0.0160 | 0.081 | 0.030 | 0.03471 | 0.00031 | 99.86 | 0.6774 | 0.0017 | 6.402 | 0.016 | 0.025 | |
| 32459-01L | 16.0 | 8.48E-14 | 2.46 | 0.6799 | 0.0015 | 1.2034 | 0.0039 | 1.8040 | 0.0170 | 0.083 | 0.045 | 0.03536 | 0.00034 | 99.85 | 0.6782 | 0.0020 | 6.410 | 0.019 | 0.027 | |
| 32459-01M | 16.0 | 5.50E-14 | 1.59 | 0.6797 | 0.0015 | 1.1983 | 0.0039 | 1.7040 | 0.0180 | 0.000 | 0.069 | 0.03339 | 0.00036 | 100.36 | 0.6815 | 0.0025 | 6.441 | 0.024 | 0.031 | |
| 32459-01N | 16.5 | 3.11E-14 | 0.90 | 0.6832 | 0.0017 | 1.2117 | 0.0056 | 1.7550 | 0.0240 | 0.110 | 0.110 | 0.03440 | 0.00048 | 99.73 | 0.6806 | 0.0038 | 6.433 | 0.036 | 0.041 | |
| 32459-01O | 16.5 | 4.08E-14 | 1.18 | 0.6795 | 0.0015 | 1.2136 | 0.0048 | 1.8130 | 0.0170 | 0.000 | 0.091 | 0.03554 | 0.00034 | 100.73 | 0.6837 | 0.0031 | 6.462 | 0.029 | 0.035 | |
| 32459-01P | 17.0 | 3.33E-14 | 0.97 | 0.6803 | 0.0015 | 1.2091 | 0.0047 | 1.7520 | 0.0230 | 0.070 | 0.120 | 0.03433 | 0.00045 | 99.90 | 0.6789 | 0.0039 | 6.417 | 0.037 | 0.042 | |
| 32459-01Q | 18.0 | 5.62E-14 | 1.63 | 0.6808 | 0.0014 | 1.2073 | 0.0037 | 1.7020 | 0.0190 | 0.000 | 0.069 | 0.03337 | 0.00038 | 100.31 | 0.6821 | 0.0025 | 6.447 | 0.024 | 0.031 | |
| 32459-01R | 19.0 | 1.38E-13 | 3.98 | 0.6775 | 0.0015 | 1.2052 | 0.0033 | 1.7340 | 0.0110 | 0.062 | 0.027 | 0.03398 | 0.00021 | 99.93 | 0.6763 | 0.0017 | 6.392 | 0.016 | 0.025 | |
| 32459-01S | 20.0 | 4.69E-14 | 1.36 | 0.6828 | 0.0014 | 1.2108 | 0.0051 | 1.7240 | 0.0210 | 0.252 | 0.065 | 0.03378 | 0.00042 | 99.11 | 0.6760 | 0.0024 | 6.389 | 0.023 | 0.030 | |
| 32459-01T | 24.0 | 1.04E-13 | 3.02 | 0.6796 | 0.0015 | 1.2073 | 0.0037 | 1.7440 | 0.0180 | 0.109 | 0.034 | 0.03418 | 0.00035 | 99.73 | 0.6771 | 0.0018 | 6.400 | 0.017 | 0.026 | |
| **252PR-C:** Mes12 (32459) J = 0.005248 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32459-02A | 2.0 | 2.01E-16 | 0.00 | 43.1700 | 0.7800 | 8.6600 | 0.2700 | 26.1000 | 1.9000 | 1464.000 | 37.000 | 0.51100 | 0.03600 | 0.00 | 0.0000 | 0.8500 | 0.0 | 8.1 | 8.057 | %40Ar* <97 |
| 32459-02B | 3.0 | 1.06E-15 | 0.02 | 1.4660 | 0.0120 | 1.9690 | 0.0450 | 7.4500 | 0.5200 | 24.700 | 2.800 | 0.14600 | 0.01000 | 50.60 | 0.7420 | 0.0850 | 7.01 | 0.80 | 0.798 | %40Ar* <97 |
| 32459-02C | 4.0 | 4.75E-15 | 0.10 | 0.8041 | 0.0029 | 1.1840 | 0.0140 | 3.6200 | 0.1500 | 4.560 | 0.600 | 0.07090 | 0.00300 | 83.60 | 0.6720 | 0.0180 | 6.35 | 0.17 | 0.174 | %40Ar* <97 |
| 32459-02D | 5.0 | 1.00E-14 | 0.20 | 0.7111 | 0.0023 | 1.2033 | 0.0091 | 2.8990 | 0.0790 | 1.290 | 0.300 | 0.05680 | 0.00150 | 95.00 | 0.6746 | 0.0094 | 6.376 | 0.089 | 0.091 | %40Ar* <97 |
| 32459-02E | 5.5 | 1.19E-14 | 0.24 | 0.6939 | 0.0020 | 1.1850 | 0.0080 | 2.5540 | 0.0650 | 0.650 | 0.250 | 0.05010 | 0.00130 | 97.50 | 0.6759 | 0.0078 | 6.388 | 0.074 | 0.076 | |
| 32459-02F | 6.0 | 1.59E-14 | 0.32 | 0.6873 | 0.0020 | 1.2127 | 0.0078 | 2.3930 | 0.0570 | 0.250 | 0.190 | 0.04690 | 0.00110 | 99.19 | 0.6811 | 0.0060 | 6.437 | 0.057 | 0.060 | |
| 32459-02G | 6.5 | 1.98E-14 | 0.40 | 0.6893 | 0.0019 | 1.1761 | 0.0077 | 2.2650 | 0.0400 | 0.280 | 0.150 | 0.04439 | 0.00078 | 99.05 | 0.6821 | 0.0050 | 6.446 | 0.047 | 0.051 | |
| 32459-02H | 7.0 | 2.57E-14 | 0.52 | 0.6846 | 0.0017 | 1.2044 | 0.0049 | 2.1960 | 0.0370 | 0.080 | 0.120 | 0.04304 | 0.00072 | 99.90 | 0.6832 | 0.0039 | 6.457 | 0.036 | 0.041 | |
| 32459-02I | 7.5 | 3.47E-14 | 0.70 | 0.6834 | 0.0015 | 1.1985 | 0.0052 | 2.0150 | 0.0270 | 0.167 | 0.095 | 0.03949 | 0.00053 | 99.52 | 0.6794 | 0.0032 | 6.421 | 0.030 | 0.036 | |
| 32459-02J | 8.0 | 3.85E-14 | 0.78 | 0.6809 | 0.0015 | 1.2116 | 0.0047 | 1.9770 | 0.0300 | 0.096 | 0.084 | 0.03874 | 0.00058 | 99.82 | 0.6790 | 0.0030 | 6.417 | 0.028 | 0.034 | |
| 32459-02K | 8.5 | 4.99E-14 | 1.01 | 0.6793 | 0.0014 | 1.2109 | 0.0041 | 1.9420 | 0.0240 | 0.000 | 0.064 | 0.03807 | 0.00046 | 100.24 | 0.6803 | 0.0024 | 6.429 | 0.023 | 0.030 | |
| 32459-02L | 9.0 | 6.57E-14 | 1.33 | 0.6814 | 0.0014 | 1.2227 | 0.0041 | 1.8440 | 0.0260 | 0.209 | 0.048 | 0.03614 | 0.00051 | 99.32 | 0.6760 | 0.0020 | 6.390 | 0.019 | 0.027 | |
| 32459-02M | 9.5 | 9.21E-14 | 1.87 | 0.6792 | 0.0015 | 1.2099 | 0.0043 | 1.8650 | 0.0220 | 0.143 | 0.033 | 0.03655 | 0.00043 | 99.60 | 0.6758 | 0.0018 | 6.388 | 0.017 | 0.026 | |
| 32459-02N | 10.0 | 1.32E-13 | 2.67 | 0.6805 | 0.0014 | 1.2145 | 0.0033 | 1.8860 | 0.0180 | 0.137 | 0.022 | 0.03697 | 0.00036 | 99.63 | 0.6773 | 0.0016 | 6.402 | 0.015 | 0.025 | |
| 32459-02O | 10.5 | 1.61E-13 | 3.27 | 0.6764 | 0.0014 | 1.2118 | 0.0031 | 1.8170 | 0.0160 | 0.090 | 0.019 | 0.03560 | 0.00032 | 99.83 | 0.6745 | 0.0015 | 6.375 | 0.014 | 0.024 | |
| 32459-02P | 11.0 | 1.98E-13 | 4.03 | 0.6783 | 0.0014 | 1.2250 | 0.0030 | 1.8500 | 0.0190 | 0.075 | 0.018 | 0.03626 | 0.00038 | 99.90 | 0.6769 | 0.0015 | 6.398 | 0.014 | 0.024 | |
| 32459-02Q | 11.5 | 4.08E-13 | 8.27 | 0.6789 | 0.0014 | 1.2105 | 0.0026 | 1.7960 | 0.0130 | 0.063 | 0.010 | 0.03520 | 0.00025 | 99.94 | 0.6778 | 0.0014 | 6.406 | 0.013 | 0.023 | |
| 32459-02R | 12.0 | 8.54E-13 | 17.30 | 0.6775 | 0.0012 | 1.2046 | 0.0025 | 1.7705 | 0.0073 | 0.054 | 0.005 | 0.03470 | 0.00014 | 99.98 | 0.6766 | 0.0013 | 6.395 | 0.012 | 0.023 | |
| 32459-02S | 13.0 | 6.50E-13 | 13.14 | 0.6803 | 0.0013 | 1.2105 | 0.0027 | 1.8080 | 0.0110 | 0.046 | 0.007 | 0.03544 | 0.00021 | 100.02 | 0.6797 | 0.0013 | 6.424 | 0.012 | 0.023 | |
| 32459-02T | 14.0 | 4.20E-13 | 8.52 | 0.6795 | 0.0012 | 1.2037 | 0.0027 | 1.7670 | 0.0100 | 0.040 | 0.010 | 0.03463 | 0.00020 | 100.04 | 0.6790 | 0.0013 | 6.418 | 0.012 | 0.023 | |
| 32459-02U | 16.0 | 4.64E-13 | 9.41 | 0.6782 | 0.0013 | 1.2057 | 0.0027 | 1.7970 | 0.0100 | 0.050 | 0.009 | 0.03522 | 0.00020 | 100.00 | 0.6774 | 0.0013 | 6.403 | 0.012 | 0.023 | |
| 32459-02V | 18.0 | 3.84E-13 | 7.79 | 0.6797 | 0.0013 | 1.2026 | 0.0027 | 1.8140 | 0.0110 | 0.046 | 0.011 | 0.03556 | 0.00021 | 100.02 | 0.6791 | 0.0013 | 6.419 | 0.013 | 0.023 | |
| 32459-02W | 21.0 | 6.70E-13 | 13.59 | 0.6784 | 0.0012 | 1.2055 | 0.0025 | 1.7600 | 0.0130 | 0.057 | 0.007 | 0.03449 | 0.00025 | 99.96 | 0.6774 | 0.0013 | 6.403 | 0.012 | 0.023 | |
| 32459-02X | 25.0 | 2.21E-13 | 4.48 | 0.6811 | 0.0013 | 1.2070 | 0.0028 | 1.7990 | 0.0130 | 0.052 | 0.017 | 0.03526 | 0.00026 | 99.99 | 0.6804 | 0.0014 | 6.430 | 0.013 | 0.024 | |
| **252PR-C:** Mes12 (32459) J = 0.005248 ± 0.000016 | | | | | | | | | | | | | | | | | | | | |
| 32459-03A | 2.0 | 2.48E-16 | 0.01 | 5.0600 | 0.1100 | 6.6100 | 0.1800 | 4.8000 | 1.8000 | 155.000 | 13.000 | 0.09400 | 0.03600 | 9.50 | 0.4800 | 0.3900 | 4.5 | 3.7 | 3.705 | %40Ar* <97 |
| 32459-03B | 3.0 | 1.19E-15 | 0.05 | 1.0164 | 0.0089 | 1.2040 | 0.0270 | 2.5200 | 0.3400 | 11.400 | 2.200 | 0.04940 | 0.00680 | 67.10 | 0.6810 | 0.0670 | 6.44 | 0.63 | 0.630 | %40Ar* <97 |
| 32459-03C | 4.0 | 4.24E-15 | 0.16 | 0.7425 | 0.0025 | 1.1580 | 0.0130 | 2.2100 | 0.1400 | 0.400 | 0.730 | 0.04340 | 0.00270 | 98.60 | 0.7320 | 0.0220 | 6.91 | 0.21 | 0.208 | |
| 32459-03D | 5.0 | 1.02E-14 | 0.38 | 0.6954 | 0.0023 | 1.2013 | 0.0096 | 1.9680 | 0.0770 | 0.470 | 0.290 | 0.03860 | 0.00150 | 98.20 | 0.6824 | 0.0091 | 6.450 | 0.086 | 0.088 | |
| 32459-03E | 5.5 | 1.06E-14 | 0.40 | 0.6855 | 0.0025 | 1.1860 | 0.0088 | 1.8110 | 0.0760 | 0.000 | 0.300 | 0.03550 | 0.00150 | 101.70 | 0.6966 | 0.0093 | 6.584 | 0.088 | 0.090 | |
| 32459-03F | 6.0 | 1.27E-14 | 0.48 | 0.6813 | 0.0020 | 1.1800 | 0.0083 | 1.6930 | 0.0340 | 0.000 | 0.250 | 0.03317 | 0.00067 | 102.20 | 0.6955 | 0.0078 | 6.573 | 0.074 | 0.076 | |
| 32459-03G | 6.5 | 1.67E-14 | 0.63 | 0.6786 | 0.0019 | 1.2084 | 0.0075 | 1.8780 | 0.0450 | 0.000 | 0.180 | 0.03682 | 0.00088 | 100.35 | 0.6802 | 0.0058 | 6.429 | 0.055 | 0.058 | |
| 32459-03H | 7.0 | 2.37E-14 | 0.89 | 0.6795 | 0.0018 | 1.1889 | 0.0063 | 1.8600 | 0.0360 | 0.140 | 0.130 | 0.03645 | 0.00070 | 99.60 | 0.6761 | 0.0042 | 6.390 | 0.040 | 0.044 | |
| 32459-03I | 7.5 | 3.35E-14 | 1.26 | 0.6824 | 0.0016 | 1.1887 | 0.0055 | 1.7810 | 0.0290 | 0.178 | 0.081 | 0.03491 | 0.00057 | 99.44 | 0.6779 | 0.0029 | 6.407 | 0.028 | 0.034 | |
| 32459-03J | 8.0 | 6.16E-14 | 2.32 | 0.6810 | 0.0014 | 1.2102 | 0.0043 | 1.7670 | 0.0210 | 0.164 | 0.042 | 0.03462 | 0.00041 | 99.50 | 0.6769 | 0.0019 | 6.398 | 0.018 | 0.027 | |
| 32459-03K | 8.5 | 1.01E-13 | 3.82 | 0.6797 | 0.0016 | 1.2188 | 0.0033 | 1.8570 | 0.0280 | 0.133 | 0.027 | 0.03640 | 0.00054 | 99.64 | 0.6766 | 0.0018 | 6.395 | 0.017 | 0.026 | |
| 32459-03L | 9.0 | 1.32E-13 | 4.97 | 0.6771 | 0.0014 | 1.2164 | 0.0032 | 1.8180 | 0.0280 | 0.100 | 0.023 | 0.03564 | 0.00055 | 99.78 | 0.6749 | 0.0016 | 6.379 | 0.015 | 0.025 | |
| 32459-03M | 9.5 | 3.08E-13 | 11.61 | 0.6790 | 0.0013 | 1.2086 | 0.0027 | 1.8260 | 0.0130 | 0.048 | 0.012 | 0.03579 | 0.00026 | 100.01 | 0.6783 | 0.0014 | 6.411 | 0.013 | 0.023 | |
| 32459-03N | 10.0 | 2.64E-13 | 9.91 | 0.6801 | 0.0014 | 1.2088 | 0.0030 | 1.7960 | 0.0190 | 0.043 | 0.013 | 0.03521 | 0.00038 | 100.03 | 0.6796 | 0.0015 | 6.423 | 0.014 | 0.024 | |
| 32459-03O | 11.0 | 2.86E-13 | 10.78 | 0.6785 | 0.0014 | 1.2034 | 0.0029 | 1.8040 | 0.0130 | 0.032 | 0.011 | 0.03536 | 0.00025 | 100.08 | 0.6783 | 0.0014 | 6.411 | 0.013 | 0.024 | |
| 32459-03P | 12.0 | 2.17E-13 | 8.20 | 0.6791 | 0.0014 | 1.2025 | 0.0029 | 1.7980 | 0.0200 | 0.088 | 0.014 | 0.03524 | 0.00039 | 99.84 | 0.6773 | 0.0015 | 6.402 | 0.014 | 0.024 | |
| 32459-03Q | 13.0 | 2.02E-13 | 7.60 | 0.6798 | 0.0014 | 1.2077 | 0.0030 | 1.8160 | 0.0130 | 0.051 | 0.014 | 0.03559 | 0.00026 | 100.00 | 0.6791 | 0.0014 | 6.418 | 0.013 | 0.024 | |
| 32459-03R | 14.0 | 1.52E-13 | 5.74 | 0.6818 | 0.0014 | 1.2038 | 0.0029 | 1.8370 | 0.0140 | 0.043 | 0.023 | 0.03601 | 0.00027 | 100.04 | 0.6813 | 0.0015 | 6.440 | 0.015 | 0.024 | |
| 32459-03S | 16.0 | 2.13E-13 | 8.02 | 0.6799 | 0.0013 | 1.2106 | 0.0029 | 1.8130 | 0.0160 | 0.040 | 0.018 | 0.03554 | 0.00031 | 100.05 | 0.6795 | 0.0014 | 6.422 | 0.014 | 0.024 | |
| 32459-03T | 18.0 | 2.11E-13 | 7.98 | 0.6803 | 0.0014 | 1.2078 | 0.0030 | 1.8160 | 0.0140 | 0.051 | 0.017 | 0.03559 | 0.00028 | 100.00 | 0.6796 | 0.0015 | 6.423 | 0.014 | 0.024 | |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{39}$Ar (% of total) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar (× 10$^{-2}$) | ± 1σ | $^{37}$Ar/$^{39}$Ar (× 10$^{-2}$) | ± 1σ | $^{36}$Ar/$^{39}$Ar (× 10$^{-4}$) | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32459-03U | 21.0 | 8.90E-14 | 3.36 | 0.6823 | 0.0015 | 1.2040 | 0.0035 | 1.7510 | 0.0210 | 0.130 | 0.038 | 0.03432 | 0.00041 | 99.65 | 0.6791 | 0.0019 | 6.419 | 0.018 | 0.026 | |
| 32459-03V | 24.0 | 3.03E-13 | 11.42 | 0.6796 | 0.0013 | 1.2028 | 0.0026 | 1.7900 | 0.0130 | 0.022 | 0.013 | 0.03508 | 0.00026 | 100.12 | 0.6797 | 0.0014 | 6.424 | 0.013 | 0.023 | |
| **Single crystal total fusions - BGC** | | | | | | | | | | | | | | | | | | | | |
| **252A:** Mes1 (32474) J = 0.0051986 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32474-01Bcomb | 5.0 | 1.47E-13 | | 0.7401 | 0.0018 | 1.2134 | 0.0049 | 0.9400 | 0.0150 | 0.004 | 0.038 | 0.01842 | 0.00028 | 100.08 | 0.7400 | 0.0021 | 6.927 | 0.020 | 0.024 | |
| 32474-02Bcomb | 5.0 | 2.00E-13 | | 0.7415 | 0.0018 | 1.2149 | 0.0048 | 1.7020 | 0.0150 | 0.109 | 0.026 | 0.03336 | 0.00029 | 99.74 | 0.7389 | 0.0020 | 6.916 | 0.019 | 0.023 | |
| 32474-03Bcomb | 5.0 | 2.20E-13 | | 0.7401 | 0.0018 | 1.2124 | 0.0042 | 0.9060 | 0.0120 | 0.128 | 0.025 | 0.01775 | 0.00024 | 99.58 | 0.7363 | 0.0020 | 6.893 | 0.019 | 0.023 | |
| 32474-04Bcomb | 5.0 | 2.00E-13 | | 0.7393 | 0.0018 | 1.2120 | 0.0042 | 0.8700 | 0.0120 | 0.103 | 0.025 | 0.01706 | 0.00023 | 99.68 | 0.7362 | 0.0020 | 6.892 | 0.018 | 0.023 | |
| 32474-05Bcomb | 5.0 | 1.62E-13 | | 0.7421 | 0.0019 | 1.2045 | 0.0050 | 0.8730 | 0.0110 | 0.120 | 0.034 | 0.01711 | 0.00021 | 99.61 | 0.7385 | 0.0022 | 6.913 | 0.021 | 0.025 | |
| 32474-06 | 5.0 | 2.14E-13 | | 0.7420 | 0.0019 | 1.2016 | 0.0036 | 0.8104 | 0.0065 | 0.084 | 0.015 | 0.01588 | 0.00013 | 99.75 | 0.7394 | 0.0020 | 6.922 | 0.018 | 0.023 | |
| 32474-07 | 5.0 | 2.71E-13 | | 0.7367 | 0.0018 | 1.2111 | 0.0034 | 0.8763 | 0.0083 | 0.039 | 0.012 | 0.01718 | 0.00016 | 99.94 | 0.7355 | 0.0018 | 6.885 | 0.017 | 0.021 | |
| 32474-08 | 5.0 | 1.63E-13 | | 0.7384 | 0.0019 | 1.2213 | 0.0039 | 0.8746 | 0.0076 | 0.059 | 0.019 | 0.01714 | 0.00015 | 99.86 | 0.7366 | 0.0019 | 6.895 | 0.018 | 0.022 | |
| **252A:** Mes1 (32480) J = 0.0051660 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32480-01Bcomb | 5.0 | 1.88E-13 | | 0.7442 | 0.0018 | 1.2110 | 0.0041 | 1.1710 | 0.0120 | 0.095 | 0.026 | 0.02295 | 0.00023 | 99.74 | 0.7415 | 0.0020 | 6.898 | 0.018 | 0.023 | |
| 32480-02Bcomb | 5.0 | 2.40E-13 | | 0.7426 | 0.0018 | 1.2067 | 0.0037 | 0.9300 | 0.0110 | 0.108 | 0.023 | 0.01822 | 0.00021 | 99.67 | 0.7394 | 0.0019 | 6.878 | 0.018 | 0.022 | |
| 32480-03Bcomb | 5.0 | 1.34E-13 | | 0.7405 | 0.0018 | 1.2090 | 0.0050 | 0.8632 | 0.0097 | 0.000 | 0.035 | 0.01692 | 0.00019 | 100.17 | 0.7410 | 0.0021 | 6.893 | 0.020 | 0.024 | |
| 32480-04 | 5.0 | 1.84E-13 | | 0.7457 | 0.0019 | 1.2101 | 0.0036 | 0.8844 | 0.0097 | 0.128 | 0.018 | 0.01733 | 0.00019 | 99.58 | 0.7419 | 0.0020 | 6.901 | 0.019 | 0.023 | |
| 32480-05 | 5.0 | 2.13E-13 | | 0.7451 | 0.0023 | 1.2134 | 0.0043 | 1.2360 | 0.0110 | 0.175 | 0.016 | 0.02423 | 0.00022 | 99.43 | 0.7401 | 0.0023 | 6.885 | 0.022 | 0.026 | |
| 32480-06 | 5.0 | 1.17E-13 | | 0.7444 | 0.0019 | 1.2253 | 0.0044 | 1.0269 | 0.0075 | 0.111 | 0.024 | 0.02013 | 0.00015 | 99.67 | 0.7412 | 0.0021 | 6.895 | 0.019 | 0.024 | |
| 32480-07 | 5.0 | 1.84E-13 | | 0.7438 | 0.0019 | 1.2082 | 0.0042 | 0.8470 | 0.0110 | 0.122 | 0.017 | 0.01660 | 0.00021 | 99.60 | 0.7401 | 0.0020 | 6.885 | 0.019 | 0.023 | |
| 32480-08 | 5.0 | 2.18E-13 | | 0.7432 | 0.0017 | 1.2161 | 0.0034 | 0.8881 | 0.0051 | 0.164 | 0.015 | 0.01741 | 0.00010 | 99.44 | 0.7383 | 0.0018 | 6.868 | 0.017 | 0.021 | |
| **252A:** Mes1 (32486) J = 0.0051876 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32486-02 | 5.0 | 2.74E-13 | | 0.7389 | 0.0017 | 1.2173 | 0.0035 | 1.1196 | 0.0077 | 0.101 | 0.012 | 0.02194 | 0.00015 | 99.71 | 0.7361 | 0.0017 | 6.876 | 0.016 | 0.021 | |
| 32486-03Bcomb | 5.0 | 3.02E-13 | | 0.7410 | 0.0018 | 1.2152 | 0.0039 | 0.9182 | 0.0089 | 0.102 | 0.019 | 0.01800 | 0.00017 | 99.69 | 0.7379 | 0.0019 | 6.893 | 0.018 | 0.022 | |
| 32486-04Bcomb | 5.0 | 2.54E-13 | | 0.7444 | 0.0019 | 1.2135 | 0.0041 | 1.0610 | 0.0120 | 0.192 | 0.022 | 0.02079 | 0.00023 | 99.35 | 0.7389 | 0.0021 | 6.902 | 0.019 | 0.023 | |
| 32486-05 | 5.0 | 1.85E-13 | | 0.7415 | 0.0018 | 1.2093 | 0.0042 | 0.8046 | 0.0080 | 0.080 | 0.016 | 0.01577 | 0.00016 | 99.76 | 0.7390 | 0.0019 | 6.903 | 0.018 | 0.022 | |
| 32486-06 | 5.0 | 1.98E-13 | | 0.7449 | 0.0019 | 1.2075 | 0.0037 | 0.9010 | 0.0110 | 0.193 | 0.016 | 0.01766 | 0.00021 | 99.33 | 0.7392 | 0.0020 | 6.905 | 0.018 | 0.023 | |
| 32486-08 | 5.0 | 1.29E-13 | | 0.7400 | 0.0019 | 1.2111 | 0.0040 | 0.8856 | 0.0086 | 0.001 | 0.022 | 0.01736 | 0.00017 | 100.09 | 0.7399 | 0.0020 | 6.911 | 0.019 | 0.023 | |
| *32486-07* | *5.0* | 1.82E-13 | | *0.7399* | *0.0018* | *1.2126* | *0.0043* | *0.8597* | *0.0078* | 0.000 | 0.018 | *0.01685* | *0.00015* | *101.89* | *0.7531* | *0.0018* | *7.035* | *0.017* | *0.022* | *>1.5 nMADs from median age* |
| **252A:** Mes4 (32470) J = 0.0052021 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32470-01Bcomb | 5.0 | 2.07E-13 | | 0.7252 | 0.0020 | 1.2188 | 0.0051 | 1.8430 | 0.0200 | 0.185 | 0.030 | 0.03612 | 0.00039 | 99.44 | 0.7205 | 0.0022 | 6.749 | 0.021 | 0.025 | |
| 32470-02Bcomb | 5.0 | 2.23E-13 | | 0.7306 | 0.0019 | 1.2245 | 0.0046 | 1.9150 | 0.0160 | 0.264 | 0.025 | 0.03754 | 0.00032 | 99.14 | 0.7235 | 0.0021 | 6.778 | 0.020 | 0.024 | |
| 32470-03Bcomb | 5.0 | 2.50E-13 | | 0.7231 | 0.0018 | 1.2134 | 0.0043 | 1.8330 | 0.0150 | 0.082 | 0.021 | 0.03592 | 0.00029 | 99.86 | 0.7214 | 0.0019 | 6.758 | 0.018 | 0.022 | |
