Geological Magazine

Supplementary Material – Origin and tectonic evolution of the north-east basement of Oman – a window into the Neoproterozoic accretionary growth of India?

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**Supplementary Material**

# **Mineral Abbreviations**

bi, biotite; chl, chlorite; cpx, clinopyroxene; ep, epidote; grt, garnet; hbl, hornblende; ilm, ilmenite; kfs, K-feldspar; ms, muscovite; mt, magnetite; pl, plagioclase; py, pyrite; qtz, quartz; sil, sillimanite; st, staurolite; ttn, titanite

## **S1. Lithology Descriptions**

## **S1.a. Al Wafi Mica Schist**

Samples from the metapelitic Al Wafi Schist (JA15-04, JA15-43) were used for phase equilibria modelling, JA15-06 was not modelled but is part of the Al Wafi Schist and was also analysed. The samples observed contain quartz, plagioclase, biotite, muscovite and sillimanite with minor ilmenite, magnetite and chlorite. Sample JA15-06 also contains minor staurolite within the matrix. In all samples fine-grained (0.1–0.4 mm) biotite, muscovite and sillimanite define a pervasive fabric that wraps around quartz and feldspar grains, in addition to larger grains (1 mm) of muscovite. Muscovite that defines the fabric can be observed as aggregates of many fine muscovite grains which often resemble larger grains of muscovite, and are interpreted to have formed from the breakdown of these larger grains. Biotite, muscovite and sillimanite are able to be observed to be in direct contact with quartz. Inclusions of biotite in quartz and inclusions of quartz within biotite are additionally observed within this sample. Sillimanite is in contact with both quartz and fine-grained, fabric-defining muscovite. Chlorite is in visible contact with both larger grained (0.5–1.0 mm) biotite and muscovite. The part of the interpreted peak mineral assemblage common to all three samples is quartz–plagioclase–muscovite–sillimanite–biotite–ilmenite–magnetite. In sample JA15-43 garnet is additionally included in the peak assemblage. Similarly, staurolite is additionally included in the peak assemblage of sample JA15-06. Post-peak metamorphism in each sample is restricted, separation of biotite and muscovite by fine grained (0.1–0.3 mm) chlorite is observed within each sample, and is interpreted as retrograde alteration.

**S1.b. Ja’alan Gneiss and related minor lithologies**

The Ja’alan Gneiss is an orthogneiss consisting of fine to medium grained biotite, muscovite, quartz, plagioclase, sillimanite, ilmenite and K-feldspar. Coarse sized grains of quartz can also be observed within this lithology. Both the Ja’alan Gneiss and Al Wafi Schist show evidence for partial melting having occurred, albeit in small areas. Small lenses of other lithologies can be observed within the Ja’alan Gneiss, the first of which being a titanite, biotite, sillimanite, staurolite ± muscovite schist observed in the south of the study area. The second of these units found within the Ja’alan Gneiss is a para-amphibolite, observed in both the south and east of the northern study area.

**S1.c. Ja’alan Granite and Hornblendite**

Jebel Ja’alan hosts a pervasive granitic pluton, called the Ja’alan Granite, which dominates the southern flank of the mountain, and is observed throughout much of the northern flank. Its mineralogy consists of quartz, plagioclase, K-feldspar and garnet with occurrences of muscovite and biotite. Most outcrops were calcic though there were occurrences of more potassic granite. Petrographic analysis of a sample from the Ja’alan granite revealed titanite, quartz, microcline, plagioclase, hornblende, zircon, and chlorite replacing amphibole and notably very little mica, suggesting that it is an I-type granite. Hornblendite was observed as a mafic intrusion within the granite, observed to reach 10 m in width. The observed mineralogy consisted of hornblende, plagioclase, quartz and ± pyroxene. Satellite photo interpretation revealed the hornblendite to be the dominant lithology in the south of the southern mapping area. The outcrops investigated provided little information regarding the relationship of the Hornblendite to the other intrusions in Jebel Ja’alan, and thus little can be said in about the relative timing of this lithology.

**S1.d. Kamil Granodiorite**

Kamil Granodiorite can be observed as relatively small intrusions within the Al Wafi Schist, it consists of coarse grained quartz, garnet and plagioclase with fine grained biotite and K-feldspar. Garnet phenocrysts can be observed in a relatively finer quartz, plagioclase, K-feldspar and biotite groundmass.

**S1.e. Jebel Ja’alan dyke swarm**

The first generation of dykes to cross-cut the Ja’alan Granite pluton is the Grey Dolerite. This lithology consists of plagioclase, hornblende, epidote and biotite with minor quartz and K-feldspar, and was observed to have a glomeroporphyritic texture of plagioclase phenocrysts in some areas. Many of these dykes display magma mingling at their margins where an intermediate rock had crystallised between it and the granite.

Field relationships suggest that the andesite dykes observed represent the second generation of dykes, cross cutting both the Ja’alan Granite and Grey Dolerite. These dykes display a similar dip angle as the grey dolerite, suggesting that they are belong to the same suite. Its mineralogy is a plagioclase-rich assemblage with hornblende replacing chlorite and titanite, magnetite and epidote are observed as accessory phases.