| 32470-04Bcomb | 5.0 | 2.20E-13 | | 0.7211 | 0.0017 | 1.2146 | 0.0048 | 1.7520 | 0.0160 | 0.086 | 0.025 | 0.03433 | 0.00031 | 99.84 | 0.7192 | 0.0019 | 6.737 | 0.017 | 0.022 | |
| 32470-05Bcomb | 5.0 | 1.77E-13 | | 0.7225 | 0.0018 | 1.2119 | 0.0048 | 1.7600 | 0.0160 | 0.046 | 0.029 | 0.03450 | 0.00031 | 100.00 | 0.7218 | 0.0020 | 6.761 | 0.019 | 0.023 | |
| 32470-06 | 5.0 | 2.74E-13 | | 0.7207 | 0.0016 | 1.2130 | 0.0034 | 1.6998 | 0.0097 | 0.109 | 0.010 | 0.03332 | 0.00019 | 99.74 | 0.7181 | 0.0017 | 6.726 | 0.016 | 0.020 | |
| 32470-07 | 5.0 | 2.18E-13 | | 0.7266 | 0.0017 | 1.2233 | 0.0035 | 1.7060 | 0.0120 | 0.157 | 0.017 | 0.03343 | 0.00023 | 99.54 | 0.7226 | 0.0018 | 6.769 | 0.017 | 0.021 | |
| 32470-08 | 5.0 | 2.18E-13 | | 0.7241 | 0.0018 | 1.2180 | 0.0047 | 1.7155 | 0.0092 | 0.084 | 0.013 | 0.03362 | 0.00018 | 99.84 | 0.7223 | 0.0019 | 6.766 | 0.018 | 0.022 | |
| **252A:** Mes4 (32476) J = 0.0051805 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32476-01Bcomb | 5.0 | 2.31E-13 | | 0.7256 | 0.0018 | 1.2059 | 0.0042 | 1.7160 | 0.0150 | 0.071 | 0.025 | 0.03364 | 0.00029 | 99.89 | 0.7241 | 0.0020 | 6.755 | 0.018 | 0.023 | |
| 32476-02Bcomb | 5.0 | 2.41E-13 | | 0.7292 | 0.0018 | 1.2125 | 0.0043 | 1.8380 | 0.0150 | 0.128 | 0.022 | 0.03603 | 0.00030 | 99.68 | 0.7261 | 0.0019 | 6.774 | 0.018 | 0.022 | |
| 32476-03Bcomb | 5.0 | 1.92E-13 | | 0.7265 | 0.0018 | 1.2145 | 0.0042 | 1.7180 | 0.0160 | 0.135 | 0.029 | 0.03367 | 0.00031 | 99.63 | 0.7231 | 0.0020 | 6.745 | 0.019 | 0.023 | |
| 32476-04Bcomb | 5.0 | 2.20E-13 | | 0.7274 | 0.0017 | 1.2115 | 0.0035 | 1.6770 | 0.0110 | 0.126 | 0.024 | 0.03286 | 0.00022 | 99.67 | 0.7243 | 0.0018 | 6.756 | 0.017 | 0.021 | |
| 32476-05 | 5.0 | 3.01E-13 | | 0.7233 | 0.0017 | 1.2108 | 0.0035 | 1.6720 | 0.0110 | 0.090 | 0.011 | 0.03277 | 0.00022 | 99.81 | 0.7213 | 0.0017 | 6.728 | 0.016 | 0.020 | |
| 32476-06 | 5.0 | 2.46E-13 | | 0.7263 | 0.0017 | 1.2136 | 0.0035 | 1.7280 | 0.0110 | 0.117 | 0.012 | 0.03386 | 0.00022 | 99.71 | 0.7235 | 0.0017 | 6.749 | 0.016 | 0.021 | |
| 32476-07 | 5.0 | 2.79E-13 | | 0.7229 | 0.0018 | 1.2093 | 0.0033 | 1.7300 | 0.0120 | 0.092 | 0.011 | 0.03390 | 0.00023 | 99.81 | 0.7208 | 0.0018 | 6.724 | 0.017 | 0.021 | |
| 32476-08 | 5.0 | 2.00E-13 | | 0.7268 | 0.0017 | 1.2088 | 0.0036 | 1.6890 | 0.0130 | 0.146 | 0.016 | 0.03310 | 0.00025 | 99.59 | 0.7231 | 0.0017 | 6.746 | 0.016 | 0.021 | |
| **252A:** Mes4 (32482) J = 0.0051695 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32482-01Bcomb | 5.0 | 2.64E-13 | | 0.7274 | 0.0020 | 1.2112 | 0.0039 | 1.7780 | 0.0150 | 0.110 | 0.021 | 0.03485 | 0.00029 | 99.74 | 0.7248 | 0.0021 | 6.747 | 0.019 | 0.023 | |
| 32482-02Bcomb | 5.0 | 2.89E-13 | | 0.7253 | 0.0017 | 1.2014 | 0.0042 | 1.7560 | 0.0150 | 0.137 | 0.020 | 0.03441 | 0.00028 | 99.63 | 0.7219 | 0.0018 | 6.720 | 0.017 | 0.021 | |
| 32482-03 | 5.0 | 2.71E-13 | | 0.7271 | 0.0024 | 1.2040 | 0.0049 | 1.7500 | 0.0120 | 0.077 | 0.013 | 0.03431 | 0.00023 | 99.87 | 0.7255 | 0.0025 | 6.753 | 0.023 | 0.026 | |
| 32482-04Bcomb | 5.0 | 3.74E-13 | | 0.7308 | 0.0018 | 1.2156 | 0.0039 | 1.7880 | 0.0130 | 0.151 | 0.016 | 0.03505 | 0.00025 | 99.58 | 0.7271 | 0.0019 | 6.768 | 0.018 | 0.022 | |
| 32482-05 | 5.0 | 2.13E-13 | | 0.7279 | 0.0021 | 1.2043 | 0.0040 | 1.6870 | 0.0140 | 0.231 | 0.015 | 0.03306 | 0.00027 | 99.24 | 0.7216 | 0.0022 | 6.718 | 0.021 | 0.024 | |
| 32482-06 | 5.0 | 1.21E-13 | | 0.7276 | 0.0020 | 1.2094 | 0.0044 | 1.7290 | 0.0170 | 0.144 | 0.023 | 0.03389 | 0.00033 | 99.60 | 0.7240 | 0.0021 | 6.739 | 0.019 | 0.023 | |
| 32482-07 | 5.0 | 2.49E-13 | | 0.7259 | 0.0017 | 1.2174 | 0.0036 | 1.7250 | 0.0110 | 0.000 | 0.013 | 0.03380 | 0.00021 | 100.31 | 0.7274 | 0.0017 | 6.771 | 0.016 | 0.021 | |
| 32482-08 | 5.0 | 2.31E-13 | | 0.7317 | 0.0016 | 1.2198 | 0.0035 | 1.7170 | 0.0120 | 0.219 | 0.014 | 0.03366 | 0.00023 | 99.30 | 0.7258 | 0.0017 | 6.757 | 0.016 | 0.021 | |
| 32482-09Bcomb | 5.0 | 2.39E-13 | | 0.7277 | 0.0019 | 1.2181 | 0.0042 | 1.8530 | 0.0160 | 0.118 | 0.025 | 0.03632 | 0.00030 | 99.72 | 0.7250 | 0.0020 | 6.749 | 0.019 | 0.023 | |
| **269A:** Mes4 (22009) J = 0.0037999 ± 0.0000080 | | | | | | | | | | | | | | | | | | | | |
| 22009-01 | 5.0 | 1.19E-13 | | 1.0016 | 0.0022 | 1.2037 | 0.0037 | 1.5810 | 0.0130 | 0.445 | 0.011 | 0.03098 | 0.00026 | 98.81 | 0.9890 | 0.0022 | 6.767 | 0.015 | 0.021 | |
| 22009-02 | 5.0 | 1.19E-13 | | 0.9987 | 0.0022 | 1.2166 | 0.0038 | 1.6130 | 0.0230 | 0.565 | 0.012 | 0.03162 | 0.00045 | 98.45 | 0.9825 | 0.0023 | 6.723 | 0.016 | 0.021 | |
| 22009-03 | 5.0 | 1.86E-13 | | 0.9868 | 0.0024 | 1.1774 | 0.0041 | 1.3950 | 0.0210 | 0.179 | 0.008 | 0.02735 | 0.00042 | 99.57 | 0.9819 | 0.0024 | 6.719 | 0.016 | 0.022 | |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{39}$Ar (% of total) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar (× 10$^{-2}$) | ± 1σ | $^{37}$Ar/$^{39}$Ar (× 10$^{-2}$) | ± 1σ | $^{36}$Ar/$^{39}$Ar (× 10$^{-4}$) | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22009-04 | 5.0 | 1.21E-13 | | 0.9947 | 0.0020 | 1.2030 | 0.0034 | 1.7020 | 0.0210 | 0.225 | 0.011 | 0.03336 | 0.00042 | 99.46 | 0.9886 | 0.0021 | 6.765 | 0.014 | 0.020 | |
| 22009-05 | 5.0 | 1.57E-13 | | 0.9938 | 0.0021 | 1.2015 | 0.0033 | 1.5320 | 0.0140 | 0.275 | 0.009 | 0.03003 | 0.00027 | 99.30 | 0.9861 | 0.0021 | 6.747 | 0.014 | 0.020 | |
| 22009-06 | 5.0 | 1.24E-13 | | 1.0084 | 0.0022 | 1.1976 | 0.0047 | 1.5380 | 0.0160 | 0.823 | 0.013 | 0.03014 | 0.00032 | 97.70 | 0.9845 | 0.0023 | 6.736 | 0.016 | 0.021 | |
| 22009-07 | 5.0 | 7.09E-14 | | 1.0083 | 0.0025 | 1.1920 | 0.0057 | 1.5620 | 0.0230 | 0.662 | 0.020 | 0.03061 | 0.00045 | 98.18 | 0.9892 | 0.0026 | 6.768 | 0.018 | 0.023 | |
| 22009-08 | 5.0 | 1.28E-13 | | 1.0024 | 0.0021 | 1.2123 | 0.0036 | 1.6120 | 0.0270 | 0.549 | 0.011 | 0.03160 | 0.00053 | 98.51 | 0.9868 | 0.0021 | 6.752 | 0.015 | 0.020 | |
| 22009-13 | 5.0 | 1.06E-13 | | 1.0038 | 0.0024 | 1.2147 | 0.0042 | 1.5970 | 0.0260 | 0.721 | 0.014 | 0.03130 | 0.00051 | 98.00 | 0.9830 | 0.0025 | 6.727 | 0.017 | 0.022 | |
| *22009-09* | *5.0* | 4.72E-14 | | *1.0265* | *0.0021* | *1.2032* | *0.0060* | *1.5270* | *0.0230* | 1.372 | 0.027 | *0.02993* | *0.00045* | *96.16* | *0.9864* | *0.0024* | *6.750* | *0.016* | *0.021* | *%40Ar* <97* |
| *22009-10* | *5.0* | 8.11E-15 | | *7.7240* | *0.0190* | *1.5990* | *0.0150* | *1.7700* | *0.1300* | 225.430 | 0.760 | *0.03460* | *0.00260* | *13.77* | *1.0630* | *0.0480* | *7.270* | *0.330* | *0.326* | *%40Ar* <97* |
| *22009-11* | *5.0* | 1.13E-13 | | *1.0299* | *0.0026* | *1.2050* | *0.0046* | *1.5480* | *0.0310* | 1.400 | 0.016 | *0.03034* | *0.00060* | *96.10* | *0.9890* | *0.0027* | *6.767* | *0.018* | *0.023* | *%40Ar* <97* |
| *22009-12* | *5.0* | 1.11E-13 | | *1.0221* | *0.0022* | *1.2082* | *0.0038* | *1.5140* | *0.0240* | 1.160 | 0.015 | *0.02968* | *0.00046* | *96.76* | *0.9883* | *0.0024* | *6.762* | *0.016* | *0.021* | *%40Ar* <97* |
| **269B:** Mes4 (22029) J = 0.0037952 ± 0.0000080 | | | | | | | | | | | | | | | | | | | | |
| 22029B-01 | 5.0 | 1.72E-13 | | 0.9928 | 0.0025 | 1.1998 | 0.0032 | 1.7070 | 0.0120 | 0.276 | 0.015 | 0.03345 | 0.00024 | 99.31 | 0.9852 | 0.0026 | 6.733 | 0.018 | 0.023 | |
| 22029B-02 | 5.0 | 1.56E-13 | | 0.9970 | 0.0024 | 1.2061 | 0.0034 | 1.6820 | 0.0130 | 0.361 | 0.018 | 0.03296 | 0.00026 | 99.06 | 0.9869 | 0.0025 | 6.745 | 0.017 | 0.022 | |
| 22029B-03 | 5.0 | 1.47E-13 | | 0.9942 | 0.0024 | 1.2105 | 0.0039 | 1.7160 | 0.0100 | 0.221 | 0.018 | 0.03364 | 0.00020 | 99.48 | 0.9883 | 0.0025 | 6.754 | 0.017 | 0.022 | |
| 22029B-04 | 5.0 | 1.66E-13 | | 0.9946 | 0.0025 | 1.1988 | 0.0039 | 1.6970 | 0.0140 | 0.182 | 0.015 | 0.03326 | 0.00027 | 99.59 | 0.9898 | 0.0025 | 6.764 | 0.017 | 0.022 | |
| 22029B-05 | 5.0 | 2.12E-13 | | 0.9924 | 0.0023 | 1.2034 | 0.0034 | 1.6468 | 0.0086 | 0.211 | 0.013 | 0.03228 | 0.00017 | 99.50 | 0.9868 | 0.0024 | 6.744 | 0.016 | 0.022 | |
| 22029B-06 | 5.0 | 2.04E-13 | | 0.9925 | 0.0024 | 1.2053 | 0.0035 | 1.6500 | 0.0100 | 0.199 | 0.014 | 0.03234 | 0.00020 | 99.54 | 0.9872 | 0.0025 | 6.747 | 0.017 | 0.022 | |
| 22029B-07 | 5.0 | 1.61E-13 | | 0.9999 | 0.0024 | 1.2008 | 0.0038 | 1.6530 | 0.0120 | 0.410 | 0.018 | 0.03240 | 0.00023 | 98.92 | 0.9884 | 0.0025 | 6.755 | 0.017 | 0.022 | |
| 22029B-08 | 5.0 | 1.42E-13 | | 1.0015 | 0.0027 | 1.2049 | 0.0039 | 1.6860 | 0.0120 | 0.354 | 0.021 | 0.03304 | 0.00023 | 99.09 | 0.9917 | 0.0028 | 6.777 | 0.019 | 0.024 | |
| 22029B-09 | 5.0 | 2.75E-13 | | 0.9938 | 0.0023 | 1.2011 | 0.0033 | 1.7313 | 0.0097 | 0.278 | 0.012 | 0.03393 | 0.00019 | 99.31 | 0.9862 | 0.0024 | 6.740 | 0.016 | 0.022 | |
| 22029B-10 | 5.0 | 1.64E-13 | | 1.0014 | 0.0027 | 1.1960 | 0.0046 | 1.7130 | 0.0150 | 0.450 | 0.018 | 0.03358 | 0.00029 | 98.80 | 0.9887 | 0.0029 | 6.757 | 0.020 | 0.024 | |
| 22029B-11 | 5.0 | 1.65E-13 | | 0.9955 | 0.0024 | 1.2048 | 0.0036 | 1.6370 | 0.0120 | 0.266 | 0.017 | 0.03209 | 0.00023 | 99.34 | 0.9882 | 0.0025 | 6.753 | 0.017 | 0.022 | |
| **269C:** Mes4 (22050) J = 0.0037910 ± 0.0000080 | | | | | | | | | | | | | | | | | | | | |
| 22050-01 | 4.0 | 1.28E-13 | | 0.9911 | 0.0027 | 1.1934 | 0.0040 | 0.1356 | 0.0076 | 0.183 | 0.009 | 0.00266 | 0.00015 | 99.46 | 0.9851 | 0.0028 | 6.725 | 0.019 | 0.024 | |
| 22050-02 | 4.0 | 1.55E-13 | | 0.9913 | 0.0026 | 1.1961 | 0.0045 | 0.2500 | 0.0130 | 0.104 | 0.008 | 0.00489 | 0.00025 | 99.71 | 0.9877 | 0.0026 | 6.742 | 0.018 | 0.023 | |
| 22050-03 | 4.0 | 1.15E-13 | | 0.9978 | 0.0026 | 1.1997 | 0.0046 | 0.2160 | 0.0140 | 0.180 | 0.010 | 0.00424 | 0.00027 | 99.48 | 0.9919 | 0.0027 | 6.771 | 0.018 | 0.023 | |
| 22050-04 | 4.0 | 1.26E-13 | | 0.9887 | 0.0027 | 1.1977 | 0.0041 | 0.3550 | 0.0220 | 0.064 | 0.010 | 0.00695 | 0.00043 | 99.83 | 0.9863 | 0.0028 | 6.733 | 0.019 | 0.024 | |
| 22050-05 | 4.0 | 1.12E-13 | | 0.9963 | 0.0025 | 1.2023 | 0.0040 | 0.1820 | 0.0140 | 0.138 | 0.010 | 0.00356 | 0.00028 | 99.60 | 0.9917 | 0.0026 | 6.769 | 0.017 | 0.022 | |
| 22050-06 | 4.0 | 1.56E-13 | | 0.9947 | 0.0025 | 1.2069 | 0.0038 | 0.2092 | 0.0086 | 0.288 | 0.008 | 0.00410 | 0.00017 | 99.16 | 0.9856 | 0.0026 | 6.728 | 0.018 | 0.023 | |
| 22050-07 | 4.0 | 1.26E-13 | | 1.0112 | 0.0033 | 1.1900 | 0.0045 | 0.2760 | 0.0190 | 0.676 | 0.011 | 0.00541 | 0.00037 | 98.04 | 0.9907 | 0.0034 | 6.763 | 0.023 | 0.027 | |
| 22050-08 | 4.0 | 1.92E-13 | | 0.9979 | 0.0023 | 1.2082 | 0.0033 | 0.2344 | 0.0094 | 0.264 | 0.007 | 0.00459 | 0.00018 | 99.23 | 0.9895 | 0.0023 | 6.755 | 0.016 | 0.021 | |
| 22050-09 | 4.0 | 1.11E-13 | | 0.9995 | 0.0025 | 1.1947 | 0.0048 | 0.1540 | 0.0130 | 0.412 | 0.011 | 0.00301 | 0.00025 | 98.79 | 0.9867 | 0.0026 | 6.736 | 0.017 | 0.022 | |
| 22050-10 | 4.0 | 1.19E-13 | | 1.0076 | 0.0026 | 1.1982 | 0.0045 | 0.2160 | 0.0110 | 0.513 | 0.011 | 0.00424 | 0.00021 | 98.51 | 0.9918 | 0.0027 | 6.771 | 0.018 | 0.023 | |
| 22050-11 | 4.0 | 1.69E-13 | | 0.9971 | 0.0022 | 1.1996 | 0.0039 | 0.2708 | 0.0077 | 0.266 | 0.008 | 0.00531 | 0.00015 | 99.23 | 0.9887 | 0.0023 | 6.750 | 0.016 | 0.021 | |
| 22050-12 | 4.0 | 1.22E-13 | | 0.9935 | 0.0025 | 1.2048 | 0.0036 | 0.2850 | 0.0180 | 0.202 | 0.010 | 0.00558 | 0.00035 | 99.42 | 0.9870 | 0.0026 | 6.738 | 0.018 | 0.023 | |
| **269D:** Mes4 (22071) J = 0.0037904 ± 0.0000057 | | | | | | | | | | | | | | | | | | | | |
| 22071-01 | 4.0 | 1.66E-13 | | 0.9975 | 0.0035 | 1.2092 | 0.0049 | 0.1970 | 0.0100 | 0.272 | 0.008 | 0.00385 | 0.00020 | 99.21 | 0.9889 | 0.0036 | 6.749 | 0.024 | 0.026 | |
| 22071-02 | 4.0 | 1.27E-13 | | 0.9968 | 0.0035 | 1.1972 | 0.0047 | 0.1420 | 0.0130 | 0.342 | 0.010 | 0.00278 | 0.00025 | 99.00 | 0.9861 | 0.0036 | 6.731 | 0.024 | 0.026 | |
| 22071-03 | 4.0 | 1.34E-13 | | 0.9950 | 0.0035 | 1.1957 | 0.0051 | 0.1770 | 0.0130 | 0.141 | 0.009 | 0.00348 | 0.00026 | 99.59 | 0.9902 | 0.0035 | 6.759 | 0.024 | 0.026 | |
| 22071-04 | 4.0 | 1.65E-13 | | 1.0008 | 0.0034 | 1.2001 | 0.0047 | 0.2172 | 0.0086 | 0.304 | 0.008 | 0.00426 | 0.00017 | 99.12 | 0.9912 | 0.0035 | 6.766 | 0.024 | 0.026 | |
| 22071-05 | 4.0 | 1.32E-13 | | 0.9908 | 0.0035 | 1.2020 | 0.0054 | 0.1610 | 0.0110 | 0.086 | 0.008 | 0.00315 | 0.00022 | 99.75 | 0.9876 | 0.0035 | 6.741 | 0.024 | 0.026 | |
| 22071-06 | 4.0 | 1.10E-13 | | 0.9875 | 0.0036 | 1.1988 | 0.0051 | 0.2240 | 0.0150 | 0.133 | 0.010 | 0.00440 | 0.00030 | 99.62 | 0.9830 | 0.0036 | 6.709 | 0.025 | 0.027 | |
| 22071-07 | 4.0 | 1.31E-13 | | 0.9883 | 0.0036 | 1.1977 | 0.0049 | 0.2980 | 0.0180 | 0.083 | 0.008 | 0.00583 | 0.00035 | 99.77 | 0.9854 | 0.0036 | 6.726 | 0.025 | 0.027 | |
| 22071-08 | 4.0 | 1.18E-13 | | 0.9988 | 0.0037 | 1.1995 | 0.0048 | 0.3850 | 0.0190 | 0.329 | 0.010 | 0.00755 | 0.00037 | 99.06 | 0.9886 | 0.0038 | 6.748 | 0.026 | 0.028 | |
| 22071-09 | 4.0 | 1.24E-13 | | 0.9889 | 0.0036 | 1.2038 | 0.0055 | 0.2530 | 0.0140 | 0.118 | 0.008 | 0.00497 | 0.00027 | 99.67 | 0.9849 | 0.0036 | 6.722 | 0.024 | 0.026 | |
| 22071-10 | 4.0 | 1.16E-13 | | 0.9876 | 0.0037 | 1.1970 | 0.0049 | 0.1840 | 0.0130 | 0.094 | 0.009 | 0.00360 | 0.00025 | 99.73 | 0.9842 | 0.0037 | 6.718 | 0.025 | 0.027 | |
| 22071-11 | 4.0 | 9.23E-14 | | 0.9876 | 0.0036 | 1.2025 | 0.0052 | 0.3600 | 0.0240 | 0.101 | 0.011 | 0.00705 | 0.00047 | 99.73 | 0.9841 | 0.0036 | 6.717 | 0.024 | 0.026 | |
| 22071-12 | 4.0 | 1.21E-13 | | 0.9921 | 0.0037 | 1.1952 | 0.0053 | 0.2350 | 0.0130 | 0.065 | 0.009 | 0.00462 | 0.00026 | 99.82 | 0.9896 | 0.0037 | 6.754 | 0.025 | 0.027 | |
| 22071-13 | 4.0 | 1.12E-13 | | 0.9925 | 0.0036 | 1.2218 | 0.0058 | 0.1910 | 0.0120 | 0.100 | 0.009 | 0.00375 | 0.00023 | 99.72 | 0.9889 | 0.0036 | 6.750 | 0.025 | 0.026 | |
| 22071-14 | 4.0 | 1.71E-13 | | 0.9890 | 0.0035 | 1.2018 | 0.0048 | 0.3130 | 0.0160 | 0.088 | 0.007 | 0.00614 | 0.00032 | 99.76 | 0.9859 | 0.0036 | 6.729 | 0.024 | 0.026 | |
| 22071-15 | 4.0 | 7.34E-14 | | 0.9920 | 0.0035 | 1.2020 | 0.0058 | 0.3550 | 0.0190 | 0.144 | 0.014 | 0.00696 | 0.00038 | 99.60 | 0.9873 | 0.0035 | 6.739 | 0.024 | 0.026 | |
| 22071-16 | 4.0 | 1.54E-13 | | 0.9881 | 0.0036 | 1.1999 | 0.0050 | 0.3930 | 0.0170 | 0.106 | 0.008 | 0.00770 | 0.00033 | 99.71 | 0.9845 | 0.0036 | 6.720 | 0.025 | 0.026 | |
| 22071-17 | 4.0 | 6.99E-14 | | 0.9847 | 0.0036 | 1.2032 | 0.0055 | 0.3210 | 0.0250 | 0.067 | 0.014 | 0.00629 | 0.00049 | 99.82 | 0.9823 | 0.0037 | 6.704 | 0.025 | 0.027 | |
| **269E:** Mes4 (22083) J = 0.0037943 ± 0.0000080 | | | | | | | | | | | | | | | | | | | | |
| 22083-01 | 3.0 | 1.73E-13 | | 0.9890 | 0.0026 | 1.2117 | 0.0043 | 1.6160 | 0.0170 | 0.089 | 0.015 | 0.03168 | 0.00033 | 99.86 | 0.9869 | 0.0026 | 6.743 | 0.018 | 0.023 | |
| 22083-03 | 3.0 | 2.14E-13 | | 0.9897 | 0.0025 | 1.2073 | 0.0038 | 1.6340 | 0.0170 | 0.063 | 0.011 | 0.03204 | 0.00033 | 99.94 | 0.9884 | 0.0025 | 6.753 | 0.017 | 0.022 | |
| 22083-05 | 3.0 | 1.35E-13 | | 0.9897 | 0.0024 | 1.1939 | 0.0045 | 1.6650 | 0.0180 | 0.130 | 0.018 | 0.03263 | 0.00035 | 99.74 | 0.9865 | 0.0025 | 6.740 | 0.017 | 0.022 | |
| 22083-06 | 3.0 | 1.51E-13 | | 0.9898 | 0.0025 | 1.2082 | 0.0044 | 1.7010 | 0.0140 | 0.052 | 0.014 | 0.03334 | 0.00028 | 99.98 | 0.9889 | 0.0025 | 6.757 | 0.017 | 0.022 | |
| 22083-07 | 3.0 | 1.38E-13 | | 0.9913 | 0.0031 | 1.2074 | 0.0052 | 1.6790 | 0.0220 | 0.096 | 0.017 | 0.03291 | 0.00044 | 99.85 | 0.9890 | 0.0031 | 6.757 | 0.021 | 0.026 | |
| 22083-08 | 3.0 | 1.06E-13 | | 0.9907 | 0.0030 | 1.1901 | 0.0063 | 1.6730 | 0.0160 | 0.084 | 0.020 | 0.03280 | 0.00031 | 99.88 | 0.9888 | 0.0031 | 6.756 | 0.021 | 0.026 | |
| 22083-09 | 3.0 | 1.26E-13 | | 0.9901 | 0.0027 | 1.1927 | 0.0039 | 1.6560 | 0.0230 | 0.059 | 0.017 | 0.03245 | 0.00044 | 99.95 | 0.9889 | 0.0027 | 6.757 | 0.019 | 0.024 | |
| *22083-02* | *3.0* | 1.77E-13 | | *0.9878* | *0.0030* | *1.1934* | *0.0055* | *1.7490* | *0.0220* | 0.117 | 0.014 | *0.03428* | *0.00044* | *99.79* | *0.9850* | *0.0030* | *6.730* | *0.021* | *0.025* | *>1.5 nMADs from median age* |
| *22083-04* | *3.0* | 7.19E-14 | | *0.9865* | *0.0027* | *1.1889* | *0.0058* | *1.6460* | *0.0200* | 0.147 | 0.027 | *0.03225* | *0.00039* | *99.69* | *0.9827* | *0.0028* | *6.715* | *0.019* | *0.024* | *>1.5 nMADs from median age* |
| *22083B-01* | *4.0* | 4.45E-14 | | *0.7879* | *0.0017* | *1.1898* | *0.0059* | *0.9860* | *0.0320* | 0.016 | 0.023 | *0.01933* | *0.00062* | *100.04* | *0.7875* | *0.0018* | *5.382* | *0.012* | *0.017* | *age < 6.5 Ma* |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{39}$Ar (% of total) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar (× $10^{-2}$) | ± 1σ | $^{37}$Ar/$^{39}$Ar (× $10^{-2}$) | ± 1σ | $^{36}$Ar/$^{39}$Ar (× $10^{-4}$) | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *22083B-02* | *4.0* | 5.70E-14 | | *0.8674* | *0.0020* | *1.1906* | *0.0049* | *1.2460* | *0.0260* | 0.055 | 0.019 | *0.02442* | *0.00052* | *99.92* | *0.8660* | *0.0021* | *5.918* | *0.015* | *0.019* | *age < 6.5 Ma* |
| *22083B-03* | *4.0* | 4.77E-14 | | *0.8853* | *0.0019* | *1.1830* | *0.0049* | *2.2030* | *0.0350* | 0.101 | 0.021 | *0.04319* | *0.00069* | *99.85* | *0.8833* | *0.0020* | *6.036* | *0.014* | *0.019* | *age < 6.5 Ma* |
| *22083B-04* | *4.0* | 5.17E-14 | | *0.8668* | *0.0017* | *1.2010* | *0.0049* | *1.3710* | *0.0320* | 0.044 | 0.021 | *0.02686* | *0.00063* | *99.97* | *0.8658* | *0.0018* | *5.917* | *0.012* | *0.017* | *age < 6.5 Ma* |
| *22083B-05* | *4.0* | 6.81E-14 | | *0.8445* | *0.0018* | *1.2113* | *0.0058* | *1.1560* | *0.0150* | 0.075 | 0.017 | *0.02266* | *0.00030* | *99.85* | *0.8425* | *0.0019* | *5.758* | *0.013* | *0.018* | *age < 6.5 Ma* |
| *22083B-06* | *4.0* | 7.97E-14 | | *0.8771* | *0.0018* | *1.1984* | *0.0040* | *1.2790* | *0.0210* | 0.052 | 0.015 | *0.02506* | *0.00040* | *99.94* | *0.8759* | *0.0019* | *5.986* | *0.013* | *0.018* | *age < 6.5 Ma* |
| *22083B-07* | *4.0* | 5.93E-14 | | *0.9029* | *0.0017* | *1.1948* | *0.0044* | *1.3090* | *0.0250* | 0.123 | 0.018 | *0.02565* | *0.00049* | *99.71* | *0.8995* | *0.0018* | *6.147* | *0.012* | *0.018* | *age < 6.5 Ma* |
| **257PR-C:** Mes8 (32529) J = 0.0051603 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32529-01 | 6.0 | 2.99E-13 | | 0.7146 | 0.0016 | 1.2208 | 0.0032 | 2.0590 | 0.0110 | 0.106 | 0.013 | 0.04036 | 0.00022 | 99.79 | 0.7124 | 0.0017 | 6.620 | 0.015 | 0.020 | |
| 32529-02 | 6.0 | 2.01E-13 | | 0.7144 | 0.0016 | 1.2291 | 0.0031 | 2.0145 | 0.0083 | 0.125 | 0.017 | 0.03948 | 0.00016 | 99.71 | 0.7116 | 0.0017 | 6.612 | 0.016 | 0.021 | |
| 32529-03 | 6.0 | 1.36E-13 | | 0.7206 | 0.0017 | 1.2118 | 0.0035 | 1.8770 | 0.0120 | 0.191 | 0.025 | 0.03678 | 0.00024 | 99.42 | 0.7158 | 0.0019 | 6.651 | 0.018 | 0.022 | |
| 32529-04 | 6.0 | 1.29E-13 | | 0.7172 | 0.0017 | 1.2474 | 0.0035 | 2.1670 | 0.0170 | 0.234 | 0.035 | 0.04248 | 0.00034 | 99.27 | 0.7113 | 0.0020 | 6.610 | 0.019 | 0.023 | |
| 32529-06 | 6.0 | 2.01E-13 | | 0.7144 | 0.0017 | 1.2258 | 0.0033 | 2.0970 | 0.0140 | 0.082 | 0.016 | 0.04110 | 0.00027 | 99.89 | 0.7130 | 0.0017 | 6.625 | 0.016 | 0.021 | |
| 32529-07 | 6.0 | 1.36E-13 | | 0.7156 | 0.0017 | 1.2208 | 0.0035 | 1.9930 | 0.0100 | 0.126 | 0.022 | 0.03906 | 0.00020 | 99.70 | 0.7128 | 0.0018 | 6.623 | 0.017 | 0.021 | |
| 32529-10 | 5.8 | 5.53E-14 | | 0.7154 | 0.0011 | 1.2096 | 0.0028 | 1.9859 | 0.0088 | 0.185 | 0.053 | 0.03892 | 0.00017 | 99.47 | 0.7109 | 0.0020 | 6.606 | 0.018 | 0.022 | |
| 32529-11 | 5.8 | 4.80E-14 | | 0.7168 | 0.0013 | 1.2031 | 0.0036 | 1.9900 | 0.0130 | 0.306 | 0.059 | 0.03900 | 0.00025 | 98.97 | 0.7087 | 0.0022 | 6.585 | 0.020 | 0.024 | |
| 32529-12 | 5.8 | 3.28E-14 | | 0.7154 | 0.0011 | 1.2091 | 0.0035 | 2.0110 | 0.0130 | 0.060 | 0.081 | 0.03941 | 0.00026 | 99.98 | 0.7146 | 0.0027 | 6.641 | 0.025 | 0.028 | |
| 32529-13 | 5.8 | 3.49E-14 | | 0.7147 | 0.0012 | 1.2065 | 0.0032 | 2.1430 | 0.0130 | 0.066 | 0.068 | 0.04200 | 0.00026 | 99.97 | 0.7138 | 0.0024 | 6.633 | 0.022 | 0.026 | |
| 32529-14 | 5.8 | 6.52E-14 | | 0.7184 | 0.0011 | 1.2094 | 0.0024 | 2.0140 | 0.0100 | 0.186 | 0.053 | 0.03948 | 0.00020 | 99.47 | 0.7138 | 0.0019 | 6.633 | 0.018 | 0.022 | |
| 32529-15 | 5.8 | 7.65E-14 | | 0.7163 | 0.0010 | 1.2083 | 0.0026 | 1.9786 | 0.0084 | 0.159 | 0.041 | 0.03878 | 0.00017 | 99.57 | 0.7125 | 0.0016 | 6.621 | 0.015 | 0.020 | |
| 32529-16 | 5.8 | 5.34E-14 | | 0.7149 | 0.0013 | 1.2077 | 0.0030 | 1.9552 | 0.0092 | 0.175 | 0.058 | 0.03832 | 0.00018 | 99.50 | 0.7106 | 0.0021 | 6.603 | 0.020 | 0.024 | |
| *32529-05* | *6.0* | 1.12E-13 | | *0.7430* | *0.0018* | *1.2243* | *0.0036* | *2.0150* | *0.0140* | 0.066 | 0.031 | *0.03950* | *0.00028* | *99.95* | *0.7420* | *0.0020* | *6.894* | *0.019* | *0.023* | *>1.5 nMADs from median age* |
| *32529-17* | *5.8* | 5.91E-14 | | *0.7227* | *0.0012* | *1.2076* | *0.0027* | *2.0028* | *0.0086* | 0.196 | 0.051 | *0.03926* | *0.00017* | *99.43* | *0.7178* | *0.0019* | *6.670* | *0.018* | *0.022* | *>1.5 nMADs from median age* |
| **257PR-C:** Mes9 (32533) J = 0.0051638 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32533-10 | 4.8 | 3.26E-14 | | 0.7108 | 0.0010 | 1.2032 | 0.0036 | 1.6012 | 0.0068 | 0.324 | 0.083 | 0.03138 | 0.00013 | 98.83 | 0.7018 | 0.0027 | 6.526 | 0.025 | 0.028 | |
| 32533-11 | 4.8 | 4.25E-14 | | 0.7107 | 0.0011 | 1.2044 | 0.0028 | 1.4612 | 0.0048 | 0.127 | 0.067 | 0.02864 | 0.00010 | 99.64 | 0.7074 | 0.0023 | 6.578 | 0.021 | 0.025 | |
| 32533-12 | 4.8 | 3.48E-14 | | 0.7222 | 0.0010 | 1.1978 | 0.0032 | 1.4387 | 0.0053 | 0.547 | 0.078 | 0.02820 | 0.00010 | 97.92 | 0.7065 | 0.0026 | 6.569 | 0.024 | 0.027 | |
| 32533-13 | 4.8 | 4.36E-14 | | 0.7091 | 0.0011 | 1.2009 | 0.0029 | 1.5103 | 0.0037 | 0.118 | 0.072 | 0.02960 | 0.00007 | 99.68 | 0.7061 | 0.0024 | 6.566 | 0.022 | 0.026 | |
| 32533-14 | 4.8 | 7.12E-14 | | 0.7117 | 0.0011 | 1.2021 | 0.0027 | 1.5079 | 0.0035 | 0.342 | 0.050 | 0.02955 | 0.00007 | 98.75 | 0.7021 | 0.0019 | 6.529 | 0.017 | 0.021 | |
| 32533-15 | 4.8 | 5.44E-14 | | 0.7081 | 0.0011 | 1.1986 | 0.0031 | 1.5972 | 0.0049 | 0.232 | 0.064 | 0.03131 | 0.00010 | 99.21 | 0.7018 | 0.0022 | 6.526 | 0.020 | 0.024 | |
| 32533-20 | 5.8 | 4.40E-14 | | 0.7098 | 0.0011 | 1.2139 | 0.0032 | 1.6412 | 0.0094 | 0.078 | 0.050 | 0.03217 | 0.00018 | 99.87 | 0.7081 | 0.0018 | 6.585 | 0.017 | 0.021 | |
| 32533-22 | 5.8 | 5.85E-14 | | 0.7083 | 0.0011 | 1.2021 | 0.0026 | 1.4922 | 0.0082 | 0.225 | 0.045 | 0.02925 | 0.00016 | 99.24 | 0.7022 | 0.0017 | 6.530 | 0.016 | 0.020 | |
| 32533-25 | 5.8 | 7.71E-14 | | 0.7086 | 0.0011 | 1.2072 | 0.0028 | 1.4857 | 0.0057 | 0.128 | 0.042 | 0.02912 | 0.00011 | 99.64 | 0.7053 | 0.0016 | 6.559 | 0.015 | 0.020 | |
| 32533-27 | 5.8 | 4.55E-14 | | 0.7186 | 0.0011 | 1.1997 | 0.0034 | 1.3909 | 0.0085 | 0.373 | 0.055 | 0.02726 | 0.00017 | 98.63 | 0.7081 | 0.0020 | 6.584 | 0.019 | 0.023 | |
| 32533-28 | 5.8 | 4.22E-14 | | 0.7103 | 0.0012 | 1.2081 | 0.0034 | 1.4994 | 0.0082 | 0.271 | 0.060 | 0.02939 | 0.00016 | 99.05 | 0.7029 | 0.0021 | 6.536 | 0.020 | 0.024 | |
| 32533-29 | 5.8 | 3.47E-14 | | 0.7127 | 0.0013 | 1.2022 | 0.0034 | 1.4690 | 0.0120 | 0.426 | 0.077 | 0.02879 | 0.00023 | 98.40 | 0.7006 | 0.0026 | 6.515 | 0.024 | 0.027 | |
| *32533-23* | *5.8* | 1.69E-15 | | *0.7784* | *0.0031* | *1.1820* | *0.0150* | *1.4640* | *0.0880* | 0.470 | 0.980 | *0.02870* | *0.00170* | *98.40* | *0.7650* | *0.0290* | *7.110* | *0.270* | *0.271* | *>1.5 nMADs from median age* |
| *32533-26* | *5.8* | 5.72E-16 | | *0.9024* | *0.0065* | *1.2110* | *0.0290* | *3.0200* | *0.2400* | 0.500 | 2.800 | *0.05920* | *0.00470* | *98.60* | *0.8890* | *0.0840* | *8.260* | *0.780* | *0.777* | *age > 7.2 Ma* |
| *32533-21* | *5.8* | 1.61E-15 | | *0.7732* | *0.0030* | *1.2290* | *0.0160* | *2.0900* | *0.0980* | 1.500 | 1.000 | *0.04100* | *0.00190* | *94.60* | *0.7310* | *0.0310* | *6.790* | *0.290* | *0.291* | *%40Ar* <97* |
| *32533-24* | *5.8* | 7.02E-15 | | *0.7529* | *0.0020* | *1.2379* | *0.0076* | *1.7650* | *0.0280* | 1.290 | 0.270 | *0.03459* | *0.00054* | *95.10* | *0.7156* | *0.0082* | *6.655* | *0.076* | *0.077* | *%40Ar* <97* |
| **257PR-C:** Mes11 (32531) J = 0.0051638 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32531-07 | 6.0 | 3.95E-14 | | 0.7087 | 0.0018 | 1.2431 | 0.0053 | 2.0740 | 0.0190 | 0.190 | 0.073 | 0.04064 | 0.00037 | 99.44 | 0.7040 | 0.0028 | 6.546 | 0.026 | 0.029 | |
| 32531-22 | 5.8 | 1.51E-14 | | 0.7102 | 0.0014 | 1.1844 | 0.0045 | 1.8740 | 0.0200 | 0.490 | 0.140 | 0.03673 | 0.00039 | 98.18 | 0.6965 | 0.0044 | 6.477 | 0.041 | 0.043 | |
| 32531-23 | 5.8 | 8.60E-15 | | 0.7128 | 0.0018 | 1.2261 | 0.0060 | 1.9680 | 0.0320 | 0.690 | 0.230 | 0.03857 | 0.00062 | 97.38 | 0.6934 | 0.0070 | 6.448 | 0.065 | 0.066 | |
| 32531-28 | 5.8 | 1.39E-14 | | 0.7038 | 0.0014 | 1.2013 | 0.0047 | 1.9650 | 0.0200 | 0.430 | 0.150 | 0.03851 | 0.00038 | 98.42 | 0.6920 | 0.0047 | 6.435 | 0.043 | 0.045 | |
| 32531-33 | 5.8 | 1.25E-14 | | 0.7109 | 0.0017 | 1.1959 | 0.0069 | 1.8660 | 0.0190 | 0.000 | 0.170 | 0.03657 | 0.00036 | 100.26 | 0.7120 | 0.0052 | 6.621 | 0.048 | 0.050 | |
| 32531-43 | 5.8 | 7.27E-15 | | 0.7148 | 0.0022 | 1.2092 | 0.0072 | 2.0410 | 0.0300 | 0.350 | 0.250 | 0.04000 | 0.00058 | 98.80 | 0.7055 | 0.0077 | 6.561 | 0.071 | 0.072 | |
| 32531-44 | 5.8 | 1.07E-14 | | 0.7039 | 0.0016 | 1.2102 | 0.0048 | 1.9390 | 0.0210 | 0.410 | 0.170 | 0.03801 | 0.00042 | 98.49 | 0.6925 | 0.0054 | 6.440 | 0.050 | 0.052 | |
| 32531-48 | 5.8 | 8.66E-15 | | 0.7047 | 0.0018 | 1.1868 | 0.0066 | 1.9890 | 0.0340 | 0.000 | 0.210 | 0.03899 | 0.00067 | 100.67 | 0.7088 | 0.0066 | 6.591 | 0.061 | 0.063 | |
| 32531-50 | 5.8 | 8.85E-15 | | 0.7055 | 0.0018 | 1.1871 | 0.0052 | 1.8930 | 0.0270 | 0.160 | 0.210 | 0.03710 | 0.00053 | 99.54 | 0.7016 | 0.0065 | 6.524 | 0.061 | 0.062 | |
| 32531-52 | 5.8 | 8.13E-15 | | 0.7034 | 0.0018 | 1.1947 | 0.0056 | 1.9220 | 0.0290 | 0.020 | 0.230 | 0.03767 | 0.00057 | 100.20 | 0.7038 | 0.0071 | 6.545 | 0.066 | 0.067 | |
| 32531-53 | 5.8 | 6.70E-15 | | 0.7112 | 0.0020 | 1.1989 | 0.0061 | 2.0600 | 0.0270 | 0.430 | 0.260 | 0.04038 | 0.00053 | 98.50 | 0.6995 | 0.0079 | 6.505 | 0.073 | 0.074 | |
| 32531-54 | 5.8 | 8.86E-15 | | 0.7050 | 0.0015 | 1.2036 | 0.0050 | 1.9060 | 0.0260 | 0.140 | 0.200 | 0.03735 | 0.00052 | 99.65 | 0.7018 | 0.0063 | 6.526 | 0.058 | 0.060 | |
| 32531-55 | 5.8 | 8.59E-15 | | 0.7062 | 0.0018 | 1.2118 | 0.0064 | 1.9040 | 0.0240 | 0.560 | 0.210 | 0.03732 | 0.00047 | 97.89 | 0.6906 | 0.0065 | 6.422 | 0.060 | 0.061 | |
| 32531-56 | 6.0 | 1.95E-14 | | 0.7132 | 0.0021 | 1.2073 | 0.0065 | 2.0110 | 0.0240 | 0.390 | 0.110 | 0.03941 | 0.00047 | 98.62 | 0.7027 | 0.0041 | 6.534 | 0.038 | 0.040 | |
| 32531-57 | 6.0 | 2.13E-14 | | 0.7036 | 0.0020 | 1.2074 | 0.0064 | 1.9920 | 0.0250 | 0.030 | 0.110 | 0.03905 | 0.00049 | 100.11 | 0.7036 | 0.0039 | 6.543 | 0.036 | 0.038 | |
| 32531-59 | 6.0 | 3.21E-14 | | 0.7031 | 0.0018 | 1.2172 | 0.0049 | 2.1270 | 0.0180 | 0.000 | 0.078 | 0.04170 | 0.00036 | 100.24 | 0.7041 | 0.0030 | 6.547 | 0.027 | 0.030 | |
| 32531-60 | 6.0 | 1.60E-14 | | 0.7142 | 0.0022 | 1.2197 | 0.0081 | 2.0100 | 0.0250 | 0.630 | 0.150 | 0.03939 | 0.00050 | 97.61 | 0.6964 | 0.0051 | 6.476 | 0.048 | 0.049 | |
| *32531-36* | *5.8* | 8.89E-15 | | *0.7019* | *0.0018* | *1.1819* | *0.0055* | *1.9300* | *0.0270* | 0.680 | 0.220 | *0.03782* | *0.00053* | *97.35* | *0.6825* | *0.0068* | *6.347* | *0.063* | *0.064* | *>1.5 nMADs from median age* |
| *32531-40* | *5.8* | 5.55E-15 | | *0.7053* | *0.0022* | *1.2035* | *0.0079* | *2.0180* | *0.0340* | 0.750 | 0.300 | *0.03956* | *0.00067* | *97.10* | *0.6842* | *0.0093* | *6.362* | *0.086* | *0.087* | *>1.5 nMADs from median age* |
| *32531-46* | *5.8* | 8.27E-15 | | *0.7017* | *0.0018* | *1.1889* | *0.0065* | *2.1470* | *0.0260* | 0.730 | 0.230 | *0.04208* | *0.00052* | *97.20* | *0.6810* | *0.0072* | *6.333* | *0.067* | *0.068* | *>1.5 nMADs from median age* |
| *32531-49* | *5.8* | 8.13E-15 | | *0.7105* | *0.0019* | *1.2104* | *0.0070* | *1.8900* | *0.0330* | 0.000 | 0.240 | *0.03704* | *0.00064* | *101.40* | *0.7194* | *0.0073* | *6.690* | *0.068* | *0.069* | *>1.5 nMADs from median age* |
| *32531-31* | *5.8* | 1.25E-15 | | *0.7685* | *0.0040* | *1.4770* | *0.0200* | *317.4000* | *1.1000* | 8.200 | 1.400 | *6.22000* | *0.02200* | *100.70* | *0.7750* | *0.0420* | *7.210* | *0.390* | *0.392* | *Ca/K >1* |
| *32531-26* | *5.8* | 5.50E-15 | | *0.7127* | *0.0022* | *1.2056* | *0.0069* | *1.9770* | *0.0370* | 0.850 | 0.340 | *0.03874* | *0.00073* | *96.70* | *0.6880* | *0.0100* | *6.402* | *0.096* | *0.097* | *%40Ar* <97* |
| *32531-27* | *5.8* | 7.60E-15 | | *0.7137* | *0.0019* | *1.1844* | *0.0063* | *2.0390* | *0.0320* | 0.850 | 0.250 | *0.03996* | *0.00063* | *96.70* | *0.6894* | *0.0077* | *6.411* | *0.071* | *0.072* | *%40Ar* <97* |
| *32531-29* | *5.8* | 5.44E-15 | | *0.7090* | *0.0020* | *1.2001* | *0.0079* | *1.6980* | *0.0350* | 1.240 | 0.350 | *0.03328* | *0.00068* | *95.00* | *0.6730* | *0.0110* | *6.260* | *0.098* | *0.098* | *%40Ar* <97* |
| *32531-34* | *5.8* | 7.27E-15 | | *0.7131* | *0.0019* | *1.1867* | *0.0069* | *1.8960* | *0.0300* | 0.900 | 0.250 | *0.03717* | *0.00058* | *96.50* | *0.6874* | *0.0076* | *6.392* | *0.070* | *0.071* | *%40Ar* <97* |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{39}$Ar (% of total) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar (× $10^{-2}$) | ± 1σ | $^{37}$Ar/$^{39}$Ar (× $10^{-2}$) | ± 1σ | $^{36}$Ar/$^{39}$Ar (× $10^{-4}$) | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *32531-41* | *5.8* | 6.75E-15 | | *0.7191* | *0.0020* | *1.2153* | *0.0059* | *2.0370* | *0.0300* | 0.820 | 0.270 | *0.03993* | *0.00059* | *96.90* | *0.6958* | *0.0082* | *6.470* | *0.076* | *0.077* | *%40Ar* <97* |
| *32531-45* | *5.8* | 5.19E-15 | | *0.7165* | *0.0022* | *1.1989* | *0.0076* | *1.8240* | *0.0410* | 1.700 | 0.340 | *0.03575* | *0.00081* | *93.20* | *0.6670* | *0.0100* | *6.203* | *0.097* | *0.098* | *%40Ar* <97* |
| *32531-47* | *5.8* | 4.00E-15 | | *0.7120* | *0.0023* | *1.1888* | *0.0095* | *2.1570* | *0.0470* | 1.000 | 0.450 | *0.04227* | *0.00093* | *96.10* | *0.6830* | *0.0140* | *6.360* | *0.130* | *0.128* | *%40Ar* <97* |
| *32531-51* | *5.8* | 3.91E-16 | | *0.8710* | *0.0100* | *1.2640* | *0.0370* | *443.6000* | *2.8000* | 22.500 | 3.800 | *8.69500* | *0.05400* | *64.00* | *0.5500* | *0.1100* | *5.200* | *1.100* | *1.062* | *%40Ar* <97* |
| **252A:** Mes12 (32472) J = 0.0052029 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32472-01Bcomb | 5.0 | 3.46E-13 | | 0.6858 | 0.0015 | 1.2030 | 0.0033 | 1.7520 | 0.0100 | 0.096 | 0.017 | 0.03434 | 0.00020 | 99.78 | 0.6836 | 0.0016 | 6.405 | 0.015 | 0.019 | |
| 32472-02Bcomb | 5.0 | 2.29E-13 | | 0.6891 | 0.0017 | 1.2182 | 0.0040 | 1.4400 | 0.0130 | 0.207 | 0.023 | 0.02823 | 0.00026 | 99.27 | 0.6834 | 0.0018 | 6.403 | 0.017 | 0.021 | |
| 32472-03Bcomb | 5.0 | 2.89E-13 | | 0.6857 | 0.0018 | 1.2172 | 0.0038 | 1.8660 | 0.0110 | 0.084 | 0.020 | 0.03657 | 0.00022 | 99.85 | 0.6840 | 0.0019 | 6.409 | 0.018 | 0.022 | |
| 32472-04Bcomb | 5.0 | 3.58E-13 | | 0.6867 | 0.0017 | 1.2125 | 0.0037 | 2.0250 | 0.0130 | 0.082 | 0.016 | 0.03970 | 0.00026 | 99.88 | 0.6851 | 0.0018 | 6.419 | 0.016 | 0.021 | |
| 32472-05Bcomb | 5.0 | 3.22E-13 | | 0.6889 | 0.0017 | 1.2084 | 0.0038 | 2.0310 | 0.0130 | 0.112 | 0.017 | 0.03981 | 0.00026 | 99.75 | 0.6864 | 0.0018 | 6.431 | 0.016 | 0.021 | |
| 32472-06 | 5.0 | 2.74E-13 | | 0.6876 | 0.0016 | 1.2155 | 0.0032 | 1.7860 | 0.0110 | 0.221 | 0.010 | 0.03500 | 0.00021 | 99.25 | 0.6818 | 0.0016 | 6.388 | 0.015 | 0.020 | |
| 32472-07 | 5.0 | 2.81E-13 | | 0.6865 | 0.0016 | 1.2091 | 0.0035 | 1.8160 | 0.0130 | 0.103 | 0.012 | 0.03560 | 0.00026 | 99.76 | 0.6841 | 0.0017 | 6.410 | 0.016 | 0.020 | |