Brown Dolerite makes up the final generation of dykes in Jebel Ja’alan. These dykes tend to be oriented on very steep angle and are generally much thicker than the other dykes, reaching *c*. 15 m width. The width of these dykes made them easily recognisable in satellite imagery, where some were observed to be in excess of 1 km long. The Brown Dolerite is an alkaline dolerite consisting of chlorite, plagioclase and clinopyroxene with minor sanidine and possibly nephylene.

**S1.f. Sedimentary cover**

In the northern study area the basement rock is unconformably overlain by chert conglomerates, lithic sandstones and shales or marls of the Qahlah Formation. These are in turn overlain by bioclastic limestones of the Simsima formation. The limestone is interpreted to be of Maastrichtian age by (Filbrandt, Nolan, and Ries, 1990) due to the presence of rudist fossils.

Supplementary Table S1. List of samples collected from Jebel Ja’alan, Oman. GPS references refer to WGS84 (zone 40N) and UTM coordinates.

|  |  |  |  |
| --- | --- | --- | --- |
| Sample Number | Lithology | GPS (E) | GPS (N) |
| JA15-01 | Psammite in Al Wafi Schist | 742350 | 2460414 |
| JA15-02 | Al Wafi Schist | 742350 | 2460414 |
| JA15-03 | Ja’alan Granite | 742350 | 2460414 |
| JA15-04 | Al Wafi Schist | 742563 | 2460600 |
| JA15-05 | Calc-silicate | 742571 | 2460591 |
| JA15-06 | Al Wafi Schist | 742573 | 2460575 |
| JA15-07 | Psammite in Al Wafi Schist | 742640 | 2460549 |
| JA15-08 | Kamil Granodiorite | 742899 | 2460099 |
| JA15-09 | Kamil Granodiorite | 742927 | 2460090 |
| JA15-10a | Ja’alan Gneiss | 742948 | 2460028 |
| JA15-11 | Ja’alan Granite | 743033 | 2400008 |
| JA15-12 | Kamil Granodiorite | 744781 | 2451023 |
| JA15-13 | Brown Dolerite | 744781 | 2451023 |
| JA15-14 | Grey Dolerite | 744781 | 2451023 |
| JA15-15 | Grey Dolerite | 744781 | 2451023 |
| JA15-16 | Mafic enclave | 744651 | 2450230 |
| JA15-17 | Grey Dolerite | 744651 | 2450230 |
| JA15-18 | Ja’alan Granite | 744651 | 2450230 |
| JA15-19 | Intermediate dyke | 744559 | 2450332 |
| JA15-20 | Grey Dolerite | 744559 | 2450332 |
| JA15-21 | Brown Dolerite | 744559 | 2450332 |
| JA15-22 | Grey Dolerite | 744946 | 2449908 |
| JA15-23 | Brown Dolerite | 744790 | 2449849 |
| JA15-24 | Intermediate dyke | 744758 | 2449476 |
| JA15-25 | Mafic intrusion | 744822 | 2449562 |
| JA15-26 | Ja’alan Gneiss | 743437 | 2459614 |
| JA15-27 | Al Wafi Schist | 743645 | 2459110 |

|  |  |  |  |
| --- | --- | --- | --- |
| Sample Number | ROCK TYPE | GPS |  |
| JA15-28 | Amphibolite | 743626 | 2458943 |
| JA15-29 | Psammite Al Wafi Schist | 742038 | 2459408 |
| JA15-30 | Intermediate dyke | 743735 | 2449942 |
| JA15-31 | Mafic intrusion | 743840 | 2449626 |
| JA15-32 | Brown Dolerite | 743552 | 2449740 |
| JA15-33 | Ja’alan Granite | 743562 | 2449591 |
| JA15-34 | Intermediate dyke | 743342 | 2448937 |
| JA15-35 | Ja’alan Granite | 742795 | 2451559 |
| JA15-36 | Ja’alan Gneiss | 743707 | 2459687 |
| JA15-37 | Ja’alan Gneiss | 743757 | 2459678 |
| JA15-38 | Mafic intrusion | 744439 | 2459934 |
| JA15-39 | Psammite in Al Wafi Schist | 744500 | 2459920 |
| JA15-40 | Al Wafi Schist | 741746 | 2460114 |
| JA15-41 | Al Wafi Schist | 741483 | 2459925 |
| JA15-42 | Brown Dolerite | 741483 | 2459356 |
| JA15-43 | Al Wafi Schist | 741148 | 2460019 |
| JA15-43a | Psammite in Al Wafi Schist | 741175 | 2460239 |
| JA15-44 | Ja’alan Granite | 743966 | 2451243 |
| JA15-45 | Calc-silicate | 743966 | 2451243 |
| JA15-46 | Intermediate dyke | 744671 | 2450248 |
| JA15-47 | Intermediate dyke | 744648 | 2450240 |
| JA15-48 | Psammite in Al Wafi Schist | 741748 | 2460439 |
| JA15-49 | Brown Dolerite | 741748 | 2460439 |
| JA15-50 | Grey Dolerite | 742489 | 2448836 |
| O14-35 | Ja’alan Granite | 741380 | 2460580 |
| O14-37 | Ja’alan Granite | 741630 | 2460560 |