| 32472-08 | 5.0 | 2.57E-13 | | 0.6857 | 0.0016 | 1.2107 | 0.0038 | 2.1420 | 0.0160 | 0.130 | 0.012 | 0.04199 | 0.00032 | 99.68 | 0.6828 | 0.0017 | 6.398 | 0.016 | 0.020 | |
| **252A:** Mes12 (32478) J = 0.0051716 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32478-01Bcomb | 5.0 | 2.23E-13 | | 0.6905 | 0.0018 | 1.2128 | 0.0050 | 2.0730 | 0.0200 | 0.151 | 0.025 | 0.04064 | 0.00039 | 99.59 | 0.6870 | 0.0020 | 6.398 | 0.019 | 0.022 | |
| 32478-02Bcomb | 5.0 | 2.66E-13 | | 0.6949 | 0.0017 | 1.2197 | 0.0044 | 2.1820 | 0.0160 | 0.331 | 0.023 | 0.04276 | 0.00031 | 98.84 | 0.6861 | 0.0019 | 6.390 | 0.018 | 0.022 | |
| 32478-03Bcomb | 5.0 | 2.61E-13 | | 0.6902 | 0.0018 | 1.2122 | 0.0040 | 1.9230 | 0.0170 | 0.117 | 0.022 | 0.03769 | 0.00033 | 99.72 | 0.6876 | 0.0019 | 6.403 | 0.018 | 0.022 | |
| 32478-04Bcomb | 5.0 | 2.70E-13 | | 0.6914 | 0.0017 | 1.2189 | 0.0043 | 2.1700 | 0.0160 | 0.187 | 0.020 | 0.04253 | 0.00032 | 99.44 | 0.6868 | 0.0019 | 6.397 | 0.017 | 0.021 | |
| 32478-05 | 5.0 | 3.02E-13 | | 0.6885 | 0.0016 | 1.2118 | 0.0035 | 1.8380 | 0.0130 | 0.097 | 0.010 | 0.03602 | 0.00025 | 99.79 | 0.6864 | 0.0017 | 6.393 | 0.016 | 0.020 | |
| 32478-06 | 5.0 | 2.48E-13 | | 0.6901 | 0.0016 | 1.2045 | 0.0032 | 1.8210 | 0.0130 | 0.130 | 0.012 | 0.03570 | 0.00025 | 99.65 | 0.6870 | 0.0017 | 6.398 | 0.015 | 0.020 | |
| 32478-07 | 5.0 | 2.18E-13 | | 0.6909 | 0.0016 | 1.2056 | 0.0040 | 1.8166 | 0.0097 | 0.166 | 0.014 | 0.03561 | 0.00019 | 99.50 | 0.6867 | 0.0017 | 6.396 | 0.016 | 0.020 | |
| *32478-08* | *5.0* | 2.82E-13 | | *0.6949* | *0.0016* | *1.2189* | *0.0032* | *1.9010* | *0.0110* | 0.243 | 0.015 | *0.03726* | *0.00021* | *99.18* | *0.6885* | *0.0017* | *6.412* | *0.016* | *0.020* | *>1.5 nMADs from median age* |
| **252A:** Mes12 (32484) J = 0.0051777 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32484-02Bcomb | 5.0 | 3.02E-13 | | 0.6900 | 0.0017 | 1.2164 | 0.0039 | 2.0040 | 0.0140 | 0.110 | 0.020 | 0.03928 | 0.00027 | 99.75 | 0.6876 | 0.0019 | 6.411 | 0.017 | 0.021 | |
| 32484-03Bcomb | 5.0 | 3.20E-13 | | 0.6886 | 0.0018 | 1.2167 | 0.0039 | 2.0360 | 0.0180 | 0.050 | 0.018 | 0.03991 | 0.00036 | 100.02 | 0.6880 | 0.0019 | 6.415 | 0.017 | 0.021 | |
| 32484-04Bcomb | 5.0 | 2.00E-13 | | 0.6968 | 0.0021 | 1.2286 | 0.0049 | 2.1470 | 0.0190 | 0.365 | 0.028 | 0.04208 | 0.00037 | 98.69 | 0.6870 | 0.0023 | 6.406 | 0.022 | 0.025 | |
| 32484-05 | 5.0 | 2.34E-13 | | 0.6896 | 0.0016 | 1.2145 | 0.0034 | 1.8130 | 0.0100 | 0.146 | 0.014 | 0.03553 | 0.00020 | 99.58 | 0.6859 | 0.0017 | 6.396 | 0.016 | 0.020 | |
| 32484-06 | 5.0 | 3.44E-13 | | 0.6899 | 0.0015 | 1.2096 | 0.0033 | 1.8530 | 0.0120 | 0.107 | 0.009 | 0.03632 | 0.00023 | 99.75 | 0.6875 | 0.0016 | 6.411 | 0.014 | 0.019 | |
| 32484-08 | 5.0 | 2.19E-13 | | 0.6911 | 0.0017 | 1.2166 | 0.0038 | 1.9040 | 0.0130 | 0.175 | 0.014 | 0.03732 | 0.00026 | 99.47 | 0.6867 | 0.0017 | 6.403 | 0.016 | 0.020 | |
| 32484-09Bcomb | 5.0 | 2.07E-13 | | 0.6925 | 0.0018 | 1.2125 | 0.0044 | 1.8130 | 0.0140 | 0.126 | 0.027 | 0.03553 | 0.00028 | 99.67 | 0.6895 | 0.0020 | 6.429 | 0.018 | 0.022 | |
| *32484-07* | *5.0* | 2.27E-13 | | *0.6883* | *0.0016* | *1.2166* | *0.0034* | *2.1500* | *0.0100* | 0.000 | 0.014 | *0.04214* | *0.00020* | *100.86* | *0.6935* | *0.0017* | *6.466* | *0.015* | *0.020* | *>1.5 nMADs from median age* |
| **257PR-C:** Mes14 (32523) J = 0.0051380 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32523-01 | 5.0 | 1.55E-13 | | 0.6919 | 0.0016 | 1.2137 | 0.0032 | 2.1300 | 0.0100 | 0.242 | 0.018 | 0.04174 | 0.00020 | 99.21 | 0.6857 | 0.0017 | 6.345 | 0.016 | 0.020 | |
| 32523-02XX | 6.0 | 2.71E-13 | | 0.6900 | 0.0015 | 1.2178 | 0.0031 | 2.2150 | 0.0120 | 0.133 | 0.012 | 0.04342 | 0.00023 | 99.68 | 0.6871 | 0.0016 | 6.358 | 0.015 | 0.019 | |
| 32523-04X | 6.0 | 1.60E-13 | | 0.6921 | 0.0017 | 1.2175 | 0.0035 | 2.7040 | 0.0150 | 0.216 | 0.021 | 0.05300 | 0.00029 | 99.38 | 0.6871 | 0.0018 | 6.358 | 0.017 | 0.021 | |
| 32523-05 | 6.0 | 1.42E-13 | | 0.6886 | 0.0016 | 1.2217 | 0.0036 | 2.4363 | 0.0096 | 0.119 | 0.020 | 0.04775 | 0.00019 | 99.77 | 0.6863 | 0.0017 | 6.350 | 0.016 | 0.020 | |
| 32523-06 | 6.0 | 1.23E-13 | | 0.6900 | 0.0017 | 1.2117 | 0.0040 | 2.2800 | 0.0120 | 0.091 | 0.023 | 0.04469 | 0.00024 | 99.87 | 0.6884 | 0.0018 | 6.370 | 0.017 | 0.021 | |
| 32523-07 | 6.0 | 1.86E-13 | | 0.6907 | 0.0017 | 1.2160 | 0.0032 | 1.9720 | 0.0120 | 0.148 | 0.016 | 0.03864 | 0.00023 | 99.59 | 0.6871 | 0.0017 | 6.358 | 0.016 | 0.020 | |
| 32523-11 | 5.7 | 9.17E-14 | | 0.6930 | 0.0010 | 1.1956 | 0.0021 | 2.0855 | 0.0056 | 0.317 | 0.041 | 0.04088 | 0.00011 | 98.89 | 0.6846 | 0.0016 | 6.334 | 0.015 | 0.019 | |
| 32523-12 | 5.7 | 6.59E-14 | | 0.6948 | 0.0011 | 1.1999 | 0.0029 | 2.7061 | 0.0070 | 0.256 | 0.048 | 0.05304 | 0.00014 | 99.22 | 0.6887 | 0.0018 | 6.373 | 0.017 | 0.021 | |
| 32523-14 | 5.7 | 8.58E-14 | | 0.6911 | 0.0010 | 1.2043 | 0.0025 | 2.0539 | 0.0065 | 0.170 | 0.040 | 0.04026 | 0.00013 | 99.51 | 0.6870 | 0.0016 | 6.356 | 0.015 | 0.019 | |
| 32523-15 | 5.7 | 6.69E-14 | | 0.6933 | 0.0012 | 1.2070 | 0.0025 | 2.2305 | 0.0054 | 0.213 | 0.049 | 0.04372 | 0.00011 | 99.35 | 0.6881 | 0.0019 | 6.367 | 0.018 | 0.022 | |
| 32523-16 | 5.7 | 8.58E-14 | | 0.6905 | 0.0011 | 1.2037 | 0.0024 | 2.2530 | 0.0071 | 0.188 | 0.040 | 0.04416 | 0.00014 | 99.45 | 0.6860 | 0.0016 | 6.348 | 0.015 | 0.019 | |
| *32523-10* | *5.6* | 8.15E-15 | | *0.7011* | *0.0019* | *1.2027* | *0.0062* | *1.8860* | *0.0120* | 0.220 | 0.260 | *0.03696* | *0.00024* | *99.30* | *0.6955* | *0.0080* | *6.436* | *0.074* | *0.075* | *>1.5 nMADs from median age* |
| *32523-13* | *5.7* | 6.87E-14 | | *0.6893* | *0.0011* | *1.1954* | *0.0028* | *2.1301* | *0.0052* | 0.292 | 0.053 | *0.04175* | *0.00010* | *98.99* | *0.6816* | *0.0020* | *6.307* | *0.018* | *0.022* | *>1.5 nMADs from median age* |
| *32523-03* | *5.0* | 1.74E-13 | | *1.0974* | *0.0025* | *1.2309* | *0.0032* | *1.9404* | *0.0071* | 0.288 | 0.020 | *0.03803* | *0.00014* | *99.37* | *1.0897* | *0.0026* | *10.073* | *0.024* | *0.031* | *age > 7.2 Ma* |
| **257PR-C:** Ifo3 (32535) J = 0.0051604 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32535-01 | 0.6 | 7.74E-14 | | 0.6770 | 0.0010 | 1.1993 | 0.0027 | 1.9416 | 0.0053 | 0.128 | 0.042 | 0.03805 | 0.00010 | 99.67 | 0.6741 | 0.0016 | 6.265 | 0.015 | 0.019 | |
| 32535-02 | 0.6 | 6.17E-14 | | 0.6805 | 0.0011 | 1.2047 | 0.0026 | 3.6610 | 0.0091 | 0.172 | 0.052 | 0.07175 | 0.00018 | 99.68 | 0.6776 | 0.0019 | 6.297 | 0.018 | 0.021 | |
| 32535-03 | 0.6 | 5.75E-14 | | 0.6766 | 0.0011 | 1.2037 | 0.0031 | 2.0046 | 0.0068 | 0.154 | 0.046 | 0.03929 | 0.00013 | 99.57 | 0.6730 | 0.0018 | 6.254 | 0.016 | 0.020 | |
| 32535-04 | 0.6 | 8.78E-14 | | 0.6780 | 0.0010 | 1.1988 | 0.0026 | 1.9811 | 0.0051 | 0.136 | 0.036 | 0.03883 | 0.00010 | 99.64 | 0.6748 | 0.0015 | 6.272 | 0.014 | 0.018 | |
| 32535-05 | 0.6 | 3.05E-14 | | 0.6795 | 0.0010 | 1.2003 | 0.0036 | 1.8749 | 0.0076 | 0.000 | 0.085 | 0.03675 | 0.00015 | 100.33 | 0.6810 | 0.0027 | 6.329 | 0.025 | 0.028 | |
| 32535-06 | 0.6 | 5.65E-14 | | 0.6832 | 0.0011 | 1.1973 | 0.0030 | 2.0028 | 0.0053 | 0.220 | 0.049 | 0.03926 | 0.00010 | 99.29 | 0.6776 | 0.0018 | 6.298 | 0.017 | 0.021 | |
| 32535-07 | 0.6 | 7.49E-14 | | 0.6799 | 0.0010 | 1.1978 | 0.0023 | 1.8955 | 0.0053 | 0.058 | 0.043 | 0.03715 | 0.00010 | 99.98 | 0.6790 | 0.0016 | 6.310 | 0.015 | 0.019 | |
| 32535-08 | 0.6 | 7.80E-14 | | 0.6809 | 0.0011 | 1.2092 | 0.0028 | 2.1153 | 0.0066 | 0.229 | 0.041 | 0.04146 | 0.00013 | 99.26 | 0.6751 | 0.0016 | 6.274 | 0.015 | 0.020 | |
| 32535-09 | 0.6 | 6.25E-14 | | 0.6782 | 0.0011 | 1.2043 | 0.0028 | 1.8655 | 0.0059 | 0.164 | 0.054 | 0.03656 | 0.00012 | 99.51 | 0.6742 | 0.0019 | 6.266 | 0.018 | 0.022 | |
| 32535-10 | 0.6 | 5.62E-14 | | 0.6794 | 0.0012 | 1.1991 | 0.0027 | 1.8056 | 0.0068 | 0.115 | 0.056 | 0.03539 | 0.00013 | 99.71 | 0.6768 | 0.0020 | 6.289 | 0.019 | 0.022 | |
| 32535-20 | 5.8 | 5.17E-14 | | 0.6810 | 0.0012 | 1.2019 | 0.0029 | 1.6920 | 0.0100 | 0.229 | 0.055 | 0.03317 | 0.00020 | 99.21 | 0.6749 | 0.0021 | 6.273 | 0.019 | 0.023 | |
| 32535-22 | 5.8 | 5.36E-14 | | 0.6792 | 0.0011 | 1.2064 | 0.0027 | 1.8572 | 0.0091 | 0.149 | 0.059 | 0.03640 | 0.00018 | 99.58 | 0.6756 | 0.0021 | 6.279 | 0.020 | 0.023 | |
| 32535-23 | 5.8 | 4.25E-14 | | 0.6842 | 0.0012 | 1.1967 | 0.0033 | 1.8740 | 0.0120 | 0.481 | 0.063 | 0.03673 | 0.00023 | 98.15 | 0.6708 | 0.0023 | 6.234 | 0.021 | 0.024 | |
| 32535-24 | 5.8 | 2.87E-14 | | 0.6788 | 0.0010 | 1.2065 | 0.0040 | 2.0540 | 0.0120 | 0.311 | 0.083 | 0.04026 | 0.00024 | 98.89 | 0.6706 | 0.0027 | 6.232 | 0.025 | 0.027 | |
| 32535-25 | 5.8 | 4.38E-14 | | 0.6786 | 0.0011 | 1.1908 | 0.0035 | 2.0460 | 0.0110 | 0.320 | 0.060 | 0.04011 | 0.00021 | 98.86 | 0.6702 | 0.0021 | 6.228 | 0.020 | 0.023 | |
| *32535-21* | *5.8* | 4.86E-15 | | *0.7051* | *0.0023* | *1.2021* | *0.0065* | *1.8740* | *0.0370* | 0.540 | 0.400 | *0.03673* | *0.00073* | *97.90* | *0.6900* | *0.0120* | *6.410* | *0.110* | *0.113* | *>1.5 nMADs from median age* |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{39}$Ar (% of total) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar (× $10^{-2}$) | ± 1σ | $^{37}$Ar/$^{39}$Ar (× $10^{-2}$) | ± 1σ | $^{36}$Ar/$^{39}$Ar (× $10^{-4}$) | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **257PR-C:** Ifo4 (32537) J = 0.0051544 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32537-01 | 5.8 | 1.23E-13 | | 0.6774 | 0.0009 | 1.1942 | 0.0023 | 1.7045 | 0.0043 | 0.118 | 0.030 | 0.03341 | 0.00008 | 99.69 | 0.6746 | 0.0013 | 6.262 | 0.012 | 0.017 | |
| 32537-02 | 5.8 | 8.51E-14 | | 0.6781 | 0.0010 | 1.2005 | 0.0025 | 1.6353 | 0.0044 | 0.198 | 0.038 | 0.03205 | 0.00009 | 99.33 | 0.6729 | 0.0015 | 6.246 | 0.014 | 0.018 | |
| 32537-03 | 5.8 | 4.76E-14 | | 0.6836 | 0.0010 | 1.2047 | 0.0029 | 2.0744 | 0.0073 | 0.517 | 0.057 | 0.04066 | 0.00014 | 98.01 | 0.6693 | 0.0020 | 6.213 | 0.019 | 0.022 | |
| 32537-04 | 5.8 | 9.01E-14 | | 0.6765 | 0.0010 | 1.2036 | 0.0024 | 1.7204 | 0.0051 | 0.162 | 0.034 | 0.03372 | 0.00010 | 99.50 | 0.6724 | 0.0015 | 6.242 | 0.014 | 0.018 | |
| 32537-05 | 5.8 | 9.18E-14 | | 0.6878 | 0.0010 | 1.2044 | 0.0026 | 1.7393 | 0.0050 | 0.499 | 0.038 | 0.03409 | 0.00010 | 98.06 | 0.6738 | 0.0015 | 6.254 | 0.014 | 0.018 | |
| 32537-06 | 5.8 | 7.96E-14 | | 0.6766 | 0.0010 | 1.2027 | 0.0022 | 1.7340 | 0.0047 | 0.157 | 0.039 | 0.03399 | 0.00009 | 99.52 | 0.6726 | 0.0015 | 6.244 | 0.014 | 0.019 | |
| 32537-07 | 5.8 | 4.27E-14 | | 0.6769 | 0.0011 | 1.2189 | 0.0030 | 1.8216 | 0.0073 | 0.108 | 0.060 | 0.03570 | 0.00014 | 99.75 | 0.6745 | 0.0021 | 6.261 | 0.019 | 0.023 | |
| 32537-08 | 5.8 | 5.39E-14 | | 0.6789 | 0.0011 | 1.2065 | 0.0029 | 1.6386 | 0.0055 | 0.318 | 0.052 | 0.03212 | 0.00011 | 98.81 | 0.6701 | 0.0019 | 6.220 | 0.018 | 0.021 | |
| 32537-09 | 5.8 | 1.22E-13 | | 0.6763 | 0.0010 | 1.1948 | 0.0025 | 1.7254 | 0.0049 | 0.178 | 0.033 | 0.03382 | 0.00010 | 99.43 | 0.6717 | 0.0014 | 6.235 | 0.013 | 0.018 | |
| 32537-10 | 5.8 | 6.19E-14 | | 0.6757 | 0.0011 | 1.1996 | 0.0026 | 1.7786 | 0.0055 | 0.218 | 0.049 | 0.03486 | 0.00011 | 99.26 | 0.6700 | 0.0019 | 6.220 | 0.017 | 0.021 | |
| 32537-21 | 5.8 | 4.39E-14 | | 0.6754 | 0.0011 | 1.1959 | 0.0036 | 1.9783 | 0.0098 | 0.288 | 0.060 | 0.03877 | 0.00019 | 98.98 | 0.6678 | 0.0021 | 6.199 | 0.019 | 0.023 | |
| 32537-25 | 5.8 | 5.36E-14 | | 0.6736 | 0.0012 | 1.1928 | 0.0028 | 1.6918 | 0.0086 | 0.219 | 0.052 | 0.03316 | 0.00017 | 99.25 | 0.6678 | 0.0019 | 6.199 | 0.018 | 0.022 | |
| 32537-26 | 5.8 | 3.04E-14 | | 0.6766 | 0.0011 | 1.1902 | 0.0034 | 1.6350 | 0.0120 | 0.092 | 0.078 | 0.03204 | 0.00024 | 99.80 | 0.6746 | 0.0026 | 6.262 | 0.024 | 0.027 | |
| *32537-20* | *5.8* | 2.91E-15 | | *0.8303* | *0.0023* | *1.2220* | *0.0110* | *1.9260* | *0.0470* | 5.450 | 0.580 | *0.03775* | *0.00093* | *80.80* | *0.6700* | *0.0170* | *6.220* | *0.160* | *0.161* | *%40Ar* <97* |
| *32537-22* | *5.8* | 1.33E-14 | | *0.6910* | *0.0014* | *1.2090* | *0.0056* | *1.8670* | *0.0210* | 1.150 | 0.170 | *0.03659* | *0.00041* | *95.29* | *0.6578* | *0.0052* | *6.107* | *0.048* | *0.049* | *%40Ar* <97* |
| *32537-23* | *5.8* | 6.46E-15 | | *0.7269* | *0.0022* | *1.2048* | *0.0060* | *2.2610* | *0.0370* | 2.520 | 0.300 | *0.04431* | *0.00072* | *90.00* | *0.6535* | *0.0091* | *6.066* | *0.085* | *0.086* | *%40Ar* <97* |
| *32537-24* | *5.8* | 2.17E-14 | | *0.6991* | *0.0012* | *1.2131* | *0.0045* | *1.7880* | *0.0150* | 0.760 | 0.110 | *0.03505* | *0.00030* | *96.99* | *0.6774* | *0.0035* | *6.288* | *0.032* | *0.034* | *%40Ar* <97* |
| **257PR-C:** Ifo5 (32539) J = 0.0051475 ± 0.0000100 | | | | | | | | | | | | | | | | | | | | |
| 32539-02 | 5.8 | 7.32E-14 | | 0.6751 | 0.0011 | 1.1928 | 0.0026 | 1.6908 | 0.0055 | 0.108 | 0.045 | 0.03314 | 0.00011 | 99.73 | 0.6726 | 0.0017 | 6.235 | 0.016 | 0.020 | |
| 32539-03 | 5.8 | 1.04E-13 | | 0.6770 | 0.0010 | 1.1958 | 0.0025 | 1.6529 | 0.0036 | 0.187 | 0.036 | 0.03240 | 0.00007 | 99.38 | 0.6721 | 0.0015 | 6.231 | 0.014 | 0.018 | |
| 32539-04 | 5.8 | 5.02E-14 | | 0.6767 | 0.0012 | 1.2035 | 0.0026 | 1.6410 | 0.0071 | 0.166 | 0.058 | 0.03216 | 0.00014 | 99.47 | 0.6724 | 0.0021 | 6.234 | 0.019 | 0.023 | |
| 32539-05 | 5.8 | 6.49E-14 | | 0.6749 | 0.0010 | 1.1988 | 0.0025 | 1.7376 | 0.0048 | 0.167 | 0.046 | 0.03406 | 0.00009 | 99.48 | 0.6706 | 0.0017 | 6.217 | 0.016 | 0.020 | |
| 32539-06 | 5.8 | 6.22E-14 | | 0.6783 | 0.0010 | 1.1999 | 0.0027 | 1.6239 | 0.0061 | 0.109 | 0.048 | 0.03183 | 0.00012 | 99.72 | 0.6757 | 0.0018 | 6.264 | 0.017 | 0.021 | |
| 32539-07 | 5.8 | 5.69E-14 | | 0.6775 | 0.0010 | 1.1967 | 0.0029 | 1.5722 | 0.0074 | 0.148 | 0.054 | 0.03082 | 0.00014 | 99.54 | 0.6737 | 0.0019 | 6.245 | 0.018 | 0.022 | |
| 32539-08 | 5.8 | 6.99E-14 | | 0.6781 | 0.0010 | 1.1976 | 0.0028 | 1.6207 | 0.0054 | 0.148 | 0.045 | 0.03177 | 0.00011 | 99.55 | 0.6743 | 0.0017 | 6.251 | 0.016 | 0.020 | |
| 32539-09 | 5.8 | 5.90E-14 | | 0.6774 | 0.0012 | 1.2027 | 0.0029 | 1.4930 | 0.0052 | 0.118 | 0.051 | 0.02926 | 0.00010 | 99.67 | 0.6744 | 0.0019 | 6.252 | 0.018 | 0.022 | |
| 32539-10 | 5.8 | 5.40E-14 | | 0.6739 | 0.0012 | 1.1901 | 0.0031 | 1.5762 | 0.0057 | 0.122 | 0.058 | 0.03089 | 0.00011 | 99.66 | 0.6709 | 0.0021 | 6.219 | 0.020 | 0.023 | |
| 32539-20 | 5.8 | 4.91E-14 | | 0.6770 | 0.0011 | 1.1933 | 0.0028 | 1.6292 | 0.0095 | 0.040 | 0.054 | 0.03193 | 0.00019 | 100.03 | 0.6764 | 0.0020 | 6.271 | 0.018 | 0.022 | |
| 32539-21 | 5.8 | 1.74E-14 | | 0.6816 | 0.0013 | 1.2034 | 0.0044 | 1.7100 | 0.0200 | 0.330 | 0.130 | 0.03352 | 0.00040 | 98.77 | 0.6725 | 0.0040 | 6.234 | 0.037 | 0.039 | |
| 32539-24 | 5.8 | 5.25E-14 | | 0.6800 | 0.0011 | 1.2007 | 0.0028 | 1.5385 | 0.0086 | 0.239 | 0.054 | 0.03015 | 0.00017 | 99.15 | 0.6735 | 0.0020 | 6.243 | 0.018 | 0.022 | |
| 32539-25 | 5.8 | 3.25E-14 | | 0.6772 | 0.0012 | 1.1997 | 0.0032 | 1.9070 | 0.0140 | 0.225 | 0.078 | 0.03737 | 0.00027 | 99.25 | 0.6714 | 0.0026 | 6.224 | 0.024 | 0.027 | |
| *32539-01* | *5.8* | 6.59E-14 | | *0.6769* | *0.0010* | *1.1946* | *0.0026* | *1.5442* | *0.0058* | 0.373 | 0.048 | *0.03027* | *0.00011* | *98.56* | *0.6664* | *0.0018* | *6.178* | *0.016* | *0.020* | *>1.5 nMADs from median age* |
| *32539-22* | *5.8* | 2.93E-15 | | *0.6994* | *0.0022* | *1.2083* | *0.0100* | *4.1700* | *0.0740* | 2.100 | 0.630 | *0.08170* | *0.00140* | *91.60* | *0.6400* | *0.0190* | *5.930* | *0.180* | *0.176* | *%40Ar* <97* |
| *32539-23* | *5.8* | 8.88E-16 | | *0.7358* | *0.0049* | *1.2150* | *0.0200* | *5.5500* | *0.2000* | 5.800 | 2.000 | *0.10890* | *0.00400* | *77.50* | *0.5690* | *0.0590* | *5.280* | *0.540* | *0.543* | *%40Ar* <97* |
| *32539-26* | *5.8* | 3.51E-14 | | *0.7279* | *0.0011* | *1.2373* | *0.0035* | *1.7090* | *0.0110* | 1.628 | 0.076 | *0.03349* | *0.00022* | *93.58* | *0.6805* | *0.0025* | *6.308* | *0.024* | *0.027* | *%40Ar* <97* |

**Single crystal total fusions - VU**

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar | ± 1σ | $^{37}$Ar/$^{39}$Ar | ± 1σ | $^{36}$Ar/$^{39}$Ar | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VU37: Mes1** (01M0165) J = 0.001849 ± 0.000005 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0165A | 20.0 | 9.51E-14 | 2.0729 | 0.0022 | 0.01208 | 0.00004 | 0.0122 | 0.0011 | 0.0000173 | 0.0000060 | 0.02838 | 0.00284 | 99.76 | 2.0679 | 0.0028 | 6.885 | 0.009 | 0.021 | |
| 01M0165B | 20.0 | 7.74E-14 | 2.0971 | 0.0024 | 0.01209 | 0.00004 | 0.0124 | 0.0019 | 0.0000731 | 0.0000087 | 0.02874 | 0.00457 | 98.97 | 2.0756 | 0.0035 | 6.910 | 0.012 | 0.023 | |
| 01M0165D | 20.0 | 8.87E-14 | 2.0829 | 0.0023 | 0.01206 | 0.00003 | 0.0096 | 0.0018 | 0.0000296 | 0.0000052 | 0.02226 | 0.00442 | 99.57 | 2.0707 | 0.0027 | 6.894 | 0.009 | 0.021 | |
| 01M0165E | 20.0 | 8.69E-14 | 2.0846 | 0.0023 | 0.01222 | 0.00004 | 0.0105 | 0.0015 | 0.0000448 | 0.0000053 | 0.02454 | 0.00360 | 99.36 | 2.0680 | 0.0028 | 6.885 | 0.009 | 0.021 | |
| 01M0165F | 20.0 | 1.08E-13 | 2.0811 | 0.0023 | 0.01215 | 0.00003 | 0.0114 | 0.0011 | 0.0000231 | 0.0000042 | 0.02660 | 0.00298 | 99.67 | 2.0709 | 0.0026 | 6.895 | 0.009 | 0.021 | |
| 01M0165H | 20.0 | 5.75E-14 | 2.1170 | 0.0023 | 0.01223 | 0.00004 | 0.0105 | 0.0018 | 0.0001366 | 0.0000090 | 0.02431 | 0.00437 | 98.09 | 2.0676 | 0.0035 | 6.884 | 0.012 | 0.022 | |
| 01M0165I | 20.0 | 7.98E-14 | 2.0882 | 0.0022 | 0.01216 | 0.00005 | 0.0075 | 0.0013 | 0.0000383 | 0.0000038 | 0.01755 | 0.00310 | 99.44 | 2.0676 | 0.0024 | 6.884 | 0.008 | 0.021 | |
| 01M0165J | 20.0 | 7.05E-14 | 2.1007 | 0.0025 | 0.01212 | 0.00004 | 0.0099 | 0.0014 | 0.0000232 | 0.0000071 | 0.02306 | 0.00355 | 99.67 | 2.0757 | 0.0032 | 6.911 | 0.011 | 0.022 | |
| **VU37: Mes4** (00M0170, 01M0191) J = 0.001449 ± 0.000003 (TCR) | | | | | | | | | | | | | | | | | | | |
| 00M0170Brecomb | 20.0 | 7.58E-15 | 2.5902 | 0.0041 | 0.01211 | 0.00014 | 0.0167 | 0.0004 | 0.0000400 | 0.0000183 | 0.03881 | | 99.56 | 2.5789 | 0.0068 | 6.729 | 0.018 | 0.023 | |
| 00M0170E | 20.0 | 4.00E-15 | 2.5948 | 0.0044 | 0.01156 | 0.00027 | 0.0162 | 0.0003 | 0.0000319 | 0.0000358 | 0.03777 | 0.00101 | 99.65 | 2.5858 | 0.0115 | 6.747 | 0.030 | 0.034 | |
| 00M0170G | 20.0 | 1.31E-15 | 2.6396 | 0.0056 | 0.01087 | 0.00027 | 0.0156 | 0.0007 | 0.0000396 | 0.0000674 | 0.03642 | 0.00175 | 99.57 | 2.6282 | 0.0207 | 6.857 | 0.054 | 0.056 | |
| 01M0191A | 20.0 | 8.04E-15 | 2.6282 | 0.0034 | 0.01256 | 0.00014 | 0.0291 | 0.0152 | 0.0000842 | 0.0000383 | 0.06779 | 0.03553 | 99.11 | 2.6245 | 0.0119 | 6.848 | 0.031 | 0.035 | |
| **VU41: Mes4** (B4) J = 0.001901 ± 0.000003 | | | | | | | | | | | | | | | | | | | |
| 01M0379A | 20.0 | 2.99E-14 | 1.9742 | 0.0055 | 0.01223 | 0.00010 | 0.0172 | 0.0002 | 0.0000337 | 0.0000102 | 0.04009 | 0.00188 | 99.52 | 1.9647 | 0.0062 | 6.726 | 0.021 | 0.024 | |
| 01M0379B | 20.0 | 1.55E-14 | 1.9758 | 0.0056 | 0.01227 | 0.00011 | 0.0162 | 0.0004 | 0.0000329 | 0.0000248 | 0.03763 | 0.00232 | 99.53 | 1.9665 | 0.0092 | 6.732 | 0.031 | 0.033 | |
| 01M0379D | 20.0 | 1.27E-14 | 1.9823 | 0.0055 | 0.01225 | 0.00011 | 0.0178 | 0.0005 | 0.0000896 | 0.0000304 | 0.04145 | 0.00273 | 98.69 | 1.9564 | 0.0105 | 6.697 | 0.036 | 0.038 | |
| 01M0379E | 20.0 | 2.57E-14 | 1.9837 | 0.0057 | 0.01223 | 0.00010 | 0.0176 | 0.0003 | 0.0000530 | 0.0000204 | 0.04092 | 0.00194 | 99.24 | 1.9685 | 0.0083 | 6.739 | 0.028 | 0.030 | |
| 01M0379F | 20.0 | 2.90E-14 | 1.9769 | 0.0055 | 0.01211 | 0.00010 | 0.0168 | 0.0002 | 0.0000460 | 0.0000141 | 0.03910 | 0.00186 | 99.34 | 1.9638 | 0.0069 | 6.722 | 0.024 | 0.026 | |
| 01M0379H | 20.0 | 3.46E-14 | 1.9988 | 0.0056 | 0.01313 | 0.00010 | 0.0152 | 0.0002 | 0.0001354 | 0.0000135 | 0.03525 | 0.00157 | 98.01 | 1.9591 | 0.0068 | 6.706 | 0.023 | 0.026 | |
| 01M0379I | 20.0 | 3.41E-14 | 2.0022 | 0.0056 | 0.01216 | 0.00010 | 0.0169 | 0.0003 | 0.0001072 | 0.0000137 | 0.03931 | 0.00190 | 98.44 | 1.9710 | 0.0068 | 6.747 | 0.023 | 0.026 | |
| 01M0379J | 20.0 | 3.28E-14 | 1.9788 | 0.0054 | 0.01213 | 0.00011 | 0.0164 | 0.0002 | 0.0000336 | 0.0000142 | 0.03815 | 0.00172 | 99.52 | 1.9693 | 0.0068 | 6.741 | 0.023 | 0.026 | |
| 01M0379N | 20.0 | 1.66E-14 | 1.9819 | 0.0055 | 0.01211 | 0.00013 | 0.0165 | 0.0003 | 0.0000781 | 0.0000165 | 0.03848 | 0.00197 | 98.86 | 1.9593 | 0.0073 | 6.707 | 0.025 | 0.027 | |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar | ± 1σ | $^{37}$Ar/$^{39}$Ar | ± 1σ | $^{36}$Ar/$^{39}$Ar | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *01M0379K* | *20.0* | *3.05E-14* | *2.0643* | *0.0059* | *0.01217* | *0.00010* | *0.0168* | *0.0002* | *0.0000621* | *0.0000172* | *0.03906* | *0.00186* | *99.13* | *2.0464* | *0.0078* | *7.005* | *0.027* | *0.029* | *>1.5 nMADs from median age* |
| **VU42: Mes4** (A3) J = 0.001869 ± 0.000005 | | | | | | | | | | | | | | | | | | | |
| 02M0267A | 20.0 | 1.48E-14 | 2.0008 | 0.0053 | 0.01223 | 0.00010 | 0.0168 | 0.0004 | 0.0000395 | 0.0000443 | 0.03899 | 0.00104 | 99.44 | 1.9896 | 0.0141 | 6.696 | 0.047 | 0.050 | |
| 02M0267C | 20.0 | 1.18E-14 | 2.0258 | 0.0055 | 0.01214 | 0.00010 | 0.0163 | 0.0004 | 0.0000866 | 0.0000583 | 0.03792 | 0.00110 | 98.76 | 2.0006 | 0.0181 | 6.733 | 0.061 | 0.063 | |
| 02M0267D | 20.0 | 2.10E-14 | 2.0332 | 0.0054 | 0.01216 | 0.00009 | 0.0170 | 0.0002 | 0.0000636 | 0.0000286 | 0.03946 | 0.00073 | 99.10 | 2.0150 | 0.0100 | 6.781 | 0.034 | 0.038 | |
| 02M0267E | 20.0 | 2.26E-14 | 2.0319 | 0.0056 | 0.01217 | 0.00008 | 0.0167 | 0.0002 | 0.0000467 | 0.0000315 | 0.03873 | 0.00075 | 99.34 | 2.0186 | 0.0108 | 6.793 | 0.036 | 0.040 | |
| 02M0267G | 20.0 | 1.34E-14 | 2.0444 | 0.0055 | 0.01239 | 0.00009 | 0.0156 | 0.0003 | 0.0001768 | 0.0000439 | 0.03639 | 0.00089 | 97.46 | 1.9925 | 0.0141 | 6.706 | 0.047 | 0.050 | |
| 02M0267H | 20.0 | 2.96E-14 | 2.0178 | 0.0053 | 0.01223 | 0.00007 | 0.0167 | 0.0001 | 0.0000809 | 0.0000275 | 0.03888 | 0.00070 | 98.84 | 1.9944 | 0.0097 | 6.712 | 0.032 | 0.037 | |
| 02M0267I | 20.0 | 2.17E-14 | 2.0511 | 0.0055 | 0.01228 | 0.00008 | 0.0170 | 0.0002 | 0.0001831 | 0.0000340 | 0.03960 | 0.00073 | 97.38 | 1.9974 | 0.0114 | 6.722 | 0.038 | 0.042 | |
| 02M0267K | 20.0 | 1.32E-14 | 2.1038 | 0.0056 | 0.01242 | 0.00010 | 0.0161 | 0.0003 | 0.0003161 | 0.0000685 | 0.03744 | 0.00085 | 95.58 | 2.0108 | 0.0209 | 6.767 | 0.070 | 0.072 | |
| 02M0267L | 20.0 | 2.32E-14 | 2.0630 | 0.0055 | 0.01227 | 0.00008 | 0.0167 | 0.0002 | 0.0002016 | 0.0000329 | 0.03895 | 0.00073 | 97.13 | 2.0038 | 0.0111 | 6.744 | 0.037 | 0.041 | |
| 02M0267M | 20.0 | 1.65E-14 | 2.0740 | 0.0055 | 0.01240 | 0.00009 | 0.0177 | 0.0002 | 0.0002476 | 0.0000522 | 0.04107 | 0.00077 | 96.50 | 2.0014 | 0.0163 | 6.736 | 0.055 | 0.057 | |
| **VU37 Mes6** (01m0171) J = 0.001563 ± 0.000004 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0171B | 20.0 | 9.90E-15 | 2.4099 | 0.0026 | 0.01220 | 0.00009 | 0.0386 | 0.0070 | 0.0001010 | 0.0000459 | 0.08978 | 0.01691 | 98.85 | 2.3822 | 0.0138 | 6.705 | 0.039 | 0.042 | |
| 01M0171D | 20.0 | 6.85E-15 | 2.4296 | 0.0030 | 0.01226 | 0.00011 | 0.0076 | 0.0109 | 0.0002036 | 0.0000586 | 0.01779 | 0.02532 | 97.51 | 2.3691 | 0.0176 | 6.668 | 0.049 | 0.052 | |
| 01M0171G | 20.0 | 4.34E-15 | 2.4509 | 0.0033 | 0.01204 | 0.00016 | 0.0205 | 0.0229 | 0.0003674 | 0.0000964 | 0.04775 | 0.05339 | 95.60 | 2.3326 | 0.0286 | 6.565 | 0.080 | 0.082 | |
| 01M0171I | 20.0 | 2.97E-15 | 2.5016 | 0.0032 | 0.01180 | 0.00026 | 0.0035 | 0.0257 | 0.0006631 | 0.0001301 | 0.00814 | 0.05984 | 92.14 | 2.2799 | 0.0382 | 6.417 | 0.107 | 0.108 | |
| 01M0171K | 20.0 | 3.23E-15 | 2.5420 | 0.0036 | 0.01212 | 0.00019 | -0.0276 | 0.0259 | 0.0003718 | 0.0001147 | --- | --- | 95.64 | 2.4048 | 0.0338 | 6.768 | 0.095 | 0.096 | |
| 01M0171N | 20.0 | 1.30E-14 | 2.5385 | 0.0033 | 0.01230 | 0.00007 | 0.0223 | 0.0058 | 0.0004631 | 0.0000262 | 0.05194 | 0.01372 | 94.64 | 2.3763 | 0.0083 | 6.688 | 0.023 | 0.028 | |
| **VU37: Mes8** (01M0192) J = 0.001460 ± 0.000003 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0192A | 20.0 | 8.11E-15 | 2.6052 | 0.0031 | 0.01254 | 0.00014 | 0.0081 | 0.0101 | 0.0002323 | 0.0000365 | 0.01879 | 0.02356 | 97.36 | 2.5363 | 0.0112 | 6.668 | 0.030 | 0.033 | |
| 01M0192B | 20.0 | 3.48E-15 | 2.5635 | 0.0037 | 0.01292 | 0.00018 | 0.0049 | 0.0293 | 0.0000433 | 0.0000615 | 0.01138 | 0.06816 | 99.48 | 2.5503 | 0.0187 | 6.705 | 0.049 | 0.051 | |
| 01M0192D | 20.0 | 4.91E-15 | 2.5463 | 0.0035 | 0.01277 | 0.00010 | 0.0045 | 0.0191 | 0.0000148 | 0.0000636 | 0.01044 | 0.04433 | 99.81 | 2.5693 | 0.0194 | 6.755 | 0.051 | 0.053 | |
| 01M0192E | 20.0 | 5.46E-15 | 2.5639 | 0.0045 | 0.01271 | 0.00015 | 0.0000 | 0.0162 | 0.0001743 | 0.0000527 | --- | --- | 97.96 | 2.5391 | 0.0164 | 6.675 | 0.043 | 0.046 | |
| 01M0192F | 20.0 | 1.30E-14 | 2.5928 | 0.0029 | 0.01244 | 0.00010 | 0.0106 | 0.0105 | 0.0003486 | 0.0000205 | 0.02469 | 0.02447 | 96.02 | 2.5238 | 0.0068 | 6.635 | 0.018 | 0.024 | |
| *01M0192G* | *20.0* | 2.00E-14 | *2.3491* | *0.0029* | *0.01252* | *0.00008* | *0.0393* | *0.0063* | *0.0003812* | *0.0000095* | *0.09134* | *0.01542* | *95.30* | *2.2693* | *0.0041* | *5.967* | *0.011* | *0.017* | *>1.5 nMADs from median age* |
| **VU42: Mes8** (A4) J = 0.001870 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0268B | 20.0 | 1.66E-14 | 2.1072 | 0.0058 | 0.01217 | 0.00009 | 0.0204 | 0.0003 | 0.0005190 | 0.0000641 | 0.04733 | 0.00102 | 92.76 | 1.9546 | 0.0197 | 6.582 | 0.066 | 0.068 | |
| 02M0268C | 20.0 | 1.63E-14 | 1.9936 | 0.0053 | 0.01223 | 0.00009 | 0.0198 | 0.0003 | 0.0001103 | 0.0000459 | 0.04610 | 0.00105 | 98.40 | 1.9617 | 0.0145 | 6.606 | 0.049 | 0.051 | |
| 02M0268D | 20.0 | 3.25E-14 | 2.0201 | 0.0054 | 0.01233 | 0.00008 | 0.0201 | 0.0002 | 0.0002246 | 0.0000267 | 0.04683 | 0.00089 | 96.75 | 1.9545 | 0.0095 | 6.582 | 0.032 | 0.035 | |
| 02M0268F | 20.0 | 2.58E-14 | 2.0302 | 0.0054 | 0.01216 | 0.00007 | 0.0202 | 0.0003 | 0.0002830 | 0.0000244 | 0.04706 | 0.00100 | 95.92 | 1.9473 | 0.0089 | 6.558 | 0.030 | 0.034 | |
| 02M0268G | 20.0 | 2.43E-14 | 2.0392 | 0.0053 | 0.01221 | 0.00009 | 0.0199 | 0.0002 | 0.0002825 | 0.0000358 | 0.04640 | 0.00085 | 95.94 | 1.9565 | 0.0118 | 6.588 | 0.040 | 0.043 | |
| 02M0268H | 20.0 | 1.49E-14 | 1.9530 | 0.0055 | 0.01219 | 0.00010 | 0.0195 | 0.0003 | 0.0000061 | 0.0000418 | 0.04528 | 0.00102 | 99.94 | 1.9519 | 0.0135 | 6.573 | 0.045 | 0.048 | |
| 02M0268J | 20.0 | 1.60E-14 | 1.9801 | 0.0052 | 0.01213 | 0.00008 | 0.0196 | 0.0003 | 0.0001022 | 0.0000512 | 0.04555 | 0.00097 | 98.51 | 1.9507 | 0.0160 | 6.569 | 0.054 | 0.056 | |
| 02M0268K | 20.0 | 2.36E-14 | 2.0624 | 0.0054 | 0.01229 | 0.00008 | 0.0203 | 0.0002 | 0.0003523 | 0.0000336 | 0.04731 | 0.00092 | 94.99 | 1.9591 | 0.0112 | 6.597 | 0.038 | 0.041 | |
| 02M0268N | 20.0 | 2.75E-14 | 2.0077 | 0.0054 | 0.01218 | 0.00008 | 0.0199 | 0.0002 | 0.0001643 | 0.0000268 | 0.04639 | 0.00091 | 97.62 | 1.9598 | 0.0095 | 6.600 | 0.032 | 0.036 | |
| 02M1267Lrecomb | 20.0 | 1.02E-14 | 1.9979 | 0.0029 | 0.0122 | 0.0001 | 0.0185 | 0.0007 | 0.0000984 | 0.0001064 | 0.04314 | | 98.57 | 1.9694 | 0.0316 | 6.632 | 0.106 | 0.107 | |
| **VU37: Mes9** (B3: 00M0239, 00M0245, 00M0246) J = 0.001853 ± 0.000005 (TCR) | | | | | | | | | | | | | | | | | | | |
| 00M0246recomb | 20.0 | 6.25E-14 | 1.9914 | 0.0043 | 0.01212 | 0.00007 | 0.0153 | 0.0002 | 0.0001088 | 0.0000060 | 0.03544 | | 97.59 | 1.9596 | 0.0047 | 6.539 | 0.016 | 0.024 | |
| 00M0245recomb | 20.0 | 1.93E-14 | 2.0270 | 0.0059 | 0.01223 | 0.00012 | 0.0155 | 0.0003 | 0.0002449 | 0.0000103 | 0.03604 | | 96.44 | 1.9550 | 0.0067 | 6.524 | 0.022 | 0.029 | |
| 00M0239recomb | 20.0 | 2.86E-14 | 2.0662 | 0.0052 | 0.01217 | 0.00008 | 0.0156 | 0.0002 | 0.0003546 | 0.0000105 | 0.03638 | | 94.94 | 1.9617 | 0.0061 | 6.546 | 0.020 | 0.028 | |
| **VU37: Mes9** (01M0167) J = 0.001861 ± 0.000006 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0167A | 20.0 | 1.14E-13 | 1.9580 | 0.0022 | 0.01206 | 0.00004 | 0.0174 | 0.0007 | 0.0000370 | 0.0000049 | 0.04057 | 0.00262 | 99.47 | 1.9476 | 0.0026 | 6.527 | 0.009 | 0.021 | |
| 01M0167C | 20.0 | 5.84E-14 | 1.9677 | 0.0020 | 0.01206 | 0.00003 | 0.0184 | 0.0009 | 0.0000437 | 0.0000086 | 0.04291 | 0.00301 | 99.37 | 1.9522 | 0.0033 | 6.542 | 0.011 | 0.022 | |
| 01M0167D | 20.0 | 1.03E-13 | 1.9650 | 0.0020 | 0.01209 | 0.00004 | 0.0167 | 0.0006 | 0.0000365 | 0.0000054 | 0.03884 | 0.00246 | 99.47 | 1.9516 | 0.0026 | 6.540 | 0.009 | 0.021 | |
| 01M0167E | 20.0 | 3.74E-14 | 1.9659 | 0.0024 | 0.01194 | 0.00005 | 0.0245 | 0.0026 | 0.0000511 | 0.0000124 | 0.05689 | 0.00664 | 99.29 | 1.9487 | 0.0044 | 6.531 | 0.015 | 0.024 | |
| 01M0167G | 20.0 | 3.11E-14 | 1.9874 | 0.0021 | 0.01211 | 0.00003 | 0.0172 | 0.0024 | 0.0000762 | 0.0000123 | 0.04001 | 0.00589 | 98.89 | 1.9527 | 0.0042 | 6.544 | 0.014 | 0.024 | |
| **VU42: Mes9** (A5) J = 0.001871 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0270A | 20.0 | 3.64E-14 | 1.9434 | 0.0052 | 0.01215 | 0.00008 | 0.0151 | 0.0001 | 0.0000516 | 0.0000182 | 0.03518 | 0.00065 | 99.23 | 1.9285 | 0.0075 | 6.498 | 0.025 | 0.029 | |
| 02M0270B | 20.0 | 1.68E-14 | 2.0484 | 0.0056 | 0.01253 | 0.00010 | 0.0149 | 0.0002 | 0.0003694 | 0.0000463 | 0.03458 | 0.00073 | 94.69 | 1.9395 | 0.0147 | 6.535 | 0.049 | 0.052 | |
| 02M0270D | 20.0 | 2.84E-14 | 2.0453 | 0.0055 | 0.01216 | 0.00009 | 0.0154 | 0.0002 | 0.0004126 | 0.0000197 | 0.03586 | 0.00070 | 94.06 | 1.9238 | 0.0078 | 6.482 | 0.026 | 0.030 | |
| 02M0270E | 20.0 | 2.00E-14 | 2.0344 | 0.0061 | 0.01213 | 0.00009 | 0.0145 | 0.0002 | 0.0003493 | 0.0000275 | 0.03375 | 0.00076 | 94.94 | 1.9314 | 0.0100 | 6.508 | 0.034 | 0.037 | |
| 02M0270F | 20.0 | 3.35E-14 | 1.9487 | 0.0052 | 0.01214 | 0.00008 | 0.0154 | 0.0002 | 0.0000750 | 0.0000264 | 0.03592 | 0.00075 | 98.88 | 1.9269 | 0.0094 | 6.492 | 0.031 | 0.035 | |
| 02M0270H | 20.0 | 2.31E-14 | 2.0070 | 0.0053 | 0.01227 | 0.00008 | 0.0154 | 0.0002 | 0.0002323 | 0.0000408 | 0.03588 | 0.00079 | 96.60 | 1.9387 | 0.0131 | 6.532 | 0.044 | 0.047 | |
| 02M0270J | 20.0 | 2.53E-14 | 1.9414 | 0.0051 | 0.01220 | 0.00008 | 0.0154 | 0.0003 | 0.0000300 | 0.0000252 | 0.03574 | 0.00082 | 99.56 | 1.9329 | 0.0090 | 6.513 | 0.030 | 0.034 | |
| 02M0270L | 20.0 | 3.44E-14 | 1.9755 | 0.0052 | 0.01217 | 0.00009 | 0.0137 | 0.0002 | 0.0001462 | 0.0000233 | 0.03195 | 0.00068 | 97.82 | 1.9325 | 0.0086 | 6.511 | 0.029 | 0.033 | |
| 02M0270M | 20.0 | 1.30E-14 | 1.9530 | 0.0053 | 0.01223 | 0.00011 | 0.0157 | 0.0003 | 0.0001208 | 0.0000528 | 0.03654 | 0.00095 | 98.19 | 1.9177 | 0.0164 | 6.462 | 0.055 | 0.057 | |
| *02M0270I* | *20.0* | 1.65E-14 | *2.0715* | *0.0055* | *0.01230* | *0.00010* | *0.0155* | *0.0003* | *0.0003717* | *0.0000345* | *0.03608* | *0.00097* | *94.71* | *1.9620* | *0.0114* | *6.611* | *0.038* | *0.041* | *>1.5 nMADs from median age* |
| **VU42: Mes10** (A7) J = 0.001873 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0272B | 20.0 | 2.15E-14 | 2.0049 | 0.0053 | 0.01199 | 0.00010 | 0.0201 | 0.0003 | 0.0002928 | 0.0000260 | 0.04667 | 0.00106 | 95.72 | 1.9191 | 0.0092 | 6.473 | 0.031 | 0.034 | |
| 02M0272C | 20.0 | 2.58E-14 | 2.0265 | 0.0055 | 0.01230 | 0.00008 | 0.0155 | 0.0003 | 0.0003391 | 0.0000228 | 0.03603 | 0.00090 | 95.07 | 1.9267 | 0.0085 | 6.499 | 0.029 | 0.032 | |
| 02M0272D | 20.0 | 2.56E-14 | 2.0329 | 0.0054 | 0.01217 | 0.00008 | 0.0211 | 0.0004 | 0.0003422 | 0.0000290 | 0.04918 | 0.00114 | 95.06 | 1.9326 | 0.0100 | 6.519 | 0.034 | 0.037 | |
| 02M0272F | 20.0 | 8.74E-15 | 2.0980 | 0.0056 | 0.01241 | 0.00012 | 0.0196 | 0.0004 | 0.0005311 | 0.0001007 | 0.04567 | 0.00122 | 92.55 | 1.9418 | 0.0302 | 6.550 | 0.102 | 0.103 | |
| 02M0272G | 20.0 | 1.73E-14 | 2.0162 | 0.0053 | 0.01220 | 0.00011 | 0.0256 | 0.0003 | 0.0003047 | 0.0000420 | 0.05947 | 0.00124 | 95.59 | 1.9273 | 0.0134 | 6.501 | 0.045 | 0.048 | |
| 02M0272K | 20.0 | 1.83E-14 | 2.0538 | 0.0055 | 0.01240 | 0.00009 | 0.0206 | 0.0002 | 0.0003847 | 0.0000263 | 0.04798 | 0.00096 | 94.50 | 1.9409 | 0.0094 | 6.547 | 0.032 | 0.035 | |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar | ± 1σ | $^{37}$Ar/$^{39}$Ar | ± 1σ | $^{36}$Ar/$^{39}$Ar | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *02M0272H* | *20.0* | *1.18E-14* | *2.0201* | *0.0054* | *0.01233* | *0.00012* | *0.0180* | *0.0003* | *0.0000650* | *0.0000720* | *0.04184* | *0.00094* | *99.08* | *2.0015* | *0.0219* | *6.750* | *0.074* | *0.075* | *>1.5 nMADs from median age* |
| *02M0272J* | *20.0* | *3.12E-14* | *2.0619* | *0.0056* | *0.01213* | *0.00009* | *0.0088* | *0.0001* | *0.0000390* | *0.0000162* | *0.02057* | *0.00046* | *99.43* | *2.0502* | *0.0073* | *6.914* | *0.025* | *0.029* | *>1.5 nMADs from median age* |
| *02M0272L* | *20.0* | *1.71E-14* | *2.2761* | *0.0062* | *0.01259* | *0.00011* | *0.0347* | *0.0004* | *0.0008464* | *0.0000625* | *0.08077* | *0.00155* | *89.09* | *2.0278* | *0.0193* | *6.839* | *0.065* | *0.067* | *>1.5 nMADs from median age* |
| **VU37: Mes11** (00m0160) J = 0.001641 ± 0.000004 (TCR) | | | | | | | | | | | | | | | | | | | |
| 00M0160A | 20.0 | 1.17E-14 | 2.2452 | 0.0039 | 0.01230 | 0.00008 | 0.0884 | 0.0005 | 0.0001919 | 0.0000065 | 0.20561 | 0.00332 | 97.74 | 2.1946 | 0.0043 | 6.485 | 0.013 | 0.020 | |
| 00M0160D | 20.0 | 8.78E-15 | 2.2926 | 0.0039 | 0.01202 | 0.00006 | 0.0553 | 0.0004 | 0.0003270 | 0.0000180 | 0.12875 | 0.00215 | 95.93 | 2.1994 | 0.0065 | 6.499 | 0.019 | 0.025 | |
| 00M0160E | 20.0 | 1.73E-14 | 2.2187 | 0.0038 | 0.01210 | 0.00009 | 0.0553 | 0.0004 | 0.0000685 | 0.0000074 | 0.12859 | 0.00215 | 99.24 | 2.2020 | 0.0043 | 6.507 | 0.013 | 0.020 | |
| 00M0160F | 20.0 | 9.42E-15 | 2.2412 | 0.0041 | 0.01219 | 0.00012 | 0.2290 | 0.0014 | 0.0001996 | 0.0000066 | 0.53309 | 0.00872 | 98.12 | 2.1995 | 0.0045 | 6.500 | 0.013 | 0.020 | |
| *00M0160B* | *20.0* | *5.08E-15* | *2.2942* | *0.0042* | *0.01220* | *0.00014* | *0.5126* | *0.0033* | *0.0004838* | *0.0000160* | *1.19318* | *0.01972* | *95.47* | *2.1910* | *0.0063* | *6.475* | *0.018* | *0.024* | *Ca/K >1* |
| **VU37: Mes12** (00M0172,00M0248,01M0168) J = 0.001723 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 00M0172A | 20.0 | 6.65E-14 | 2.1060 | 0.0035 | 0.01215 | 0.00006 | 0.0170 | 0.0001 | 0.0001322 | 0.0000040 | 0.03964 | 0.00069 | 98.16 | 2.0674 | 0.0036 | 6.415 | 0.011 | 0.020 | |
| 00M0172D | 20.0 | 5.67E-14 | 2.1469 | 0.0036 | 0.01198 | 0.00005 | 0.0179 | 0.0002 | 0.0001958 | 0.0000059 | 0.04159 | 0.00076 | 97.33 | 2.0689 | 0.0039 | 6.420 | 0.012 | 0.020 | |
| 00M0248D | 20.0 | 1.04E-14 | 2.1019 | 0.0070 | 0.01215 | 0.00011 | 0.0175 | 0.0005 | 0.0000210 | 0.0000153 | 0.04081 | 0.00158 | 99.73 | 2.0658 | 0.0082 | 6.410 | 0.025 | 0.030 | |
| 01M0168A | 20.0 | 1.12E-13 | 2.0970 | 0.0023 | 0.01209 | 0.00003 | 0.0224 | 0.0007 | 0.0001171 | 0.0000046 | 0.05206 | 0.00305 | 98.39 | 2.0633 | 0.0026 | 6.402 | 0.008 | 0.018 | |
| 01M0168D | 20.0 | 1.63E-13 | 2.0902 | 0.0022 | 0.01211 | 0.00004 | 0.0188 | 0.0006 | 0.0001029 | 0.0000028 | 0.04384 | 0.00258 | 98.57 | 2.0605 | 0.0024 | 6.393 | 0.007 | 0.018 | |
| 01M0168E | 20.0 | 7.96E-14 | 2.1049 | 0.0026 | 0.01198 | 0.00005 | 0.0231 | 0.0010 | 0.0000499 | 0.0000061 | 0.05364 | 0.00358 | 99.34 | 2.0608 | 0.0031 | 6.394 | 0.010 | 0.019 | |
| *01M0168B* | *20.0* | *7.42E-14* | *2.1397* | *0.0023* | *0.01217* | *0.00005* | *0.0226* | *0.0013* | *0.0002363* | *0.0000081* | *0.05250* | *0.00395* | *96.78* | *2.0503* | *0.0032* | *6.362* | *0.010* | *0.019* | *>1.5 nMADs from median age* |
| *00M0248E* | *20.0* | *2.74E-14* | *2.6949* | *0.0185* | *0.01290* | *0.00016* | *0.0134* | *0.0003* | *0.0004205* | *0.0000189* | *0.03122* | *0.00102* | *95.39* | *2.5335* | *0.0184* | *7.858* | *0.057* | *0.060* | *age > 7.2 Ma* |
| **VU42: Mes12** (A8) J = 0.001874 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0273A | 20.0 | 3.12E-14 | 1.9333 | 0.0052 | 0.01229 | 0.00008 | 0.0187 | 0.0002 | 0.0000882 | 0.0000194 | 0.04347 | 0.00081 | 98.68 | 1.9078 | 0.0077 | 6.439 | 0.026 | 0.030 | |
| 02M0273B | 20.0 | 2.58E-14 | 2.0217 | 0.0053 | 0.01243 | 0.00008 | 0.0193 | 0.0002 | 0.0004071 | 0.0000266 | 0.04488 | 0.00089 | 94.08 | 1.9021 | 0.0093 | 6.419 | 0.031 | 0.034 | |
| 02M0273D | 20.0 | 3.23E-14 | 2.0168 | 0.0053 | 0.01232 | 0.00008 | 0.0134 | 0.0002 | 0.0004106 | 0.0000348 | 0.03127 | 0.00066 | 93.99 | 1.8957 | 0.0114 | 6.398 | 0.039 | 0.041 | |
| 02M0273E | 20.0 | 2.31E-14 | 2.0612 | 0.0054 | 0.01233 | 0.00009 | 0.0182 | 0.0003 | 0.0005397 | 0.0000352 | 0.04231 | 0.00102 | 92.29 | 1.9023 | 0.0115 | 6.420 | 0.039 | 0.041 | |
| 02M0273F | 20.0 | 2.43E-14 | 2.1041 | 0.0058 | 0.01262 | 0.00008 | 0.0191 | 0.0003 | 0.0006833 | 0.0000411 | 0.04451 | 0.00096 | 90.43 | 1.9028 | 0.0132 | 6.422 | 0.045 | 0.047 | |
| 02M0273H | 20.0 | 3.38E-14 | 2.0181 | 0.0053 | 0.01231 | 0.00008 | 0.0172 | 0.0002 | 0.0003797 | 0.0000265 | 0.04000 | 0.00080 | 94.46 | 1.9064 | 0.0093 | 6.434 | 0.031 | 0.034 | |
| 02M0273I | 20.0 | 4.90E-14 | 1.9324 | 0.0051 | 0.01233 | 0.00008 | 0.0211 | 0.0002 | 0.0000963 | 0.0000180 | 0.04903 | 0.00090 | 98.57 | 1.9047 | 0.0074 | 6.428 | 0.025 | 0.029 | |
| 02M0273J | 20.0 | 3.62E-14 | 1.9488 | 0.0052 | 0.01219 | 0.00007 | 0.0192 | 0.0002 | 0.0001429 | 0.0000183 | 0.04465 | 0.00084 | 97.87 | 1.9072 | 0.0074 | 6.437 | 0.025 | 0.029 | |
| 02M0273M | 20.0 | 2.62E-14 | 1.9128 | 0.0052 | 0.01221 | 0.00008 | 0.0181 | 0.0002 | 0.0000600 | 0.0000238 | 0.04206 | 0.00085 | 99.10 | 1.8957 | 0.0087 | 6.398 | 0.029 | 0.033 | |
| *02M0273L* | *20.0* | 3.57E-14 | *1.9329* | *0.0051* | *0.01226* | *0.00008* | *0.0179* | *0.0002* | *0.0001749* | *0.0000267* | *0.04159* | *0.00077* | *97.35* | *1.8817* | *0.0093* | *6.351* | *0.031* | *0.034* | *>1.5 nMADs from median age* |
| **VU37: Mes14** (01M0166) J = 0.001636 ± 0.000004 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0166A | 20.0 | 1.85E-14 | 2.1587 | 0.0023 | 0.01221 | 0.00012 | 0.0081 | 0.0054 | 0.0000206 | 0.0000174 | 0.01891 | 0.01270 | 99.71 | 2.1524 | 0.0057 | 6.342 | 0.017 | 0.023 | |
| 01M0166B | 20.0 | 6.15E-14 | 2.1442 | 0.0023 | 0.01210 | 0.00004 | 0.0179 | 0.0011 | 0.0000369 | 0.0000058 | 0.04161 | 0.00332 | 99.52 | 2.1339 | 0.0029 | 6.287 | 0.008 | 0.017 | |
| 01M0166C | 20.0 | 2.92E-14 | 2.1691 | 0.0023 | 0.01218 | 0.00004 | 0.0327 | 0.0024 | 0.0000334 | 0.0000202 | 0.07602 | 0.00685 | 99.62 | 2.1491 | 0.0064 | 6.332 | 0.019 | 0.024 | |
| 01M0166E | 20.0 | 3.51E-14 | 2.1974 | 0.0023 | 0.01221 | 0.00005 | 0.0303 | 0.0016 | 0.0001581 | 0.0000104 | 0.07038 | 0.00511 | 97.94 | 2.1404 | 0.0038 | 6.306 | 0.011 | 0.019 | |
| 01M0166F | 20.0 | 4.12E-14 | 2.2088 | 0.0026 | 0.01219 | 0.00006 | 0.0332 | 0.0018 | 0.0001645 | 0.0000107 | 0.07713 | 0.00578 | 97.88 | 2.1501 | 0.0040 | 6.335 | 0.012 | 0.019 | |
| 01M0166G | 20.0 | 2.80E-14 | 2.1779 | 0.0024 | 0.01226 | 0.00006 | 0.0437 | 0.0030 | 0.0000374 | 0.0000122 | 0.10156 | 0.00865 | 99.61 | 2.1442 | 0.0043 | 6.318 | 0.013 | 0.020 | |
| 01M0166I | 20.0 | 2.62E-14 | 2.1950 | 0.0026 | 0.01218 | 0.00007 | 0.0172 | 0.0036 | 0.0000493 | 0.0000180 | 0.04003 | 0.00865 | 99.36 | 2.1556 | 0.0059 | 6.351 | 0.017 | 0.023 | |
| 01M0166J | 20.0 | 1.47E-14 | 2.3416 | 0.0025 | 0.01223 | 0.00007 | 0.0065 | 0.0049 | 0.0000248 | 0.0000268 | 0.01508 | 0.01137 | 99.67 | 2.1641 | 0.0077 | 6.376 | 0.023 | 0.027 | |
| **VU42: Mes14** (A9) J = 0.001874 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0275A | 20.0 | 1.08E-14 | 1.8803 | 0.0051 | 0.01225 | 0.00010 | 0.0173 | 0.0005 | 0.0000170 | 0.0000676 | 0.04023 | 0.00133 | 99.76 | 1.8757 | 0.0206 | 6.330 | 0.069 | 0.071 | |
| 02M0275C | 20.0 | 2.29E-14 | 1.9321 | 0.0052 | 0.01212 | 0.00008 | 0.0204 | 0.0003 | 0.0001996 | 0.0000305 | 0.04739 | 0.00100 | 96.98 | 1.8739 | 0.0103 | 6.324 | 0.035 | 0.037 | |
| 02M0275D | 20.0 | 9.65E-15 | 1.8716 | 0.0051 | 0.01219 | 0.00010 | 0.0190 | 0.0003 | 0.0000054 | 0.0000657 | 0.04423 | 0.00096 | 99.95 | 1.8707 | 0.0201 | 6.313 | 0.068 | 0.069 | |
| 02M0275E | 20.0 | 1.80E-14 | 1.9081 | 0.0051 | 0.01226 | 0.00009 | 0.0172 | 0.0002 | 0.0001132 | 0.0000241 | 0.03994 | 0.00085 | 98.27 | 1.8751 | 0.0087 | 6.328 | 0.029 | 0.032 | |
| 02M0275G | 20.0 | 1.90E-14 | 1.9311 | 0.0051 | 0.01215 | 0.00008 | 0.0216 | 0.0003 | 0.0003001 | 0.0000383 | 0.05019 | 0.00107 | 95.45 | 1.8433 | 0.0123 | 6.221 | 0.042 | 0.044 | |
| 02M0275I | 20.0 | 3.31E-14 | 1.9628 | 0.0054 | 0.01225 | 0.00008 | 0.0220 | 0.0002 | 0.0003583 | 0.0000198 | 0.05111 | 0.00096 | 94.65 | 1.8578 | 0.0078 | 6.270 | 0.026 | 0.030 | |
| 02M0275K | 20.0 | 3.15E-14 | 1.9576 | 0.0053 | 0.01226 | 0.00008 | 0.0215 | 0.0002 | 0.0003267 | 0.0000171 | 0.04992 | 0.00098 | 95.11 | 1.8619 | 0.0071 | 6.284 | 0.024 | 0.028 | |
| 02M0275L | 20.0 | 1.90E-14 | 2.0124 | 0.0054 | 0.01220 | 0.00008 | 0.0190 | 0.0003 | 0.0004665 | 0.0000437 | 0.04411 | 0.00102 | 93.18 | 1.8752 | 0.0138 | 6.329 | 0.047 | 0.049 | |
| 02M0275M | 20.0 | 1.87E-14 | 2.0900 | 0.0056 | 0.01218 | 0.00008 | 0.0235 | 0.0003 | 0.0007781 | 0.0000401 | 0.05470 | 0.00111 | 89.04 | 1.8611 | 0.0128 | 6.281 | 0.043 | 0.045 | |
| *02M0275H* | *20.0* | 1.56E-14 | *1.8966* | *0.0051* | *0.01215* | *0.00008* | *0.0201* | *0.0004* | *0.0002204* | *0.0000407* | *0.04680* | *0.00120* | *96.60* | *1.8322* | *0.0130* | *6.184* | *0.044* | *0.046* | *>1.5 nMADs from median age* |
| **VU42: Mes15** (A11) J = 0.001875 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0277B | 20.0 | 2.13E-14 | 1.9238 | 0.0054 | 0.01115 | 0.00008 | 0.0219 | 0.0003 | 0.0002334 | 0.0000375 | 0.05097 | 0.00105 | 96.46 | 1.8558 | 0.0123 | 6.266 | 0.041 | 0.044 | |
| 02M0277D | 20.0 | 2.83E-14 | 1.9013 | 0.0054 | 0.01128 | 0.00007 | 0.0180 | 0.0002 | 0.0001599 | 0.0000232 | 0.04183 | 0.00086 | 97.54 | 1.8546 | 0.0086 | 6.263 | 0.029 | 0.032 | |
| 02M0277E | 20.0 | 2.02E-14 | 1.9842 | 0.0055 | 0.01116 | 0.00007 | 0.0200 | 0.0003 | 0.0004278 | 0.0000477 | 0.04656 | 0.00106 | 93.66 | 1.8585 | 0.0150 | 6.276 | 0.051 | 0.052 | |
| 02M0277F | 20.0 | 3.11E-14 | 1.9645 | 0.0057 | 0.01145 | 0.00007 | 0.0186 | 0.0002 | 0.0003678 | 0.0000338 | 0.04320 | 0.00080 | 94.50 | 1.8564 | 0.0113 | 6.269 | 0.038 | 0.041 | |
| 02M0277H | 20.0 | 2.87E-14 | 1.9375 | 0.0052 | 0.01148 | 0.00007 | 0.0193 | 0.0002 | 0.0002961 | 0.0000253 | 0.04495 | 0.00091 | 95.52 | 1.8507 | 0.0090 | 6.249 | 0.030 | 0.033 | |
| 02M0277I | 20.0 | 6.89E-15 | 2.1367 | 0.0062 | 0.00866 | 0.00011 | 0.0160 | 0.0005 | 0.0009690 | 0.0000889 | 0.03726 | 0.00121 | 86.62 | 1.8508 | 0.0268 | 6.250 | 0.090 | 0.091 | |
| 02M0277L | 20.0 | 4.61E-14 | 1.9207 | 0.0051 | 0.01180 | 0.00007 | 0.0193 | 0.0002 | 0.0002086 | 0.0000215 | 0.04492 | 0.00091 | 96.82 | 1.8597 | 0.0080 | 6.280 | 0.027 | 0.030 | |
| 02M0277M | 20.0 | 3.27E-14 | 1.9213 | 0.0052 | 0.01153 | 0.00008 | 0.0195 | 0.0002 | 0.0002211 | 0.0000237 | 0.04546 | 0.00093 | 96.63 | 1.8566 | 0.0086 | 6.269 | 0.029 | 0.032 | |
| **VU42: Mes16** (A12) J = 0.001875 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0279A | 20.0 | 3.15E-14 | 1.9191 | 0.0061 | 0.01221 | 0.00008 | 0.0180 | 0.0002 | 0.0002212 | 0.0000266 | 0.04197 | 0.00081 | 96.62 | 1.8544 | 0.0099 | 6.262 | 0.033 | 0.036 | |
| 02M0279C | 20.0 | 3.07E-14 | 1.9156 | 0.0052 | 0.01204 | 0.00007 | 0.0183 | 0.0002 | 0.0001729 | 0.0000177 | 0.04248 | 0.00087 | 97.36 | 1.8651 | 0.0073 | 6.298 | 0.025 | 0.028 | |
| 02M0279D | 20.0 | 3.18E-14 | 1.8656 | 0.0052 | 0.01218 | 0.00008 | 0.0178 | 0.0002 | 0.0000519 | 0.0000207 | 0.04149 | 0.00076 | 99.21 | 1.8508 | 0.0080 | 6.250 | 0.027 | 0.030 | |
| 02M0279E | 20.0 | 3.03E-14 | 1.9461 | 0.0053 | 0.01232 | 0.00008 | 0.0182 | 0.0002 | 0.0003001 | 0.0000235 | 0.04242 | 0.00087 | 95.47 | 1.8580 | 0.0086 | 6.274 | 0.029 | 0.032 | |
| 02M0279G | 20.0 | 4.86E-14 | 1.8754 | 0.0050 | 0.01216 | 0.00008 | 0.0183 | 0.0002 | 0.0000632 | 0.0000140 | 0.04260 | 0.00083 | 99.03 | 1.8573 | 0.0065 | 6.272 | 0.022 | 0.026 | |