**S2. Supplementary geochronological data**

Supplementary Table S2. 40Ar–39Ar geochronological data for Ja’alan Granite sample JA15-03.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Relative Abundances** | |  | 36Ar [V] | %1s | 37Ar [V] | %1s | 38Ar [V] | %1s | 39Ar [V] | %1s | 40Ar [V] | %1s | 40(r)/39(k) | ± 2s | Age | ± 2s | 40Ar(r) | 39Ar(k) | K/Ca | ± 2s |
| (Ma) | | (%) | (%) |
| 5M38967D | 60 °C | 4 | 0.0000173 | 39.318 | 0.0000292 | 489.312 | 0.0000186 | 25.256 | 0.0008699 | 1.184 | 0.0527685 | 0.168 | 54.73523 | ± 4.84212 | 826.63 | ± 58.69 | 90.23 | 12.05 | 12.8 | ± 125.4 |
| 5M38968D | 61 °C | 4 | 0.0000168 | 43.191 | 0.0000181 | 663.176 | 0.0000264 | 16.411 | 0.0022223 | 0.720 | 0.1262498 | 0.190 | 54.54942 | ± 2.11717 | 824.37 | ± 25.69 | 96.02 | 30.78 | 52.7 | ± 698.4 |
| 5M38969D | 61 °C | 4 | 0.0000016 | 435.948 | 0.0000315 | 469.014 | 0.0000337 | 13.856 | 0.0027369 | 0.890 | 0.1519948 | 0.091 | 55.71253 | ± 1.83879 | 838.43 | ± 22.14 | 100.32 | 37.91 | 37.4 | ± 350.8 |
| 5M38974D | 63 °C | 4 | 0.0000058 | 123.568 | 0.0001871 | 66.156 | 0.0000075 | 56.729 | 0.0005081 | 1.337 | 0.0282885 | 0.246 | 52.24558 | ± 8.47821 | 796.20 | ± 104.51 | 93.87 | 7.04 | 1.2 | ± 1.5 |
| 5M38975D | 67 °C | 4 | 0.0000045 | 170.023 | 0.0000706 | 181.263 | 0.0000133 | 33.356 | 0.0008813 | 1.155 | 0.0502160 | 0.162 | 55.44972 | ± 5.33353 | 835.27 | ± 64.34 | 97.32 | 12.21 | 5.4 | ± 19.5 |
|  |  | S | 0.0000427 | 37.593 | 0.0001789 | 166.174 | 0.0000994 | 10.069 | 0.0072185 | 0.461 | 0.4095176 | 0.076 |  |  |  |  |  |  |  |  |

Supplementary Table S3. 40Ar–39Ar geochronological data for Al Wafi Schist sample JA15-04.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Relative Abundances** | |  | 36Ar [V] | %1s | 37Ar [V] | %1s | 38Ar [V] | %1s | 39Ar [V] | %1s | 40Ar [V] | %1s | 40(r)/39(k) | ± 2s | Age | ± 2s | 40Ar(r) | 39Ar(k) | K/Ca | ± 2s |
| (Ma) | | (%) | (%) |
| 5M38951D | 60 °C | 4 | 0.0000054 | 97.681 | 0.0000742 | 154.284 | 0.0000183 | 18.565 | 0.0018316 | 0.813 | 0.1015696 | 0.096 | 54.57517 | ± 1.92406 | 824.69 | ± 23.35 | 98.42 | 16.86 | 10.6 | ± 32.7 |
| 5M38952D | 60 °C | 4 | 0.0000044 | 124.624 | 0.0000090 | 1129.117 | 0.0000878 | 4.655 | 0.0068412 | 0.364 | 0.3757115 | 0.103 | 55.10993 | ± 0.63401 | 831.16 | ± 7.67 | 100.35 | 62.97 | 325.6 | ± 7352.7 |
| 5M38953D | 61 °C | 4 | 0.0000058 | 88.656 | 0.0000746 | 158.583 | 0.0000110 | 27.596 | 0.0004504 | 1.916 | 0.0245609 | 0.436 | 58.35593 | ± 7.19419 | 869.99 | ± 85.14 | 107.03 | 4.15 | 2.6 | ± 8.2 |
| 5M38955D | 61 °C | 4 | 0.0000033 | 163.000 | 0.0001368 | 91.241 | 0.0000091 | 40.100 | 0.0007134 | 1.252 | 0.0393807 | 0.272 | 56.56043 | ± 4.74415 | 848.62 | ± 56.81 | 102.48 | 6.57 | 2.2 | ± 4.1 |
| 5M38956D | 61 °C | 4 | 0.0000010 | 606.394 | 0.0000866 | 124.510 | 0.0000084 | 35.572 | 0.0007438 | 1.294 | 0.0402594 | 0.309 | 54.53469 | ± 5.00433 | 824.19 | ± 60.74 | 100.75 | 6.85 | 3.7 | ± 9.2 |
| 5M38958D | 61 °C | 4 | 0.0000011 | 505.661 | 0.0000316 | 329.379 | 0.0000092 | 51.520 | 0.0002831 | 1.811 | 0.0154932 | 0.467 | 55.85214 | ± 11.51000 | 840.12 | ± 138.48 | 102.06 | 2.61 | 3.9 | ± 25.4 |
|  |  | S | 0.0000102 | 130.471 | 0.0001764 | 155.785 | 0.0001437 | 6.300 | 0.0108636 | 0.307 | 0.5969753 | 0.075 |  |  |  |  |  |  |  |  |