| Lab ID# | Laser Power (W) | $^{39}$Ar (moles) | $^{40}$Ar/$^{39}$Ar | ± 1σ | $^{38}$Ar/$^{39}$Ar | ± 1σ | $^{37}$Ar/$^{39}$Ar | ± 1σ | $^{36}$Ar/$^{39}$Ar | ± 1σ | Ca/K | ± 1σ | $^{40}$Ar* (%) | $^{40}$Ar*/$^{39}$Ar$_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02M0279H | 20.0 | 3.40E-14 | 1.8836 | 0.0051 | 0.01225 | 0.00008 | 0.0184 | 0.0003 | 0.0001113 | 0.0000194 | 0.04275 | 0.00091 | 98.28 | 1.8513 | 0.0076 | 6.251 | 0.026 | 0.029 | |
| 02M0279I | 20.0 | 1.85E-14 | 1.9697 | 0.0063 | 0.01226 | 0.00008 | 0.0182 | 0.0003 | 0.0003927 | 0.0000324 | 0.04233 | 0.00099 | 94.14 | 1.8542 | 0.0113 | 6.261 | 0.038 | 0.040 | |
| 02M0279K | 20.0 | 2.42E-14 | 1.9307 | 0.0052 | 0.01222 | 0.00010 | 0.0188 | 0.0002 | 0.0002789 | 0.0000380 | 0.04374 | 0.00090 | 95.76 | 1.8489 | 0.0123 | 6.243 | 0.041 | 0.044 | |
| 02M0279L | 20.0 | 1.96E-14 | 1.8694 | 0.0051 | 0.01231 | 0.00010 | 0.0178 | 0.0003 | 0.0000857 | 0.0000372 | 0.04128 | 0.00094 | 98.67 | 1.8446 | 0.0121 | 6.229 | 0.041 | 0.043 | |
| 02M0279M | 20.0 | 1.59E-14 | 1.9172 | 0.0053 | 0.01239 | 0.00010 | 0.0172 | 0.0002 | 0.0002329 | 0.0000391 | 0.04009 | 0.00083 | 96.44 | 1.8488 | 0.0127 | 6.243 | 0.043 | 0.045 | |
| **VU37: Mes17** (00M0237,00M0238) J = 0.001736 ± 0.000004 (TCR) | | | | | | | | | | | | | | | | | | | |
| 00M0237B | 20.0 | 3.09E-14 | 2.0209 | 0.0068 | 0.01212 | 0.00011 | 0.0168 | 0.0003 | 0.0001149 | 0.0000104 | 0.03899 | 0.00115 | 98.34 | 1.9875 | 0.0075 | 6.214 | 0.023 | 0.028 | |
| 00M0237D | 20.0 | 3.17E-14 | 2.1454 | 0.0075 | 0.01213 | 0.00019 | 0.0230 | 0.0005 | 0.0005215 | 0.0000343 | 0.05346 | 0.00168 | 92.86 | 1.9923 | 0.0126 | 6.229 | 0.039 | 0.042 | |
| 00M0238recomb | 20.0 | 3.64E-14 | 2.0570 | 0.0064 | 0.01211 | 0.00010 | 0.0155 | 0.0003 | 0.0002017 | 0.0000083 | 0.03596 | | 97.06 | 1.9977 | 0.0068 | 6.246 | 0.021 | 0.026 | |
| **VU37: Mes17** (00M0236) J = 0.001747 ± 0.000004 (TCR) | | | | | | | | | | | | | | | | | | | |
| 00M0236recomb | 20.0 | 5.94E-14 | 2.0733 | 0.0067 | 0.01209 | 0.00009 | 0.0147 | 0.0002 | 0.0003414 | 0.0000055 | 0.03414 | | 95.14 | 1.9727 | 0.0069 | 6.207 | 0.022 | 0.027 | |
| **VU42: Mes17** (A13) J = 0.001875 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0280A | 20.0 | 4.14E-14 | 1.9374 | 0.0060 | 0.01245 | 0.00008 | 0.0159 | 0.0002 | 0.0002828 | 0.0000221 | 0.03689 | 0.00072 | 95.71 | 1.8542 | 0.0087 | 6.261 | 0.029 | 0.032 | |
| 02M0280B | 20.0 | 4.56E-14 | 1.9117 | 0.0054 | 0.01227 | 0.00007 | 0.0173 | 0.0002 | 0.0001932 | 0.0000199 | 0.04027 | 0.00081 | 97.04 | 1.8551 | 0.0079 | 6.264 | 0.027 | 0.030 | |
| 02M0280C | 20.0 | 3.47E-14 | 1.9148 | 0.0056 | 0.01227 | 0.00008 | 0.0181 | 0.0003 | 0.0002412 | 0.0000211 | 0.04204 | 0.00093 | 96.31 | 1.8441 | 0.0082 | 6.227 | 0.028 | 0.031 | |
| 02M0280E | 20.0 | 2.44E-14 | 1.9154 | 0.0053 | 0.01210 | 0.00008 | 0.0162 | 0.0002 | 0.0002513 | 0.0000322 | 0.03768 | 0.00076 | 96.14 | 1.8416 | 0.0108 | 6.219 | 0.036 | 0.039 | |
| 02M0280F | 20.0 | 1.76E-14 | 1.9966 | 0.0057 | 0.01241 | 0.00010 | 0.0173 | 0.0002 | 0.0004788 | 0.0000352 | 0.04032 | 0.00079 | 92.94 | 1.8556 | 0.0117 | 6.266 | 0.039 | 0.042 | |
| 02M0280G | 20.0 | 2.60E-14 | 1.9438 | 0.0059 | 0.01216 | 0.00008 | 0.0148 | 0.0002 | 0.0003252 | 0.0000385 | 0.03450 | 0.00077 | 95.07 | 1.8480 | 0.0127 | 6.240 | 0.043 | 0.045 | |
| 02M0280I | 20.0 | 3.21E-14 | 1.8807 | 0.0050 | 0.01219 | 0.00008 | 0.0168 | 0.0002 | 0.0001046 | 0.0000280 | 0.03919 | 0.00076 | 98.38 | 1.8503 | 0.0096 | 6.248 | 0.032 | 0.035 | |
| 02M0280J | 20.0 | 2.54E-14 | 1.9358 | 0.0052 | 0.01217 | 0.00009 | 0.0180 | 0.0002 | 0.0002629 | 0.0000316 | 0.04193 | 0.00085 | 96.01 | 1.8587 | 0.0106 | 6.276 | 0.036 | 0.038 | |
| 02M0280K | 20.0 | 2.46E-14 | 1.8500 | 0.0049 | 0.01211 | 0.00009 | 0.0164 | 0.0002 | 0.0000044 | 0.0000266 | 0.03804 | 0.00077 | 99.95 | 1.8491 | 0.0093 | 6.244 | 0.031 | 0.034 | |
| 02M0280M | 20.0 | 2.79E-14 | 1.8748 | 0.0053 | 0.01219 | 0.00008 | 0.0169 | 0.0003 | 0.0001039 | 0.0000235 | 0.03919 | 0.00087 | 98.39 | 1.8446 | 0.0087 | 6.229 | 0.029 | 0.032 | |
| **VU42: Mes18** (A15) J = 0.001874 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0302C | 20.0 | 1.30E-14 | 1.8584 | 0.0021 | 0.01226 | 0.00005 | 0.0160 | 0.0002 | 0.0000554 | 0.0000444 | 0.03711 | 0.00084 | 99.14 | 1.8425 | 0.0133 | 6.218 | 0.045 | 0.047 | |
| 02M0302D | 20.0 | 2.38E-14 | 1.8467 | 0.0019 | 0.01220 | 0.00005 | 0.0176 | 0.0002 | 0.0000049 | 0.0000206 | 0.04093 | 0.00095 | 99.95 | 1.8458 | 0.0064 | 6.230 | 0.021 | 0.025 | |
| 02M0302E | 20.0 | 1.32E-14 | 1.8581 | 0.0021 | 0.01236 | 0.00008 | 0.0153 | 0.0004 | 0.0000568 | 0.0000455 | 0.03567 | 0.00121 | 99.11 | 1.8416 | 0.0136 | 6.216 | 0.046 | 0.048 | |
| 02M0302G | 20.0 | 1.19E-14 | 1.8709 | 0.0021 | 0.01228 | 0.00006 | 0.0179 | 0.0003 | 0.0000343 | 0.0000421 | 0.04156 | 0.00106 | 99.49 | 1.8613 | 0.0126 | 6.282 | 0.042 | 0.045 | |
| 02M0302H | 20.0 | 1.80E-14 | 1.8486 | 0.0019 | 0.01226 | 0.00005 | 0.0217 | 0.0002 | 0.0000439 | 0.0000366 | 0.05050 | 0.00108 | 99.34 | 1.8365 | 0.0110 | 6.198 | 0.037 | 0.039 | |
| 02M0302I | 20.0 | 1.40E-14 | 1.8513 | 0.0021 | 0.01233 | 0.00005 | 0.0220 | 0.0005 | 0.0000526 | 0.0000264 | 0.05126 | 0.00160 | 99.21 | 1.8367 | 0.0081 | 6.199 | 0.027 | 0.030 | |
| 02M0302K | 20.0 | 1.98E-14 | 1.8637 | 0.0022 | 0.01222 | 0.00004 | 0.0166 | 0.0002 | 0.0000628 | 0.0000272 | 0.03869 | 0.00089 | 99.03 | 1.8456 | 0.0083 | 6.229 | 0.028 | 0.031 | |
| 02MA302A | 20.0 | 1.02E-14 | 1.8400 | 0.0013 | 0.01228 | 0.00005 | 0.0227 | 0.0006 | 0.0000494 | 0.0000469 | 0.05268 | 0.00197 | 99.26 | 1.8263 | 0.0139 | 6.164 | 0.047 | 0.049 | |
| 02MA302C | 20.0 | 9.16E-15 | 1.8497 | 0.0015 | 0.01224 | 0.00006 | 0.0189 | 0.0012 | 0.0000122 | 0.0000576 | 0.04387 | 0.00309 | 99.95 | 1.8467 | 0.0171 | 6.233 | 0.058 | 0.059 | |
| *02MA302B* | 20.0 | *1.11E-14* | *1.8704* | *0.0013* | *0.01229* | *0.00006* | *0.0198* | *0.0007* | *0.0000054* | *0.0000484* | *0.04609* | *0.00201* | *99.84* | 1.8695 | 0.0144 | *6.309* | *0.048* | *0.050* | *>1.5 nMADs from median age* |
| **VU42: Ifo1** (A17) J = 0.001873 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0304A | 20.0 | 4.73E-14 | 1.9974 | 0.0021 | 0.01240 | 0.00003 | 0.0181 | 0.0001 | 0.0003206 | 0.0000220 | 0.04199 | 0.00088 | 95.28 | 1.9032 | 0.0068 | 6.420 | 0.023 | 0.027 | |
| 02M0304B | 20.0 | 1.96E-14 | 1.9245 | 0.0025 | 0.01244 | 0.00006 | 0.0182 | 0.0003 | 0.0000883 | 0.0000568 | 0.04228 | 0.00105 | 98.67 | 1.8990 | 0.0170 | 6.405 | 0.057 | 0.059 | |
| 02M0304D | 20.0 | 1.91E-14 | 1.9212 | 0.0020 | 0.01234 | 0.00006 | 0.0186 | 0.0004 | 0.0000923 | 0.0000491 | 0.04314 | 0.00133 | 98.61 | 1.8945 | 0.0147 | 6.390 | 0.049 | 0.051 | |
| 02M0304E | 20.0 | 2.98E-14 | 1.9329 | 0.0020 | 0.01249 | 0.00005 | 0.0193 | 0.0002 | 0.0001115 | 0.0000334 | 0.04493 | 0.00099 | 98.33 | 1.9007 | 0.0101 | 6.411 | 0.034 | 0.036 | |
| 02M0304F | 20.0 | 4.47E-14 | 1.9653 | 0.0024 | 0.01237 | 0.00004 | 0.0175 | 0.0001 | 0.0002126 | 0.0000230 | 0.04067 | 0.00081 | 96.83 | 1.9030 | 0.0072 | 6.419 | 0.024 | 0.028 | |
| 02M0304H | 20.0 | 3.97E-14 | 1.9687 | 0.0023 | 0.01241 | 0.00003 | 0.0202 | 0.0002 | 0.0002508 | 0.0000234 | 0.04704 | 0.00102 | 96.27 | 1.8954 | 0.0073 | 6.393 | 0.025 | 0.028 | |
| 02M0304I | 20.0 | 2.41E-14 | 1.9276 | 0.0022 | 0.01244 | 0.00005 | 0.0196 | 0.0002 | 0.0000949 | 0.0000440 | 0.04561 | 0.00097 | 98.58 | 1.9003 | 0.0132 | 6.410 | 0.044 | 0.046 | |
| 02M0304M | 20.0 | 2.30E-14 | 1.9428 | 0.0030 | 0.01256 | 0.00006 | 0.0194 | 0.0002 | 0.0001276 | 0.0000467 | 0.04517 | 0.00105 | 98.09 | 1.9058 | 0.0141 | 6.428 | 0.048 | 0.049 | |
| *02M0304J* | 20.0 | *3.44E-14* | *1.9298* | *0.0020* | *0.01236* | *0.00003* | *0.0185* | *0.0002* | *0.0000493* | *0.0000285* | *0.04302* | *0.00096* | *99.28* | 1.9158 | 0.0087 | *6.462* | *0.029* | *0.032* | *>1.5 nMADs from median age* |
| *02M0304L* | 20.0 | *4.59E-14* | *1.9563* | *0.0023* | *0.01250* | *0.00005* | *0.0172* | *0.0001* | *0.0001428* | *0.0000238* | *0.04008* | *0.00083* | *97.87* | 1.9146 | 0.0074 | *6.458* | *0.025* | *0.028* | *>1.5 nMADs from median age* |
| **VU42: Ifo2** (A16) J = 0.001874 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0303A | 20.0 | 1.83E-14 | 1.9071 | 0.0025 | 0.01225 | 0.00006 | 0.0187 | 0.0002 | 0.0000228 | 0.0000293 | 0.04355 | 0.00092 | 99.68 | 1.9010 | 0.0090 | 6.416 | 0.030 | 0.034 | |
| 02M0303B | 20.0 | 4.46E-14 | 1.9213 | 0.0026 | 0.01241 | 0.00005 | 0.0185 | 0.0001 | 0.0000586 | 0.0000110 | 0.04291 | 0.00090 | 99.13 | 1.9046 | 0.0041 | 6.428 | 0.014 | 0.020 | |
| 02M0303C | 20.0 | 4.22E-14 | 1.9076 | 0.0025 | 0.01235 | 0.00005 | 0.0182 | 0.0001 | 0.0000301 | 0.0000164 | 0.04231 | 0.00088 | 99.56 | 1.8993 | 0.0054 | 6.410 | 0.018 | 0.023 | |
| 02M0303E | 20.0 | 2.40E-14 | 1.9066 | 0.0021 | 0.01254 | 0.00006 | 0.0192 | 0.0002 | 0.0000111 | 0.0000234 | 0.04469 | 0.00098 | 99.86 | 1.9040 | 0.0072 | 6.426 | 0.024 | 0.028 | |
| 02M0303F | 20.0 | 2.32E-14 | 1.9017 | 0.0033 | 0.01229 | 0.00004 | 0.0201 | 0.0003 | 0.0000082 | 0.0000232 | 0.04672 | 0.00113 | 99.91 | 1.9000 | 0.0076 | 6.412 | 0.026 | 0.029 | |
| 02M0303I | 20.0 | 2.61E-14 | 1.9027 | 0.0022 | 0.01233 | 0.00004 | 0.0192 | 0.0001 | 0.0000051 | 0.0000197 | 0.04456 | 0.00093 | 99.95 | 1.9019 | 0.0062 | 6.418 | 0.021 | 0.025 | |
| 02M0303K | 20.0 | 2.26E-14 | 1.9099 | 0.0024 | 0.01239 | 0.00004 | 0.0205 | 0.0003 | 0.0000244 | 0.0000218 | 0.04758 | 0.00110 | 99.66 | 1.9035 | 0.0069 | 6.424 | 0.023 | 0.027 | |
| 02M0303M | 20.0 | 3.67E-14 | 1.9143 | 0.0022 | 0.01234 | 0.00004 | 0.0188 | 0.0002 | 0.0000384 | 0.0000204 | 0.04362 | 0.00093 | 99.44 | 1.9035 | 0.0064 | 6.424 | 0.022 | 0.026 | |
| *02M0303G* | 20.0 | *1.96E-14* | *1.8955* | *0.0022* | *0.01233* | *0.00006* | *0.0203* | *0.0003* | *0.0000058* | *0.0000326* | *0.04713* | *0.00113* | *99.95* | 1.8946 | 0.0099 | *6.394* | *0.033* | *0.036* | *>1.5 nMADs from median age* |
| *02M0303J* | 20.0 | *1.49E-14* | *1.9424* | *0.0022* | *0.01230* | *0.00009* | *0.0201* | *0.0003* | *0.0000249* | *0.0000300* | *0.04670* | *0.00110* | *99.66* | 1.9358 | 0.0091 | *6.533* | *0.031* | *0.034* | *>1.5 nMADs from median age* |
| **VU37: Ifo3** (01M0110) J = 0.001813 ± 0.000005 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0110B | 20.0 | 5.53E-14 | 1.9587 | 0.0022 | 0.01212 | 0.00005 | 0.0340 | 0.0012 | 0.0001266 | 0.0000070 | 0.07916 | 0.00476 | 98.18 | 1.9231 | 0.0030 | 6.279 | 0.010 | 0.019 | |
| 01M0110D | 20.0 | 7.65E-14 | 2.0140 | 0.0022 | 0.01222 | 0.00003 | 0.0214 | 0.0007 | 0.0002958 | 0.0000059 | 0.04980 | 0.00288 | 95.70 | 1.9274 | 0.0027 | 6.293 | 0.009 | 0.019 | |
| 01M0110F | 20.0 | 1.42E-13 | 2.0253 | 0.0023 | 0.01211 | 0.00004 | 0.0219 | 0.0004 | 0.0003442 | 0.0000038 | 0.05104 | 0.00261 | 95.02 | 1.9244 | 0.0025 | 6.283 | 0.008 | 0.018 | |
| 01M0110H | 20.0 | 7.47E-14 | 2.0049 | 0.0024 | 0.01210 | 0.00005 | 0.0232 | 0.0011 | 0.0003322 | 0.0000052 | 0.05389 | 0.00371 | 95.15 | 1.9171 | 0.0028 | 6.260 | 0.009 | 0.019 | |
| 01M0110K | 20.0 | 9.20E-14 | 1.9807 | 0.0024 | 0.01208 | 0.00004 | 0.0230 | 0.0008 | 0.0002787 | 0.0000050 | 0.05360 | 0.00313 | 95.89 | 1.9150 | 0.0027 | 6.253 | 0.009 | 0.019 | |
| 01M0110N | 20.0 | 1.06E-13 | 1.9506 | 0.0026 | 0.01209 | 0.00004 | 0.0202 | 0.0008 | 0.0001704 | 0.0000041 | 0.04703 | 0.00296 | 97.45 | 1.9167 | 0.0029 | 6.258 | 0.009 | 0.019 | |
| 01M0110P | 20.0 | 1.00E-13 | 1.9159 | 0.0026 | 0.01196 | 0.00004 | 0.0218 | 0.0010 | 0.0000191 | 0.0000038 | 0.05066 | 0.00344 | 99.75 | 1.9206 | 0.0028 | 6.271 | 0.009 | 0.019 | |
| 01M0110Q | 20.0 | 8.08E-14 | 1.9255 | 0.0021 | 0.01221 | 0.00005 | 0.0204 | 0.0015 | 0.0000392 | 0.0000051 | 0.04752 | 0.00424 | 99.44 | 1.9305 | 0.0026 | 6.303 | 0.009 | 0.018 | |

| Lab ID# | Laser Power (W) | $^{39}Ar$ (moles) | $^{40}Ar/^{39}Ar$ | ± 1σ | $^{38}Ar/^{39}Ar$ | ± 1σ | $^{37}Ar/^{39}Ar$ | ± 1σ | $^{36}Ar/^{39}Ar$ | ± 1σ | Ca/K | ± 1σ | $^{40}Ar^{*}$ (%) | $^{40}Ar^{*}/^{39}Ar_K$ | ± 1σ | Age (Ma) | ± 1σ excluding error on J | ± 1σ including error on J | Omitted because |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VU42: Ifo3** (A19) J = 0.001872 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0307B | 20.0 | 1.92E-14 | 1.8746 | 0.0019 | 0.01235 | 0.00005 | 0.0200 | 0.0003 | 0.0000255 | 0.0000460 | 0.04646 | 0.00112 | 97.13 | 1.8678 | 0.0137 | 6.297 | 0.046 | 0.048 | |
| 02M0307C | 20.0 | 2.54E-14 | 1.8650 | 0.0026 | 0.01229 | 0.00005 | 0.0215 | 0.0001 | 0.0000111 | 0.0000200 | 0.04990 | 0.00102 | 98.49 | 1.8625 | 0.0065 | 6.279 | 0.022 | 0.025 | |
| 02M0307D | 20.0 | 2.20E-14 | 1.8710 | 0.0023 | 0.01238 | 0.00007 | 0.0176 | 0.0001 | 0.0000082 | 0.0000260 | 0.04085 | 0.00085 | 98.18 | 1.8691 | 0.0080 | 6.302 | 0.027 | 0.030 | |
| 02M0307F | 20.0 | 3.41E-14 | 1.9027 | 0.0022 | 0.01230 | 0.00005 | 0.0203 | 0.0001 | 0.0001177 | 0.0000259 | 0.04719 | 0.00099 | 95.70 | 1.8687 | 0.0080 | 6.300 | 0.027 | 0.030 | |
| 02M0307G | 20.0 | 2.49E-14 | 1.8961 | 0.0023 | 0.01238 | 0.00006 | 0.0211 | 0.0003 | 0.0000629 | 0.0000302 | 0.04908 | 0.00122 | 95.02 | 1.8783 | 0.0092 | 6.332 | 0.031 | 0.034 | |
| 02M0307H | 20.0 | 4.86E-14 | 1.9345 | 0.0025 | 0.01236 | 0.00005 | 0.0201 | 0.0001 | 0.0002408 | 0.0000150 | 0.04666 | 0.00096 | 95.15 | 1.8641 | 0.0051 | 6.284 | 0.017 | 0.022 | |
| 02M0307J | 20.0 | 2.20E-14 | 1.8872 | 0.0022 | 0.01237 | 0.00005 | 0.0192 | 0.0003 | 0.0001041 | 0.0000329 | 0.04474 | 0.00116 | 95.89 | 1.8571 | 0.0100 | 6.261 | 0.034 | 0.036 | |
| 02M0307K | 20.0 | 2.45E-14 | 1.9214 | 0.0019 | 0.01239 | 0.00005 | 0.0205 | 0.0001 | 0.0001459 | 0.0000219 | 0.04762 | 0.00097 | 97.45 | 1.8790 | 0.0067 | 6.335 | 0.023 | 0.026 | |
| 02M0307L | 20.0 | 3.69E-14 | 1.9141 | 0.0021 | 0.01250 | 0.00003 | 0.0196 | 0.0001 | 0.0001879 | 0.0000130 | 0.04562 | 0.00096 | 99.75 | 1.8593 | 0.0044 | 6.268 | 0.015 | 0.020 | |
| 02M0307N | 20.0 | 2.30E-14 | 1.8887 | 0.0020 | 0.01235 | 0.00007 | 0.0194 | 0.0002 | 0.0000986 | 0.0000274 | 0.04500 | 0.00099 | 99.44 | 1.8602 | 0.0084 | 6.272 | 0.028 | 0.031 | |
| **VU37: Ifo4** (01M0113/01M0193) J = 0.001807 ± 0.000005 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0193B | 20.0 | 5.08E-14 | 1.9590 | 0.0025 | 0.01224 | 0.00006 | 0.0169 | 0.0022 | 0.0001206 | 0.0000092 | 0.03934 | 0.00558 | 98.20 | 1.9238 | 0.0037 | 6.261 | 0.012 | 0.020 | |
| 01M0193C | 20.0 | 5.62E-14 | 1.9527 | 0.0022 | 0.01216 | 0.00004 | 0.0173 | 0.0028 | 0.0001034 | 0.0000055 | 0.04033 | 0.00686 | 98.46 | 1.9226 | 0.0027 | 6.257 | 0.009 | 0.018 | |
| 01M0193D | 20.0 | 7.00E-14 | 1.9447 | 0.0026 | 0.01215 | 0.00006 | 0.0180 | 0.0025 | 0.0000792 | 0.0000059 | 0.04194 | 0.00617 | 98.82 | 1.9144 | 0.0031 | 6.230 | 0.010 | 0.019 | |
| 01M0193F | 20.0 | 5.65E-14 | 1.9382 | 0.0022 | 0.01215 | 0.00003 | 0.0224 | 0.0021 | 0.0000521 | 0.0000058 | 0.05204 | 0.00561 | 99.25 | 1.9163 | 0.0028 | 6.236 | 0.009 | 0.019 | |
| 01M0113C | 20.0 | 1.03E-13 | 1.9880 | 0.0024 | 0.01211 | 0.00004 | 0.0228 | 0.0009 | 0.0001960 | 0.0000026 | 0.05309 | 0.00323 | 97.13 | 1.9150 | 0.0025 | 6.232 | 0.008 | 0.018 | |
| 01M0113E | 20.0 | 1.43E-13 | 1.9566 | 0.0031 | 0.01247 | 0.00004 | 0.0188 | 0.0005 | 0.0000762 | 0.0000062 | 0.04367 | 0.00238 | 98.88 | 1.9186 | 0.0036 | 6.244 | 0.012 | 0.020 | |
| *01M0193A* | *20.0* | *4.74E-14* | *1.9619* | *0.0023* | *0.01228* | *0.00005* | *0.0223* | *0.0026* | *0.0000527* | *0.0000092* | *0.05189* | *0.00659* | *99.25* | *1.9473* | *0.0035* | *6.337* | *0.012* | *0.020* | *>1.5 nMADs from median age* |
| **VU42: Ifo4** (A20) J = 0.001870 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0308A | 20.0 | 3.08E-14 | 1.9050 | 0.0023 | 0.01230 | 0.00004 | 0.0179 | 0.0001 | 0.0001437 | 0.0000361 | 0.04158 | 0.00088 | 97.80 | 1.8631 | 0.0109 | 6.274 | 0.037 | 0.039 | |
| 02M0308B | 20.0 | 2.16E-14 | 1.8594 | 0.0028 | 0.01235 | 0.00005 | 0.0185 | 0.0004 | 0.0000056 | 0.0000543 | 0.04297 | 0.00126 | 99.94 | 1.8583 | 0.0163 | 6.259 | 0.055 | 0.056 | |
| 02M0308D | 20.0 | 4.34E-14 | 1.8626 | 0.0019 | 0.01233 | 0.00004 | 0.0176 | 0.0001 | 0.0000050 | 0.0000275 | 0.04103 | 0.00088 | 99.95 | 1.8617 | 0.0083 | 6.270 | 0.028 | 0.031 | |
| 02M0308E | 20.0 | 2.16E-14 | 1.9078 | 0.0019 | 0.01255 | 0.00004 | 0.0174 | 0.0002 | 0.0000793 | 0.0000496 | 0.04057 | 0.00093 | 98.80 | 1.8849 | 0.0148 | 6.348 | 0.050 | 0.051 | |
| 02M0308F | 20.0 | 3.81E-14 | 1.9027 | 0.0022 | 0.01247 | 0.00004 | 0.0182 | 0.0002 | 0.0001880 | 0.0000297 | 0.04231 | 0.00099 | 97.11 | 1.8477 | 0.0090 | 6.223 | 0.030 | 0.033 | |
| 02M0308H | 20.0 | 4.34E-14 | 1.8760 | 0.0020 | 0.01230 | 0.00003 | 0.0179 | 0.0002 | 0.0000373 | 0.0000212 | 0.04157 | 0.00090 | 99.44 | 1.8655 | 0.0066 | 6.283 | 0.022 | 0.026 | |
| 02M0308I | 20.0 | 3.22E-14 | 1.8682 | 0.0027 | 0.01237 | 0.00004 | 0.0185 | 0.0002 | 0.0000179 | 0.0000294 | 0.04304 | 0.00093 | 99.75 | 1.8635 | 0.0091 | 6.276 | 0.030 | 0.033 | |
| 02M0308J | 20.0 | 2.43E-14 | 1.8563 | 0.0025 | 0.01238 | 0.00005 | 0.0181 | 0.0002 | 0.0000197 | 0.0000427 | 0.04208 | 0.00096 | 99.72 | 1.8510 | 0.0129 | 6.234 | 0.043 | 0.045 | |
| 02M0308L | 20.0 | 4.58E-14 | 1.9175 | 0.0036 | 0.01262 | 0.00004 | 0.0175 | 0.0001 | 0.0001492 | 0.0000231 | 0.04059 | 0.00085 | 97.73 | 1.8739 | 0.0077 | 6.311 | 0.026 | 0.029 | |
| 02M0308M | 20.0 | 1.85E-14 | 1.9020 | 0.0028 | 0.01265 | 0.00004 | 0.0179 | 0.0002 | 0.0000399 | 0.0000561 | 0.04159 | 0.00101 | 99.41 | 1.8908 | 0.0168 | 6.368 | 0.056 | 0.058 | |
| **VU37: Ifo5** (01M0112) J = 0.001761 ± 0.000005 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0112A | 20.0 | 7.48E-14 | 2.0776 | 0.0023 | 0.01225 | 0.00004 | 0.0218 | 0.0014 | 0.0003944 | 0.0000060 | 0.05071 | 0.00407 | 94.43 | 1.9619 | 0.0028 | 6.222 | 0.009 | 0.018 | |
| 01M0112D | 20.0 | 8.28E-14 | 1.9623 | 0.0021 | 0.01206 | 0.00003 | 0.0166 | 0.0008 | 0.0000713 | 0.0000051 | 0.03851 | 0.00257 | 98.95 | 1.9626 | 0.0026 | 6.224 | 0.008 | 0.018 | |
| 01M0112F | 20.0 | 8.96E-14 | 2.0430 | 0.0022 | 0.01218 | 0.00004 | 0.0198 | 0.0010 | 0.0003620 | 0.0000033 | 0.04615 | 0.00315 | 94.80 | 1.9653 | 0.0023 | 6.233 | 0.007 | 0.018 | |
| 01M0112I | 20.0 | 5.00E-14 | 2.0795 | 0.0024 | 0.01225 | 0.00005 | 0.0185 | 0.0010 | 0.0003695 | 0.0000082 | 0.04303 | 0.00318 | 94.78 | 1.9630 | 0.0034 | 6.226 | 0.011 | 0.019 | |
| 01M0112K | 20.0 | 6.82E-14 | 2.0688 | 0.0024 | 0.01213 | 0.00003 | 0.0210 | 0.0006 | 0.0004304 | 0.0000076 | 0.04883 | 0.00275 | 93.89 | 1.9633 | 0.0033 | 6.227 | 0.010 | 0.019 | |
| 01M0112N | 20.0 | 1.86E-13 | 2.0107 | 0.0022 | 0.01209 | 0.00003 | 0.0190 | 0.0004 | 0.0002242 | 0.0000032 | 0.04410 | 0.00228 | 96.73 | 1.9661 | 0.0023 | 6.235 | 0.007 | 0.018 | |
| **VU42: Ifo5** (A21) J = 0.001869 ± 0.000004 | | | | | | | | | | | | | | | | | | | |
| 02M0309A | 20.0 | 2.00E-14 | 1.8696 | 0.0025 | 0.01258 | 0.00004 | 0.0166 | 0.0004 | 0.0000910 | 0.0000372 | 0.03853 | 0.00117 | 98.58 | 1.8431 | 0.0113 | 6.204 | 0.038 | 0.040 | |
| 02M0309C | 20.0 | 1.17E-14 | 1.8496 | 0.0020 | 0.01212 | 0.00010 | 0.0167 | 0.0005 | 0.0000049 | 0.0000780 | 0.03875 | 0.00135 | 99.95 | 1.8486 | 0.0231 | 6.223 | 0.078 | 0.079 | |
| 02M0309D | 20.0 | 8.83E-15 | 1.8559 | 0.0022 | 0.01219 | 0.00009 | 0.0150 | 0.0003 | 0.0000042 | 0.0000735 | 0.03499 | 0.00100 | 99.95 | 1.8550 | 0.0218 | 6.244 | 0.073 | 0.075 | |
| 02M0309E | 20.0 | 1.72E-14 | 1.8823 | 0.0022 | 0.01243 | 0.00007 | 0.0180 | 0.0002 | 0.0001394 | 0.0000514 | 0.04192 | 0.00094 | 97.84 | 1.8417 | 0.0154 | 6.199 | 0.052 | 0.053 | |
| 02M0309G | 20.0 | 3.37E-14 | 1.8449 | 0.0019 | 0.01216 | 0.00005 | 0.0167 | 0.0001 | 0.0000045 | 0.0000255 | 0.03886 | 0.00083 | 99.95 | 1.8441 | 0.0078 | 6.207 | 0.026 | 0.029 | |
| 02M0309H | 20.0 | 1.86E-14 | 1.9045 | 0.0022 | 0.01214 | 0.00006 | 0.0157 | 0.0003 | 0.0001765 | 0.0000406 | 0.03652 | 0.00096 | 97.28 | 1.8528 | 0.0122 | 6.236 | 0.041 | 0.043 | |
| 02M0309I | 20.0 | 3.94E-14 | 1.8846 | 0.0019 | 0.01213 | 0.00003 | 0.0163 | 0.0001 | 0.0001564 | 0.0000188 | 0.03789 | 0.00079 | 97.57 | 1.8388 | 0.0059 | 6.190 | 0.020 | 0.024 | |
| 02M0309K | 20.0 | 3.29E-14 | 1.8835 | 0.0019 | 0.01216 | 0.00004 | 0.0167 | 0.0001 | 0.0001523 | 0.0000231 | 0.03877 | 0.00082 | 97.63 | 1.8389 | 0.0071 | 6.190 | 0.024 | 0.027 | |
| 02M0309L | 20.0 | 2.88E-14 | 1.8722 | 0.0019 | 0.01216 | 0.00004 | 0.0172 | 0.0001 | 0.0000985 | 0.0000296 | 0.04003 | 0.00083 | 98.47 | 1.8436 | 0.0089 | 6.206 | 0.030 | 0.033 | |
| 02M0309M | 20.0 | 4.38E-14 | 1.8520 | 0.0025 | 0.01215 | 0.00003 | 0.0152 | 0.0002 | 0.0000196 | 0.0000188 | 0.03533 | 0.00079 | 99.70 | 1.8465 | 0.0061 | 6.215 | 0.021 | 0.024 | |
| **VU37: Iza1** (00M0153,01M0190) J = 0.001576 ± 0.000005 (TCR) | | | | | | | | | | | | | | | | | | | |
| 01M0190A | 20.0 | 3.99E-14 | 2.3828 | 0.0030 | 0.01214 | 0.00006 | 0.0200 | 0.0026 | 0.0000464 | 0.0000087 | 0.04655 | 0.00652 | 99.45 | 2.3699 | 0.0040 | 6.726 | 0.011 | 0.019 | |
| 01M0190B | 20.0 | 6.11E-14 | 2.3946 | 0.0027 | 0.01206 | 0.00004 | 0.0155 | 0.0017 | 0.0000896 | 0.0000057 | 0.03605 | 0.00437 | 98.91 | 2.3685 | 0.0032 | 6.722 | 0.009 | 0.018 | |
| 01M0190E | 20.0 | 1.22E-13 | 2.3986 | 0.0032 | 0.01211 | 0.00003 | 0.0176 | 0.0010 | 0.0001448 | 0.0000044 | 0.04093 | 0.00308 | 98.24 | 2.3698 | 0.0034 | 6.725 | 0.010 | 0.018 | |
| 01M0190F | 20.0 | 5.30E-14 | 2.3760 | 0.0029 | 0.01225 | 0.00005 | 0.0112 | 0.0021 | 0.0001087 | 0.0000056 | 0.02604 | 0.00510 | 98.65 | 2.3722 | 0.0034 | 6.732 | 0.010 | 0.018 | |
| 01M0190G | 20.0 | 1.17E-13 | 2.4147 | 0.0032 | 0.01227 | 0.00003 | 0.0224 | 0.0010 | 0.0002384 | 0.0000042 | 0.05217 | 0.00357 | 97.12 | 2.3734 | 0.0034 | 6.736 | 0.010 | 0.018 | |
| 01M0190I | 20.0 | 3.28E-14 | 2.3754 | 0.0029 | 0.01220 | 0.00007 | 0.0249 | 0.0040 | 0.0000465 | 0.0000089 | 0.05799 | 0.00978 | 99.47 | 2.3762 | 0.0039 | 6.744 | 0.011 | 0.019 | |
| 00M0153A | 20.0 | 3.79E-15 | 10.6057 | 0.0275 | 0.69504 | 0.01372 | 1.5984 | 0.0125 | 0.0285710 | 0.0007479 | 3.72334 | 0.06256 | 21.48 | 2.3929 | 0.2316 | 6.791 | 0.656 | 0.656 | *$^{40}Ar^{*}$ < 50%* |
| 00M0153B | 20.0 | 2.15E-15 | 3.0538 | 0.0058 | 0.00967 | 0.00064 | 2.3862 | 0.0134 | 0.0026186 | 0.0001042 | 5.56139 | 0.08840 | 80.70 | 2.5906 | 0.0329 | 7.351 | 0.093 | 0.095 | *>1.5 nMADs from median age* |
| 00M0153C | 20.0 | 2.31E-15 | 2.3412 | 0.0043 | 0.01019 | 0.00053 | 0.0186 | 0.0004 | 0.0001226 | 0.0000590 | 0.04321 | 0.00114 | 98.48 | 2.4196 | 0.0188 | 6.866 | 0.053 | 0.056 | *>1.5 nMADs from median age* |
| 00M0153E | 20.0 | 5.75E-15 | 2.4990 | 0.0049 | 0.01228 | 0.00024 | 0.0174 | 0.0002 | 0.0006450 | 0.0000189 | 0.04044 | 0.00070 | 92.38 | 2.4230 | 0.0075 | 6.876 | 0.021 | 0.027 | *>1.5 nMADs from median age* |
| 01M0190C | 20.0 | 5.54E-14 | 2.4334 | 0.0031 | 0.01233 | 0.00006 | 0.0121 | 0.0030 | 0.0000860 | 0.0000052 | 0.02824 | 0.00712 | 98.96 | 2.4371 | 0.0034 | 6.916 | 0.010 | 0.019 | *>1.5 nMADs from median age* |

Isotope ratios are corrected for mass discrimination, blank values and radio-active decay

**Age and error equations for astronomically calibrated standard**

$$T_{FC} = \frac{1}{\lambda} \times \ln\left[\left(e^{\lambda t_{astro}} - 1\right) \times R^{FC}_{astro} + 1\right] = \frac{1}{\lambda} \times \ln\left[X\right] \qquad \text{[equation 5 in (}S1\text{)]}$$

$$\sigma_{T_{FC}} = \sqrt{\left(\frac{\partial T_{FC}}{\partial \lambda}\right)^2 \times \sigma^2_{\lambda} + \left(\frac{\partial T_{FC}}{\partial t_{astro}}\right)^2 \times \sigma^2_{T_{astro}} + \left(\frac{\partial T_{FC}}{\partial R^{FC}_{astro}}\right)^2 \times \sigma^2_{R^{FC}_{astro}}}$$

with

$$\frac{\partial T_{FC}}{\partial \lambda} = \frac{-1}{\lambda^2} \times \ln\left[X\right] + \frac{R^{FC}_{astro} \times t_{astro} \times e^{\lambda t_{astro}}}{\lambda \times X}$$

$$\frac{\partial T_{FC}}{\partial t_{astro}} = \frac{R^{FC}_{astro} \times e^{\lambda t_{astro}}}{X}$$

$$\frac{\partial T_{FC}}{\partial R^{FC}_{astro}} = \frac{\left(e^{\lambda t_{astro}} - 1\right)}{\lambda \times X}$$

$\lambda = (5.463 \pm 0.107) \times 10^{-10}$
[decay constant, note that this not the value used by convention, but the value of (*S9*)]

$t_{astro} = 6.500 \pm 0.005) \times 10^6$ yr
[astronomical age]

$R^{FC}_{astro} = 4.3664 \pm 0.0009$
[intercalibration factor between FCs and Melilla tephra, see caption Fig. 2]

Above values yield 28.201 ± 0.023 Ma for FCs (1 sigma), or 28.201 ± 0.046 Ma (2 sigma)

Note that the error increases to ± 0.044 Ma and ± 0.087 Ma for respectively an uncertainty of ± 10 kyr and ± 20 kyr in the astronomical age (all 1 sigma).

## Table S3 Published $^{40}Ar/^{39}Ar$ data for Matuyama-Bruhnes reversal

Dates are reported as in the original publication along with the standard, standard age, dated material and analytical methods. To allow direct comparison all data are recalculated to the astronomically calibrated FCs age of 28.201 ± 0.046 Ma (this study). Not all studies report their data relative to FCs. Those data are converted to FCs ages using the following intercalibration factors: $R^{FC}_{TC}$ 0.9889 ± 0.0020 (*S1*); $R^{FC}_{AC}$ 23.646 ± 0.068 (*S1*); $R^{FC}_{SB\text{-}3}$ 0.1626 [calculated with FC 27.51 Ma and SB-3 162.9 Ma (*S10*)], $R^{FC}_{FCT\text{-}3biotite}$ 0.9950 ± 0.0168 (*S11*) and $R^{FC}_{Be4\text{-}biotite} = R^{FC}_{SB\text{-}3} \times R^{SB\text{-}3}_{Be4\text{-}biotite} = 0.1626 \times 9.8588 = 1.6031$ [with Be4-biotite 17.25 Ma relative to 162.9 SB-3 biotite (*S12*)]. Total external uncertainties at the 95% confidence level are reported for recalculated ages. For $R^{FC}_{SB\text{-}3}$ and $R^{FC}_{Be4\text{-}biotite}$ uncertainties are not given and are excluded in uncertainties in recalculated ages. The astronomical age for this boundary is 781 kyr (*S13*).

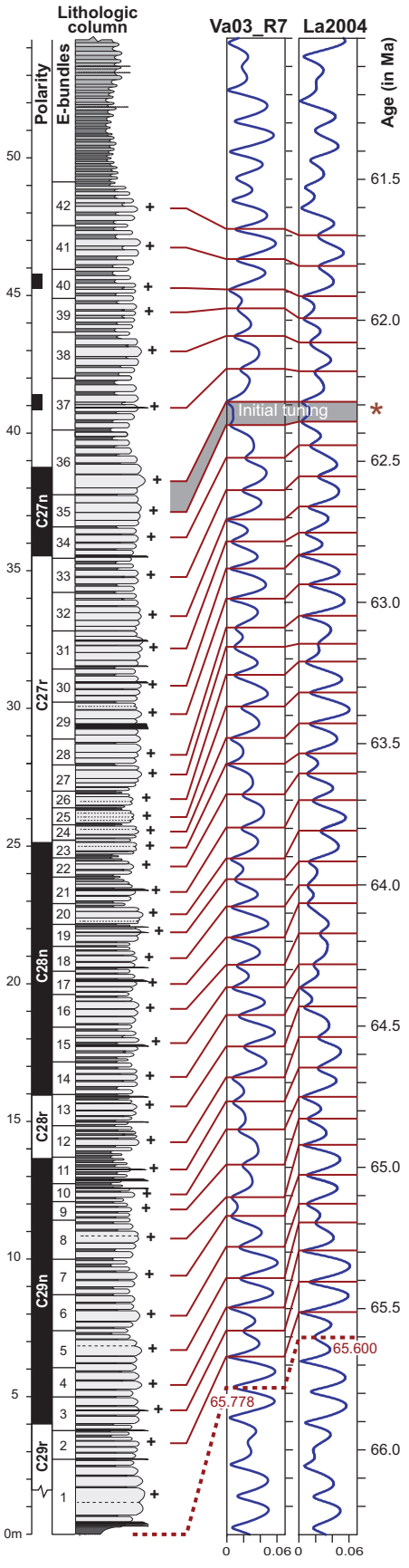
| Publi-cation | Age (ka) | Material | Standard | Method* | Age relative to FCs 28.201 Ma (in ka) |
|---|---|---|---|---|---|
| **$^{40}Ar/^{39}Ar$ dating on lava flows with transitional polarity assuming to be the MB boundary** | | | | | |
| (***S14***) | 783 ± 16 | whole rock of 3 flows, Maui, Hawaii | FCT3 biotite 27.95 Ma rel. to SB3-bio 162.9 | wm of 3 isochron ages | 794 ± 16 |
| (***S15***) | 775.6 ± 2.0 | whole rock and groundmass of 6 flows, Maui, Hawai | TCs 28.34 / ACs 1.194 | wm of 6 isochron ages, 20 experiments | 780 ± 2 |
| (***S16***) | 798.4 ± 12.4 | groundmass of 3 flows, La Palma | ACs 1.194 | wm of 3 isochron ages, 14 experiments + isochron age La Palma flow (*S17*) | 803 ± 12 |
| (***S17***) | 778.7 ± 3.8 | plagioclase, groundmass and whole rock of 8 flows, on Maui, Tahiti, Chili and La Palma | TCs 27.92 | wm of 8 isochron ages | 795 ± 4 |
| (***S18***)† | 791.7 ± 3.0 | whole rock of 9 flows, Chili | TCs 28.34 / ACs 1.194 | wm of 9 isochron ages, 22 experiments | 797 ± 4 |
| **$^{40}Ar/^{39}Ar$ dating on volcanic domes with slightly below the MB boundary (reversed polarity)** | | | | | |
| (***S19***) | 793 ± 18 | sanidine of Cerro Santa Rosa II dome, Jemez Mountains, New Mexico | FCs 27.55 / TCs 27.92 both rel. to MMhb-1 513.9 | wm of 4 multigrain laser fusions | 812 ± 18 |
| (***S19***) | 812 ± 24 | sanidine of Cerro San Luis dome, Jemez Mountains, New Mexico | FCs 27.55 / TCs 27.92 both rel. to MMhb-1 513.9 | wm of 9 multigrain laser fusions | 831 ± 24 |
| (***S19***) | 794 ± 8 | sanidine of Serro Seco dome, Jemez Mountains, New Mexico | FCs 27.55 / TCs 27.92 both rel. to MMhb-1 513.9 | wm of multigrain 4 laser fusions | 813 ± 8 |
| (***S20***) | 787 ± 30 | sanidine of Santa Rosa II dome, Valles caldera, New Mexico | FCT-3s 27.9 | isochron age of 8 single crystal laser fusions | 795 ± 30 |
| (***S20***) | 800 ± 6 | sanidine of San Luis dome, Valles caldera, New Mexico | FCT-3s 27.9 | isochron age of 11 single crystal laser fusions | 809 ± 6 |
| (***S20***) | 800 ± 14 | sanidine of Seco dome, Valles caldera, New Mexico | FCT-3s 27.9 | isochron age of 14 single crystal laser fusions | 809 ± 14 |
| **$^{40}Ar/^{39}Ar$ dating on volcanic layers bracketing the MB boundary** | | | | | |
| (***S19***) | 789 ± 6 | Sanidine of Oldest Toba Tuff, Sumatra (reversed polarity) | FCs 27.55 / TCs 27.92 both rel. to MMhb-1 513.9 | wm of multigrain laser fusion (n=4) | 808 ± 6 |
| (***S21***) | > 747 ± 12 | anorthoclase of airfall ash, Olorgesaillie Fm, Kenya (in normal polarity interval) | FCs 27.84 | isochron age of 12 single crystal anorthoclase laser fusions | > 757 ± 12 |
| (***S22***) | 791 ± 40 | biotite of ash-D ODP site 758 (ash D = 5 cm below MBB) | FCT-3 biotite 27.99 | wm of 4 multigrain laser fusions: 800 ± 20 ka for ash-D. Age for MB by linear interpolation of sedimentation rate | 801 ± 40 |
| (***S19***) | 772 ± 4 | sanidine of pumice of upper unit and basal airfall unit Bishop Tuff | FCs 27.55 & TCs 27.92 both rel. to MMhb-1 513.9 | wm of 23 multigrain laser fusions: 760 ± 2 ka. Age for MB by adding 12 kyr based on linear interpolation of sedimentation rate | 790 ± 4 |
| (***S23***) | 774.2 ± 3.6 | sanidine of air fall pumice and ash flow of Bishop Tuff | TCs 27.92 Ma rel. to MMhb-1 513.9 | wm of 69 single crystal laser fusions: 758.9 ± 1.8 ka. Age for MB by adding 15.3 (± 2.2) kyr based on linear interpolation of sedimentation rate | 791 ± 4 |

* wm = weighted mean; † Authors indicate that they probably dated a MB precursor.