Supplementary Table S4. A table of results for Sm-Nd analysis of unknowns and standards.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample | dummy | BCR-2 | G-2 | JA15-14 | JA15-18 | JA15-25 | JA15-34 | JA15-42 |
| **Input age of rock T (Ma)** | 830 | 840 | 840 | 840 | 843 | 840 | 840 | 840 |
| **Unmixed 143/144Nd** | 0.51298 | 0.51263 | 0.51222 | 0.51297 | 0.51222 | 0.51263 | 0.51262 | 0.51238 |
| **Nd (ug.g)-1** | 24.7 | 28.8 | 52.3 | 11.5 | 23.7 | 27.2 | 37.6 | 58.8 |
| **Sm (ug.g)-1** | 6.1 | 6.8 | 7.9 | 3.7 | 4.1 | 7.3 | 9.5 | 14.0 |
| **147Sm/144Nd** | 0.1497 | 0.1423 | 0.0916 | 0.1930 | 0.1044 | 0.1616 | 0.1523 | 0.1436 |
| **Nd (T=0)** | 6.65 | -0.19 | -8.21 | 6.39 | -8.23 | -0.17 | -0.44 | -5.14 |
| **143Nd/144Nd (T)** | 0.51216 | 0.51184 | 0.51171 | 0.51190 | 0.51164 | 0.51174 | 0.51178 | 0.51158 |
| **Nd (T)** | 11.65 | 5.65 | 3.09 | 6.78 | 1.72 | 3.59 | 4.32 | 0.56 |
| **TDM (Ma)** | 403 | 1102 | 1156 | 1310 | 1291 | 1499 | 1309 | 1663 |
| **TCHUR (Ma)** | -1116 | 28 | 611 | -14720 | 698 | 39 | 79 | 758 |
| **DM at age of rock (T)** | 0.51198 | 0.51197 | 0.51197 | 0.51197 | 0.51196 | 0.51197 | 0.51197 | 0.51197 |
| **CHUR at age of rock (T)** | 0.51157 | 0.51157 | 0.51157 | 0.51157 | 0.51157 | 0.51157 | 0.51157 | 0.51157 |

Supplementary Table S5. Individual U–Pb ages for zircon standards.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **JA15-08** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Isotope ratios and 1σ error (absolute) | | | | | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | | | |
| Analysis |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 208Pb | 232Pb | 238U |
| GJ01 | 0.0590 |  | 0.0011 | 0.1007 | 0.0014 | 0.8188 | 0.0160 | 565.6 | 40.82 | 618.7 | 8.45 | 607.4 | 8.94 | 19 | 7392 | 445 | 95 | 3084 | 93666 |
| GJ02 | 0.0587 |  | 0.0011 | 0.1000 | 0.0014 | 0.8097 | 0.0161 | 556.5 | 41.76 | 614.5 | 8.42 | 602.3 | 9.05 | 12 | 7705 | 461 | 85 | 3254 | 98099 |
| GJ03 | 0.0608 |  | 0.0012 | 0.0982 | 0.0014 | 0.8237 | 0.0163 | 633 | 40.88 | 604 | 8.28 | 610.1 | 9.06 | 5 | 7696 | 477 | 88 | 3285 | 99761 |
| GJ04 | 0.0598 |  | 0.0012 | 0.0968 | 0.0014 | 0.7985 | 0.0159 | 597.5 | 41.35 | 595.6 | 8.18 | 596 | 8.95 | 0 | 7666 | 467 | 91 | 3261 | 100823 |
| GJ05 | 0.0600 |  | 0.0012 | 0.0983 | 0.0014 | 0.8134 | 0.0161 | 604.1 | 41.12 | 604.5 | 8.28 | 604.4 | 9.01 | 0 | 7761 | 474 | 94 | 3247 | 100500 |
| PLES01 | 0.0551 |  | 0.0010 | 0.0520 | 0.0007 | 0.3947 | 0.0076 | 414.1 | 40.62 | 326.8 | 4.52 | 337.8 | 5.53 | 1 | 11620 | 652 | 386 | 26187 | 285792 |
| PLES02 | 0.0537 |  | 0.0009 | 0.0523 | 0.0007 | 0.3872 | 0.0071 | 356.5 | 39.28 | 328.9 | 4.46 | 332.3 | 5.22 | 7 | 11964 | 654 | 447 | 26780 | 290891 |
| PLES03 | 0.0516 |  | 0.0010 | 0.0515 | 0.0008 | 0.3663 | 0.0076 | 267.3 | 45.79 | 323.8 | 4.57 | 316.9 | 5.64 | 2 | 11452 | 603 | 402 | 25872 | 284676 |
| PLES04 | 0.0537 |  | 0.0011 | 0.0524 | 0.0008 | 0.3880 | 0.0079 | 358.4 | 44.6 | 329.3 | 4.64 | 332.9 | 5.81 | 3 | 11752 | 645 | 379 | 26268 | 287134 |
| PLES05 | 0.0542 |  | 0.0010 | 0.0529 | 0.0007 | 0.3955 | 0.0072 | 379.8 | 38.87 | 332.4 | 4.49 | 338.4 | 5.27 | 18 | 11520 | 636 | 359 | 25989 | 276346 |
| PLES06 | 0.0528 |  | 0.0010 | 0.0522 | 0.0008 | 0.3800 | 0.0076 | 318.2 | 43.62 | 328.3 | 4.58 | 327 | 5.6 | 0 | 11748 | 629 | 384 | 26600 | 287035 |
| PLES07 | 0.0545 |  | 0.0010 | 0.0519 | 0.0007 | 0.3904 | 0.0071 | 393.3 | 38.33 | 326.3 | 4.41 | 334.7 | 5.2 | 0 | 11638 | 647 | 416 | 26527 | 284364 |
| PLES08 | 0.0527 |  | 0.0009 | 0.0513 | 0.0007 | 0.3726 | 0.0070 | 316.4 | 40.1 | 322.3 | 4.38 | 321.6 | 5.15 | 12 | 12017 | 643 | 375 | 27542 | 297799 |
| GJ06 | 0.0605 |  | 0.0012 | 0.0969 | 0.0014 | 0.8081 | 0.0167 | 620.2 | 43.2 | 596.4 | 8.28 | 601.4 | 9.36 | 12 | 7232 | 443 | 81 | 3162 | 94625 |
| GJ07 | 0.0598 |  | 0.0012 | 0.0972 | 0.0014 | 0.8007 | 0.0165 | 595.2 | 43.97 | 597.7 | 8.29 | 597.2 | 9.32 | 1 | 7298 | 442 | 76 | 3158 | 95275 |
| GJ08 | 0.0590 |  | 0.0012 | 0.0970 | 0.0014 | 0.7895 | 0.0164 | 567.8 | 43.85 | 596.9 | 8.29 | 590.9 | 9.29 | 0 | 7291 | 436 | 90 | 3135 | 95297 |
| GJ09 | 0.0596 |  | 0.0012 | 0.0978 | 0.0014 | 0.8039 | 0.0166 | 590.7 | 43.35 | 601.3 | 8.34 | 599 | 9.32 | 0 | 7438 | 449 | 92 | 3215 | 96459 |
| GJ10 | 0.0609 |  | 0.0012 | 0.0974 | 0.0014 | 0.8179 | 0.0168 | 637.1 | 43.01 | 598.8 | 8.31 | 606.9 | 9.4 | 0 | 7395 | 456 | 92 | 3164 | 96305 |