## Astronomical tuning of the K-T boundary (figs. S2, S3a-c, S4)

**Figure S2: Original tuning of (*S24*) to the eccentricity time series of the Va03_R7 (*S25*) solution.**

Dinares-Turell et al. (*S24*) using the lithological expression of a 2.4 Myr eccentricity minimum (marked by * around 62 Ma) in their cycle bundles 35-36 as starting point for the tuning. This tuning was extended by matching successive 100-kyr limestone beds to successive 100-kyr eccentricity minima arriving at an K-T boundary age of ~65.8 Ma. The eccentricity time series of the La2004 solution (*S26*) and corresponding tuning are added for comparison following the same approach with limestone beds 35-36 as starting point and extending the tuning by matching successive 100-kyr limestone beds to successive 100-kyr eccentricity minima now arriving at an K-T boundary age of ~65.6 Ma. Numbers indicated in the column left of the lithological column denote the successive prominent ~100 kyr eccentricity related cycles of (*S24*) with limestone beds tuned to eccentricity minima in the middle. Note that the position of the boundaries of the 100-kyr cycles differ slightly from the positions indicated in (*S24*). Crosses to the right of the lithological column mark mid-points of limestone dominated parts of the 100-kyr cycle that correlate with 100-kyr eccentricity minima. The boundaries between the cycles represent mid-points of the more marly intervals of the 100-kyr cycle that correlate with 100-kyr eccentricity maxima. The magnetostratigraphy ranges from top C29r into C27r. Partially filled black shading denotes two short intervals of normal polarities above C27n, which may represent cryptochrons *(S24)*. The K-T boundary is located at 0 m at the base of this part of the section.



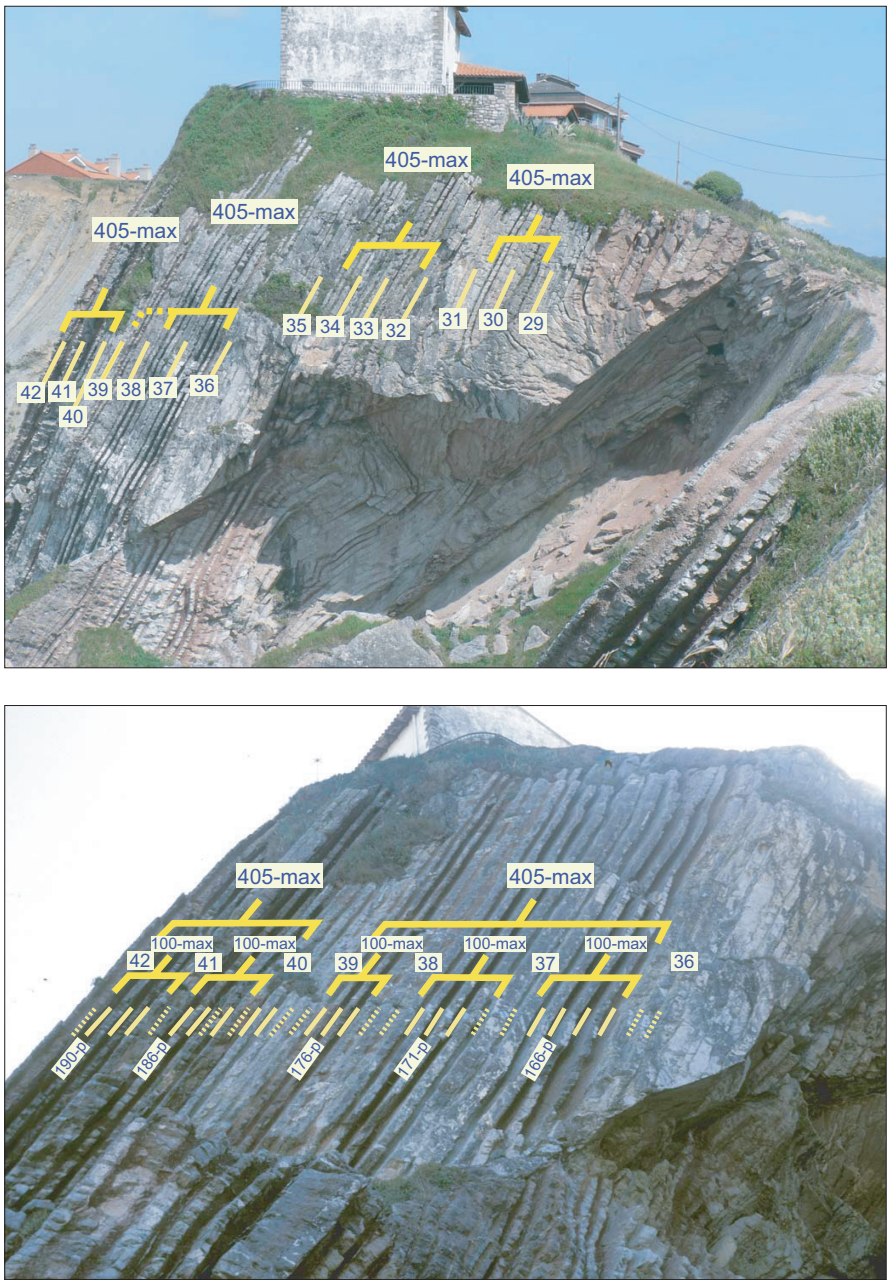



**Figure S3a. Upper part of the Zumaia section of (*S24*) below the San Telmo chapel.**

In the upper photograph, both 100-kyr limestone beds 29 to 42 of (*S24*) and large scale clusters of precession-related basic cycles that mark successive 405-kyr eccentricity maxima have been indicated. Lower photograph shows the detailed pattern of the precession-related basic cycles (limestone-marl couplet) in the interval that ranges from 100-kyr limestone bed 36 to bed 42. Solid lines mark distinct to prominent marlbeds of the individual precession related cycles, dashed lines mark less distinct to vague marlbeds. Precession cycle numbers (with a -p) correspond to number as in (*S24*). The phase relations with the 100- and 405-kyr eccentricity cycles have also been indicated (see also caption to Fig. S4).

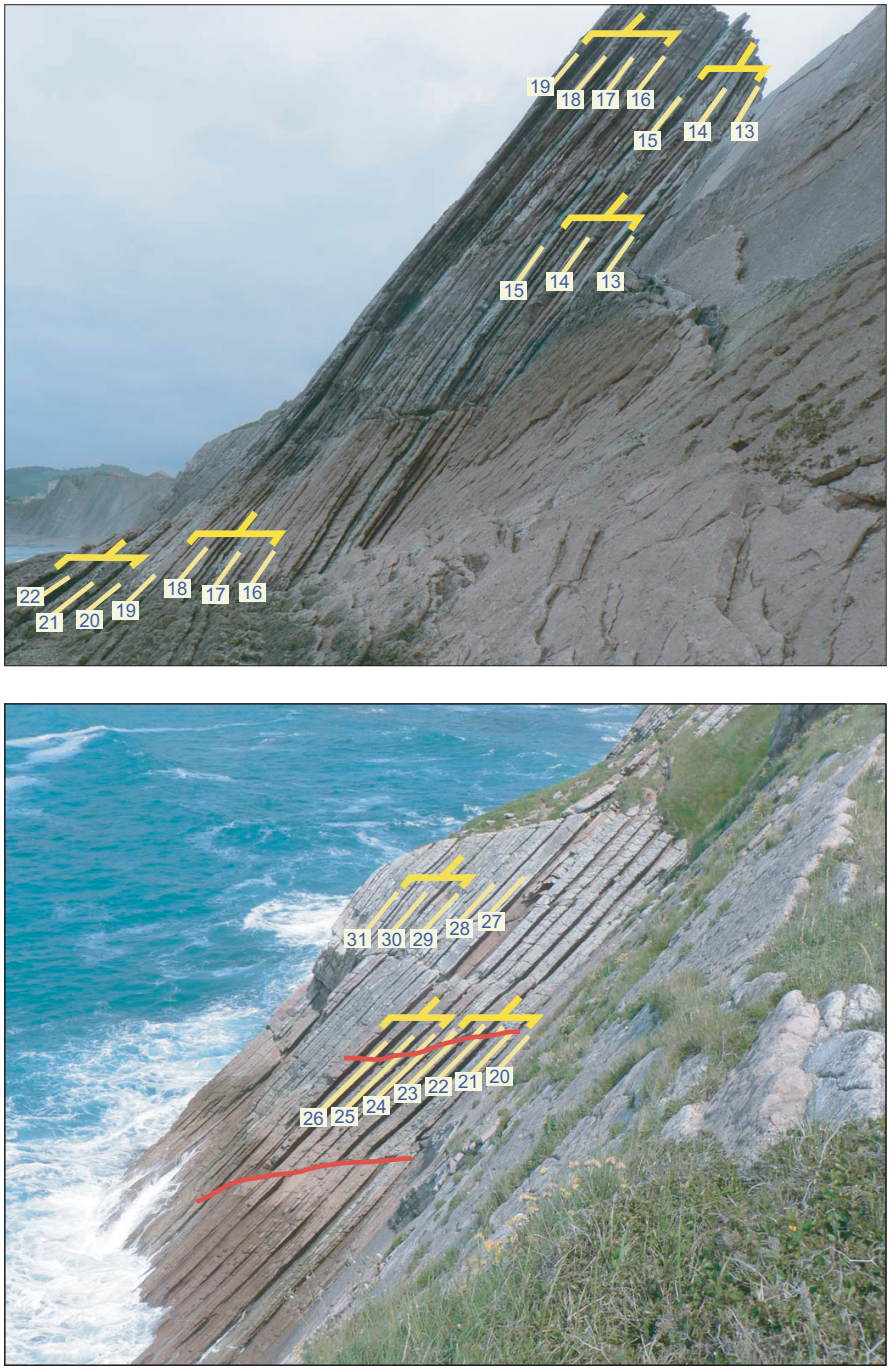



**Figure S3b. Middle part of the Zumaia section of (*S24*).**

The lower photograph shows the interval ranging from 100-kyr limestone bed 21 to 31 of (*S24*), with a stratigraphic overlap with the upper part of the section shown in Fig. S3a. Also shown are clusters of well-developed 100-kyr marl beds that mark successive 405-kyr eccentricity maxima. Upper photograph shows the interval ranging from 100-kyr limestone bed 13 to 22 of (*S24*) and the clustering of intervals with well-developed marly layers that mark successive 405-kyr eccentricity maxima. Red lines mark small faults.

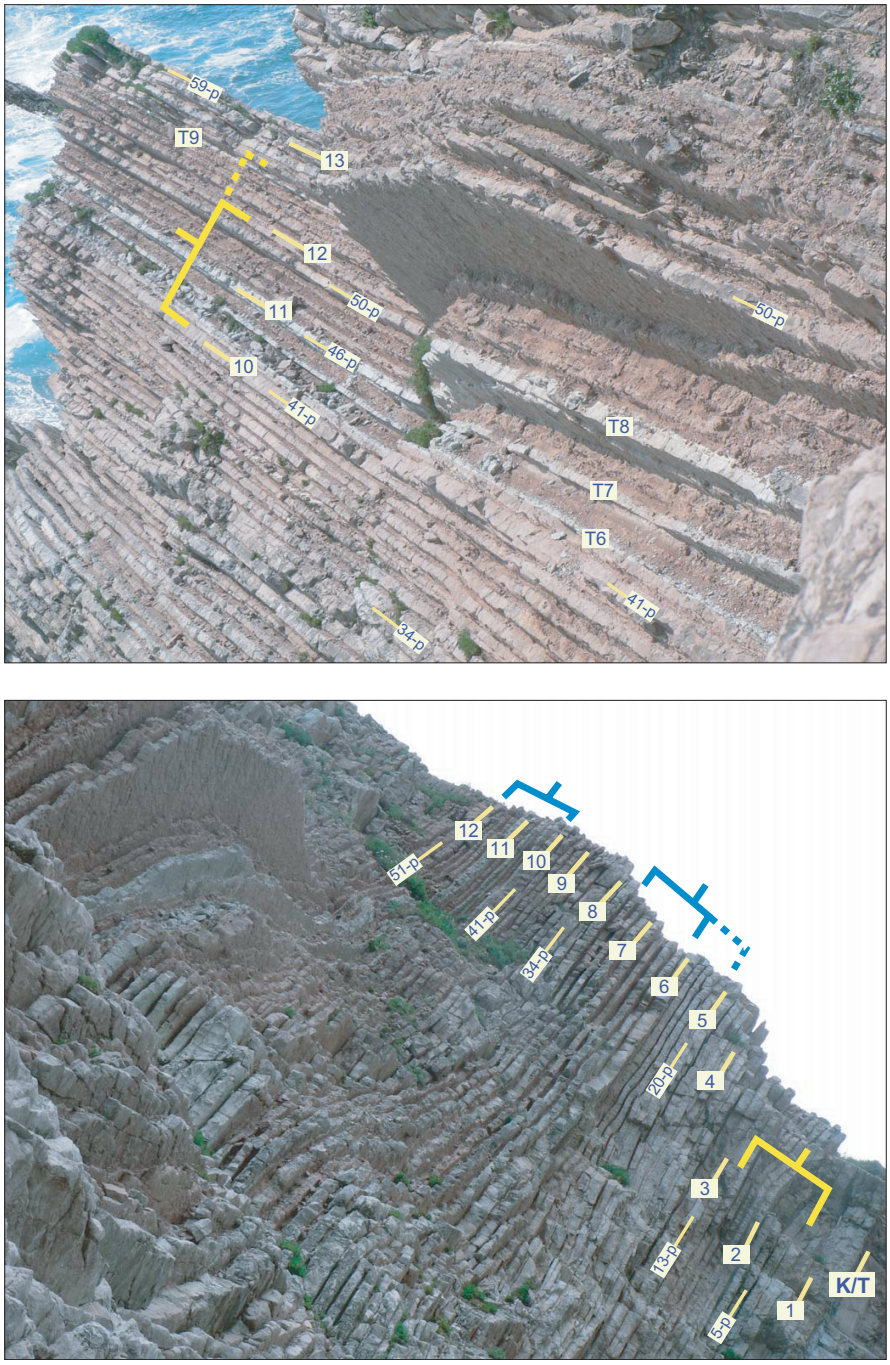
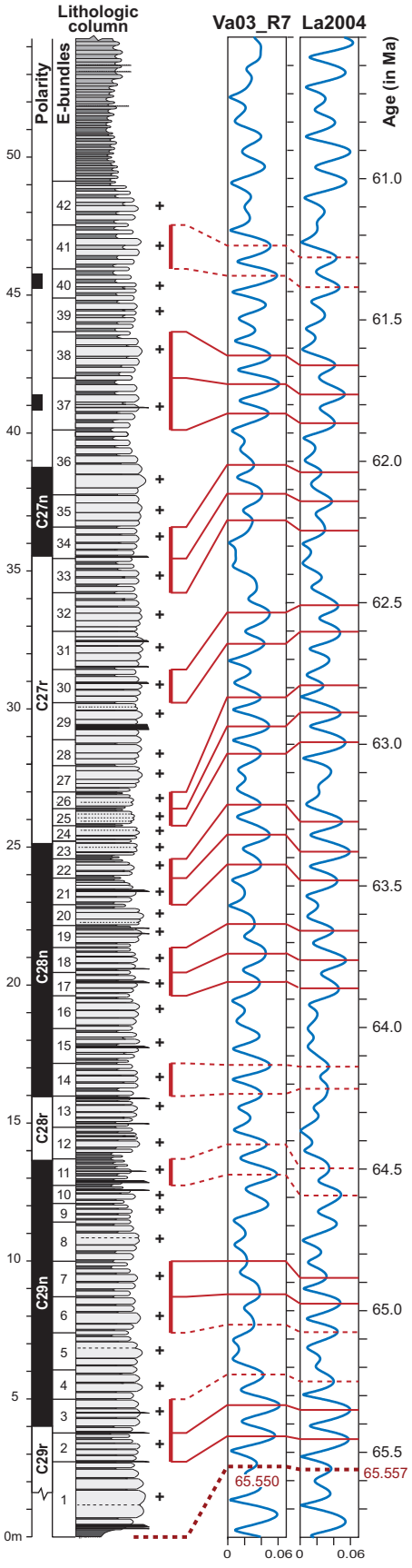



**Figure S3c. Lower part of the Zumaia section of (*S24*) as exposed on the SW side of the Aitzgorri headland.** The upper photograph shows the interval ranging from 100-kyr limestone bed 10 to 13 of (*S24*). Also shown is the cluster of well-developed marly layers between 100-kyr limestone beds 10 and 12 (or 13) that corresponds to a single 405-kyr eccentricity maximum. Patterns are less obvious due to the intercalation of several turbidites (T6-9). Lower photograph shows the interval ranging from the K-T boundary up to the 100-kyr limestone bed 12 of (*S24*) and the clustering of intervals with well-developed marly layers that corresponds to successive 405-kyr maxima. On both photographs, numbers of some characteristic precession-related cycles of (*S24*) are indicated (with a –p).

**Figure S4: Alternative option to tune the large scale cycles one 405 kyr eccentricity cycle younger.**

This revised tuning is consistent with ~65.56 Ma for the K-T boundary, which can be converted to ~28.02-28.09 Ma for FCs using the data of (*S27-S29*) and is more in agreement with the commonly used age of 28.02 Ma (*S1*) adopted in GTS2004 (*S13*). Note however, that the absolute uncertainty in $^{40}Ar/^{39}Ar$ ages calculated with 28.02 ± 0.28 Ma is too large to pinpoint the correct 405 kyr eccentricity maximum when all uncertainties are included and is therefore within error consistent with an astronomically tuned age of ~65.95 Ma for the K-T boundary (Fig. 4). Tuning one 405 kyr cycle older than our preferred tuning shown in Fig. 4 yields a K-T boundary age of ~66.43 Ma which converts to ~28.38-28.46 Ma for FCs, coincidently equivalent to the U/Pb age of FC zircon and titanite of (*S30*). See further also captions to figs. 4 and S2.



## Chixculub impact crater and K-T boundary event

We are aware of the existing and ongoing controversy about relating the Chixculub impact crater to the K-T boundary event. Keller et al. (*S31*) argue that the Chixculub impact predates the K-T boundary by ~300,000 years, based among others on the presence of alleged planktonic foraminifera of late Maastrichtian age in a 0.5 meter thick laminated limestone between the suevite impact breccia and the K-T boundary in Core Yaxcopoil-1 drilled in the Chixculub structure and the occurrence of multiple tektite layers below the K-T boundary in sections around the Gulf of Mexico. These layers as well as younger tektite layers of Danian age have been interpreted as reworked material from the oldest tektite layer which is supposedly associated with the Chixculub impact, although an additional tektite-producing event is not completely excluded. Smit (*S32*) opts for a single impact at the K-T boundary arguing that the multiple tektite layers and the sandstone bed ("event deposit") result from tidal waves generated by the impact. He further mentions the single "dual layer" of impact ejecta observed in continental sections further north in the US and Canada as argument for his scenario; moreover the most complete marine sections do not reveal evidence for a multiple impact history. Evidently this ongoing discussion has consequences for our use of $^{40}Ar/^{39}Ar$ ages from the K-T boundary interval which come both from tektites (Beloc, Haïti), glassy impact melt (Chixculub crater) and from ash layers that closely coincide with the K-T boundary in continental sections in North America.

We therefore preferred to use only single sanidine ages using FCs as main neutron fluence monitor from the Ir-Z and Z-coal bentonites closely associated with the K-T boundary to arrive at an astronomically calibrated $^{40}Ar/^{39}Ar$ age between 65.84 – 65.99 Ma for the boundary (table S4; the limited number of replicate analyses in Izett et al. (*S27*) are ignored). Note however that the $^{40}Ar/^{39}Ar$ ages of the tektites and Chixculub impact melt (table S4) do not reveal unequivocal differences with this age of the K-T boundary while, according to Keller et al. (*S31*), the tektites and impact melt should be ~300,000 year older. The fact that these ages are certainly not 300,000 years older than the continental sanidine ages (in spite of some minor discrepancies) actually seems to favour the single event scenario advocated by Smit (*S32*).

**Table S4: Details on published $^{40}Ar/^{39}Ar$ data of K-T boundary(*S27-S29, S33*).**

In bold are the ages regarded as best age estimates in original publications. All ages are recalcuted to the astronomically calibrated age of 28.201 ± 0.046 Ma for FCs and full absolute errors are given. The K-T boundary as defined in the Western Interior continental sections in northern America is located at the base of lignite or coal beds including IrZ –and Z-coal.

| Sample | Method | Standard and standard age (Ma) | Age (in Ma; ± 2SE) | Age (in Ma; ± 2SE); FCs = 28.201 Ma |
|---|---|---|---|---|
| **Izett et al., 1991** | | | | |
| Beloc tektite, Haiti | weighted mean of 23 total fusion on single tektites | MMhb-1 513.9 / TCR 27.92 / FCT 27.55 | **64.48 ± 0.16** | **65.98 ± 0.20** |
| Beloc tektite, Haiti | weighted mean age of 4 incremental heating experiments on single tektites | MMhb-1 513.9 / TCR 27.92 / FCT 27.55 | 64.38 ± 0.36 | 65.88 ± 0.38 |
| Beloc tektite, Haiti | 1 bulk incremental heating experiment with furnace | MMhb-1 520.4 / TCR 28.20 / FCT 27.80 | 64.8 ± 1.4 | 65.7 ± 1.4 |
| HC bentonite in Z-coal, Hell Creek Montana - sanidine | weighted mean of 3 single total fusions | MMhb-1 513.9 / TCR 27.92 / FCT 27.55 | 64.57 ± 0.46 | 66.07 ± 0.48 |
| **Swisher et al., 1992** | | | | |
| C1 glassy melt rock of Chicxulub crater | weighted mean age of 3 plateau ages on glassy (andesitic) rock chips | FCT 27.84 | **64.98 ± 0.10** | **65.81 ± 0.14** |
| Beloc tektites (between levels f and g), Haiti | weighted mean age of 5 plateau ages on single tektites (4 tektites did not yield well-defined plateaus) | FCT 27.84 | 65.01 ± 0.16 | 65.84 ± 0.18 |
| Beloc and Arroyo el Mimbral microtektites | weighted mean of 3 Beloc and 2 Mimbral total fusion on single tektites | FCT 27.84 | 65.07 ± 0.20 | 65.90 ± 0.22 |
| **Swisher et al., 1993** | | | | |
| IrZ-coal bentonite - sanidine | weighted mean age of 9 single fusions | FCT 27.84 | **65.16 ± 0.08** | **65.99 ± 0.12** |
| IrZ-coal bentonite - plagioclase | weighted mean age of 4 single fusions | FCT 27.84 | 65.16 ± 0.78 | 65.99 ± 0.78 |
| Z-coal at McGuire Creek - sanidine | weighted mean age of 20 single fusions | FCT 27.84 | 65.03 ± 0.08 | 65.86 ± 0.12 |
| Z-coal at Hell Creek State Park Access Road - sanidine | weighted mean age of 13 single fusions | FCT 27.84 | 64.96 ± 0.10 | 65.79 ± 0.14 |
| Z-coal combined | weighted mean age of 33 single fusions | FCT 27.84 | **65.01 ± 0.06** | **65.84 ± 0.12** |
| **Dalrymple et al., 1993** | | | | |
| Beloc tektites | weighted mean of 52 total fusion on single tektites in several irradiations (of which 23 in Izett et al., 1991) | MMhb-1 513.9 / TCR 27.92 / FCT 27.55 | 64.42 ± 0.14 | 65.92 ± 0.18 |
| Z-coal bentonite - sanidine | weighted mean of 28 single total fusions in several irradiations (of which 3 in Izett et al., 1991) | MMhb-1 513.9 / TCR 27.92 / FCT 27.55 | 64.77 ± 0.14 | 66.28 ± 0.16 |
| Z-coal bentonite - sanidine | weighted mean of 25 single total fusions in several irradiations with TCR as standard | TCR 27.92 | 64.80 ± 0.16 | 66.18 ± 0.`16* |

*recalculated relative to TCR 28.523 Ma using FC 28.201 Ma and the $R^{FC}_{TCR}$ of Renne et al. (*S1*).

**References in Supporting Online Material**


S1. P. R. Renne *et al.*, *Chemical Geology* **145**, 117-152 (1998).
S2. R. H. Steiger, E. Jäger, *Earth and Planetary Science Letters* **36**, 359 (1977).
S3. J. R. Wijbrans, M. S. Pringle, A. A. P. Koppers, R. Scheveers, *Proc. Kon. Ned. Akad, v, Wetensch.* **98**, 185 (1995).
S4. K. F. Kuiper, F. J. Hilgen, J. Steenbrink, J. R. Wijbrans, *Earth and Planetary Science Letters* **222**, 583 (2004).
S5. A. A. P. Koppers, *Computers & Geosciences* **28**, 605 (2002).
S6. K. J. Cunningham, R. H. Benson, K. Rakic-El Bied, L. W. McKenna, *Sedimentary Geology* **107**, 147 (1997).
S7. P. Münch *et al.*, *International Journal of Earth Sciences* **95**, 491 (2006).
S8. S. Roger *et al.*, *Earth and Planetary Science Letters* **179**, 101 (2000).
S9. K. W. Min, R. Mundil, P. R. Renne, K. R. Ludwig, *Geochimica Et Cosmochimica Acta* **64**, 73 (2000).
S10. M. A. Lanphere, H. Baadsgaard, *Chemical Geology* **175**, 653 (2001).
S11. A. Dazé, J. K. W. Lee, M. Villeneuve, *Chemical Geology* **199**, 111 (2003).
S12. A. K. Baksi, D. A. Archibald, E. Farrar, *Chemical Geology* **129**, 307 (1996).
S13. F. M. Gradstein, J. G. Ogg, A. G. Smith, *A Geologic Time Scale 2004*, Cambridge University Press (2004), 589 pp.
S14. A. K. Baksi, V. Hsu, M. O. McWilliams, E. Farrar, *Science* **256**, 356 (1992).
S15. R. S. Coe, B. S. Singer, M. S. Pringle, X. X. Zhao, *Earth and Planetary Science Letters* **222**, 667 (2004).
S16. B. S. Singer *et al.*, *Journal of Geophysical Research-Solid Earth* **107** (2002).
S17. B. S. Singer, M. S. Pringle, *Earth and Planetary Science Letters* **139,** 47 (1996).
S18. L. L. Brown, B. S. Singer, J. C. Pickens, B. R. Jicha, *Journal of Geophysical Research-Solid Earth* **109** (2004).
S19. G. A. Izett, J. D. Obradovich, *Journal of Geophysical Research* **99**, 2925 (1994).
S20. T. L. Spell, I. McDougall, *Geophysical Research Letters* **19**, 1181 (1992).
S21. L. Tauxe, A. D. Deino, A. K. Behrensmeyer, R. Potts, *Earth and Planetary Science Letters* **109**, 561-572 (1992).
S22. C. M. Hall, J. W. Farrell, *Earth and Planetary Science Letters* **133**, 327-338 (1995).
S23. A. M. Sarna-Wojcicki, M. S. Pringle, J. Wijbrans, *Journal of Geophysical Research* **105**, 211,431-21,443 (2000).
S24. J. Dinares-Turell *et al.*, *Earth and Planetary Science Letters* **216**, 483 (2003).
S25. F. Varadi, B. Runnegar, M. Ghil, *Astrophysical Journal* **592**, 620 (2003).
S26. J. Laskar *et al.*, *Astronomy & Astrophysics* **428**, 261 (2004).
S27. G. A. Izett, G. B. Dalrymple, L. W. Snee, *Science* **252**, 1539 (1991).
S28. C. C. Swisher, L. Dingus, R. F. Butler, *Canadian Journal of Earth Sciences* **30**, 1981 (1993).
S29. C. C. Swisher III *et al.*, *Science* **257**, 954 (1992).
S30. M. D. Schmitz, S. A. Bowring, *Geochimica Et Cosmochimica Acta* **65**, 2571 (2001).
S31. G. Keller *et al.*, *Earth and Planetary Science Letters* **255**, 339 (2007).
S32. J. Smit, *Annual Review of Earth and Planetary Sciences* **27**, 75 (1999).
S33. G. B. Dalrymple, G. A. Izett, L. W. Snee, J. D. Obradovich, $^{40}Ar/^{39}Ar$ age spectra and total-fusion ages of tektites from Cretaceous-Tertiary boundary sedimentary rocks in the Beloc Formation, Haiti, *U. S. Geological Survey Bulletin* (U. S. Geological Survey, Reston, VA, United States, 1993).

**Supporting Online Material**
ww.sciencemag.org
Materials and Methods
Age and error equations
Text on Chixculub impact and K-T boundary controversy
Tables S1, S2, S3, S4
Figs. S1, S2, S3, S4