| GJ11 | 0.0593 |  | 0.0012 | 0.0978 | 0.0014 | 0.7996 | 0.0167 | 578.7 | 43.98 | 601.3 | 8.36 | 596.6 | 9.39 | 0 | 7290 | 438 | 93 | 3173 | 94522 |
| PLES09 | 0.0540 |  | 0.0010 | 0.0536 | 0.0008 | 0.3987 | 0.0076 | 368.9 | 40.77 | 336.6 | 4.58 | 340.7 | 5.48 | 0 | 11157 | 610 | 362 | 24270 | 263145 |
| PLES10 | 0.0513 |  | 0.0010 | 0.0540 | 0.0008 | 0.3818 | 0.0075 | 255.6 | 42.95 | 338.8 | 4.66 | 328.4 | 5.48 | 0 | 10901 | 568 | 328 | 23169 | 256830 |
| PLES11 | 0.0534 |  | 0.0010 | 0.0540 | 0.0008 | 0.3977 | 0.0078 | 346.4 | 42.49 | 339.1 | 4.67 | 340 | 5.66 | 5 | 10983 | 594 | 347 | 23789 | 257715 |
| PLES12 | 0.0529 |  | 0.0010 | 0.0542 | 0.0008 | 0.3954 | 0.0078 | 326 | 42.79 | 340.1 | 4.69 | 338.3 | 5.67 | 10 | 10856 | 582 | 341 | 23170 | 253908 |
| PLES13 | 0.0526 |  | 0.0011 | 0.0551 | 0.0008 | 0.3993 | 0.0083 | 311.8 | 46.02 | 345.5 | 4.88 | 341.1 | 6.05 | 0 | 11351 | 608 | 357 | 24067 | 262318 |
| PLES14 | 0.0534 |  | 0.0011 | 0.0548 | 0.0008 | 0.4029 | 0.0084 | 343.9 | 45.96 | 343.8 | 4.83 | 343.8 | 6.09 | 1 | 11132 | 599 | 340 | 23775 | 256744 |
| PLES15 | 0.0526 |  | 0.0011 | 0.0554 | 0.0008 | 0.4010 | 0.0082 | 309.4 | 44.8 | 347.3 | 4.84 | 342.4 | 5.92 | 0 | 10984 | 585 | 342 | 22994 | 251072 |
| PLES16 | 0.0532 |  | 0.0012 | 0.0544 | 0.0008 | 0.3991 | 0.0088 | 339.2 | 48.74 | 341.3 | 4.9 | 341 | 6.37 | 0 | 10573 | 569 | 334 | 22516 | 246729 |
| PLES17 | 0.0543 |  | 0.0011 | 0.0541 | 0.0008 | 0.4044 | 0.0086 | 381.8 | 46.56 | 339.4 | 4.81 | 344.9 | 6.22 | 0 | 10269 | 562 | 339 | 22182 | 239897 |
| GJ12 | 0.0609 |  | 0.0014 | 0.0971 | 0.0015 | 0.8146 | 0.0180 | 633.8 | 46.93 | 597.5 | 8.5 | 605 | 10.09 | 12 | 7539 | 462 | 83 | 3261 | 98042 |
| GJ13 | 0.0598 |  | 0.0013 | 0.0995 | 0.0015 | 0.8204 | 0.0182 | 596.7 | 47.27 | 611.5 | 8.68 | 608.2 | 10.14 | 9 | 7710 | 465 | 91 | 3251 | 97855 |
| GJ14 | 0.0598 |  | 0.0013 | 0.0978 | 0.0015 | 0.8069 | 0.0180 | 597.3 | 47.7 | 601.7 | 8.58 | 600.7 | 10.13 | 0 | 7503 | 452 | 83 | 3192 | 96830 |
| GJ15 | 0.0601 |  | 0.0013 | 0.0968 | 0.0014 | 0.8013 | 0.0179 | 606.5 | 47.64 | 595.3 | 8.49 | 597.6 | 10.09 | 4 | 7566 | 458 | 88 | 3227 | 98742 |
| GJ16 | 0.0604 |  | 0.0014 | 0.0974 | 0.0015 | 0.8113 | 0.0182 | 619.3 | 47.85 | 599 | 8.56 | 603.2 | 10.21 | 4 | 7417 | 452 | 88 | 3187 | 96153 |
| **JA15-09** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Isotope ratios and 1σ error (absolute) | | | | | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | | | |
| Analysis |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 208Pb | 232Pb | 238U |
| GJ01 | 0.0605 |  | 0.0010 | 0.1322 | 0.0019 | 1.1030 | 0.0200 | 621.8 | 35.38 | 800.5 | 10.9 | 754.8 | 9.64 | 26 | 11450 | 704 | 153 | 4252 | 116393 |
| GJ02 | 0.0605 |  | 0.0010 | 0.1004 | 0.0015 | 0.8384 | 0.0151 | 622.8 | 35.15 | 617 | 8.5 | 618.2 | 8.33 | 26 | 10400 | 641 | 135 | 4229 | 138991 |
| GJ03 | 0.0600 |  | 0.0010 | 0.0979 | 0.0014 | 0.8099 | 0.0145 | 602.5 | 35.15 | 602.3 | 8.3 | 602.4 | 8.15 | 13 | 10557 | 645 | 135 | 4418 | 144681 |
| GJ04 | 0.0605 |  | 0.0010 | 0.0970 | 0.0014 | 0.8084 | 0.0144 | 619.8 | 34.54 | 596.8 | 8.2 | 601.6 | 8.06 | 0 | 11128 | 685 | 144 | 4470 | 154016 |
| GJ05 | 0.0599 |  | 0.0010 | 0.0969 | 0.0014 | 0.7994 | 0.0144 | 598.6 | 35.41 | 595.9 | 8.22 | 596.5 | 8.14 | 0 | 10468 | 638 | 140 | 4348 | 145076 |
| PLES01 | 0.0523 |  | 0.0009 | 0.0529 | 0.0008 | 0.3809 | 0.0070 | 297.5 | 38.05 | 332 | 4.66 | 327.7 | 5.15 | 11 | 12892 | 687 | 449 | 32640 | 327870 |
| PLES02 | 0.0532 |  | 0.0009 | 0.0526 | 0.0008 | 0.3852 | 0.0072 | 335.4 | 38.45 | 330.2 | 4.66 | 330.8 | 5.27 | 0 | 11179 | 604 | 355 | 26871 | 286145 |
| PLES03 | 0.0532 |  | 0.0009 | 0.0524 | 0.0008 | 0.3839 | 0.0070 | 335.8 | 37.08 | 329.1 | 4.61 | 329.9 | 5.11 | 10 | 11282 | 610 | 375 | 27058 | 289147 |
| PLES04 | 0.0531 |  | 0.0009 | 0.0530 | 0.0008 | 0.3881 | 0.0072 | 334.3 | 38.05 | 332.8 | 4.68 | 333 | 5.25 | 0 | 10828 | 584 | 334 | 25719 | 274581 |
| PLES05 | 0.0536 |  | 0.0009 | 0.0538 | 0.0008 | 0.3976 | 0.0074 | 352.5 | 38.04 | 338 | 4.75 | 339.9 | 5.34 | 45 | 11508 | 623 | 398 | 26526 | 287007 |
| PLES06 | 0.0532 |  | 0.0009 | 0.0535 | 0.0008 | 0.3927 | 0.0073 | 337.1 | 38.39 | 336.2 | 4.73 | 336.3 | 5.34 | 18 | 11307 | 608 | 404 | 26013 | 283519 |
| PLES07 | 0.0530 |  | 0.0010 | 0.0526 | 0.0008 | 0.3846 | 0.0074 | 328.4 | 40.16 | 330.7 | 4.71 | 330.4 | 5.44 | 17 | 11180 | 597 | 360 | 26299 | 285574 |
| PLES08 | 0.0536 |  | 0.0010 | 0.0528 | 0.0008 | 0.3904 | 0.0078 | 354.6 | 42.12 | 331.8 | 4.78 | 334.7 | 5.7 | 0 | 10899 | 588 | 349 | 25393 | 277536 |
| GJ06 | 0.0599 |  | 0.0010 | 0.0970 | 0.0014 | 0.8013 | 0.0148 | 600.3 | 36.46 | 596.9 | 8.28 | 597.6 | 8.34 | 6 | 10634 | 644 | 130 | 4471 | 147171 |
| GJ07 | 0.0593 |  | 0.0010 | 0.0961 | 0.0014 | 0.7860 | 0.0145 | 579.2 | 36.43 | 591.4 | 8.2 | 588.9 | 8.23 | 9 | 10905 | 655 | 133 | 4568 | 152367 |
| GJ08 | 0.0603 |  | 0.0010 | 0.0970 | 0.0014 | 0.8066 | 0.0149 | 613.9 | 36.36 | 597 | 8.28 | 600.5 | 8.37 | 3 | 10853 | 661 | 129 | 4484 | 150161 |
| GJ09 | 0.0597 |  | 0.0010 | 0.0971 | 0.0014 | 0.7992 | 0.0150 | 593 | 36.9 | 597.4 | 8.32 | 596.4 | 8.48 | 0 | 9996 | 603 | 130 | 4195 | 138217 |
| GJ10 | 0.0601 |  | 0.0010 | 0.0960 | 0.0014 | 0.7956 | 0.0147 | 607.1 | 36.52 | 591 | 8.21 | 594.3 | 8.33 | 0 | 10699 | 649 | 129 | 4414 | 149608 |
| GJ11 | 0.0613 |  | 0.0011 | 0.0966 | 0.0014 | 0.8166 | 0.0152 | 649.2 | 36.49 | 594.7 | 8.27 | 606.1 | 8.49 | 8 | 10535 | 652 | 137 | 4433 | 146361 |
| PLES09 | 0.0534 |  | 0.0009 | 0.0533 | 0.0008 | 0.3924 | 0.0074 | 345.2 | 39.29 | 334.8 | 4.74 | 336.1 | 5.43 | 0 | 10848 | 585 | 368 | 24949 | 273219 |
| PLES10 | 0.0535 |  | 0.0010 | 0.0533 | 0.0008 | 0.3935 | 0.0076 | 350.9 | 40.2 | 334.9 | 4.76 | 336.9 | 5.54 | 0 | 11090 | 595 | 379 | 25711 | 279318 |
| PLES11 | 0.0532 |  | 0.0009 | 0.0535 | 0.0008 | 0.3925 | 0.0074 | 338.7 | 39.02 | 335.8 | 4.75 | 336.2 | 5.41 | 0 | 11413 | 613 | 395 | 26137 | 286728 |
| PLES12 | 0.0532 |  | 0.0009 | 0.0525 | 0.0008 | 0.3855 | 0.0072 | 337.8 | 38.61 | 330.1 | 4.66 | 331.1 | 5.29 | 27 | 11885 | 638 | 398 | 27536 | 303726 |
| PLES13 | 0.0536 |  | 0.0010 | 0.0545 | 0.0008 | 0.4027 | 0.0081 | 355.8 | 42.08 | 341.8 | 4.92 | 343.6 | 5.83 | 30 | 10782 | 581 | 368 | 24521 | 265877 |
| PLES14 | 0.0536 |  | 0.0010 | 0.0539 | 0.0008 | 0.3983 | 0.0079 | 353.4 | 41.82 | 338.5 | 4.86 | 340.4 | 5.76 | 0 | 11310 | 609 | 394 | 25603 | 281696 |
| PLES15 | 0.0533 |  | 0.0010 | 0.0532 | 0.0008 | 0.3913 | 0.0080 | 343.3 | 43.08 | 334.2 | 4.84 | 335.3 | 5.83 | 0 | 11170 | 595 | 375 | 25908 | 281961 |
| PLES16 | 0.0538 |  | 0.0010 | 0.0536 | 0.0008 | 0.3978 | 0.0081 | 362.4 | 43.13 | 336.8 | 4.88 | 340 | 5.91 | 1 | 11533 | 618 | 370 | 26650 | 288947 |
| PLES17 | 0.0540 |  | 0.0011 | 0.0530 | 0.0008 | 0.3942 | 0.0084 | 369.3 | 45.12 | 332.8 | 4.89 | 337.4 | 6.09 | 8 | 11546 | 624 | 388 | 26941 | 293253 |
| GJ12 | 0.0600 |  | 0.0012 | 0.0993 | 0.0015 | 0.8215 | 0.0169 | 603.7 | 41.82 | 610.3 | 8.74 | 608.9 | 9.42 | 1 | 8814 | 530 | 108 | 3584 | 119199 |
| GJ13 | 0.0604 |  | 0.0012 | 0.0973 | 0.0015 | 0.8099 | 0.0166 | 617.4 | 41.44 | 598.5 | 8.56 | 602.4 | 9.29 | 2 | 9127 | 553 | 102 | 3822 | 125998 |
| GJ14 | 0.0599 |  | 0.0012 | 0.0976 | 0.0015 | 0.8067 | 0.0164 | 601.1 | 41.18 | 600.5 | 8.56 | 600.6 | 9.22 | 0 | 9783 | 587 | 126 | 4021 | 134565 |
| GJ15 | 0.0617 |  | 0.0012 | 0.0974 | 0.0015 | 0.8292 | 0.0170 | 665 | 41.12 | 599.3 | 8.58 | 613.2 | 9.42 | 0 | 9298 | 574 | 112 | 3831 | 128129 |
| GJ16 | 0.0606 |  | 0.0012 | 0.0984 | 0.0015 | 0.8226 | 0.0171 | 626.1 | 42.29 | 605.1 | 8.71 | 609.5 | 9.54 | 15 | 8538 | 518 | 103 | 3587 | 116500 |
| **JA15-26** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Isotope ratios and 1σ error (absolute) | | | | | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | | | |
| Analysis |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 208Pb | 232Pb | 238U |
| GJ01 | 0.0603 |  | 0.0012 | 0.1087 | 0.0016 | 0.9038 | 0.0178 | 615.6 | 40.92 | 665 | 8.99 | 653.7 | 9.51 | 18 | 8569 | 518 | 106 | 3360 | 99413 |
| GJ02 | 0.0597 |  | 0.0012 | 0.1009 | 0.0014 | 0.8301 | 0.0165 | 592.9 | 40.76 | 619.6 | 8.4 | 613.7 | 9.13 | 29 | 8562 | 512 | 102 | 3540 | 106921 |
| GJ03 | 0.0605 |  | 0.0012 | 0.0963 | 0.0014 | 0.8029 | 0.0160 | 621.1 | 41.27 | 592.7 | 8.07 | 598.5 | 8.98 | 0 | 8301 | 503 | 89 | 3596 | 108628 |
| GJ04 | 0.0608 |  | 0.0012 | 0.0960 | 0.0014 | 0.8051 | 0.0160 | 632.9 | 41.09 | 591 | 8.04 | 599.7 | 8.97 | 2 | 8429 | 514 | 92 | 3680 | 110558 |
| GJ05 | 0.0601 |  | 0.0012 | 0.0958 | 0.0014 | 0.7937 | 0.0157 | 606.7 | 41.23 | 589.9 | 8.02 | 593.3 | 8.9 | 0 | 8334 | 502 | 99 | 3525 | 109523 |
| PLES01 | 0.0544 |  | 0.0010 | 0.0520 | 0.0007 | 0.3902 | 0.0075 | 387.9 | 41.01 | 326.9 | 4.47 | 334.5 | 5.47 | 17 | 9007 | 499 | 284 | 18608 | 218562 |
| PLES02 | 0.0530 |  | 0.0011 | 0.0526 | 0.0008 | 0.3846 | 0.0078 | 329.8 | 44.35 | 330.6 | 4.57 | 330.4 | 5.73 | 1 | 8445 | 450 | 260 | 17273 | 202061 |
| PLES03 | 0.0538 |  | 0.0010 | 0.0528 | 0.0007 | 0.3914 | 0.0077 | 360.9 | 42.63 | 331.8 | 4.54 | 335.4 | 5.61 | 0 | 8237 | 445 | 251 | 16813 | 196469 |
| PLES04 | 0.0520 |  | 0.0010 | 0.0529 | 0.0008 | 0.3791 | 0.0076 | 285.7 | 43.96 | 332.2 | 4.56 | 326.4 | 5.59 | 0 | 7596 | 397 | 341 | 15499 | 180863 |
| PLES05 | 0.0559 |  | 0.0012 | 0.0531 | 0.0008 | 0.4092 | 0.0090 | 447.9 | 47.98 | 333.6 | 4.77 | 348.3 | 6.5 | 15 | 8231 | 462 | 258 | 16814 | 194109 |
| PLES06 | 0.0579 |  | 0.0012 | 0.0537 | 0.0008 | 0.4288 | 0.0088 | 527 | 44.05 | 337.1 | 4.69 | 362.3 | 6.23 | 1 | 7964 | 464 | 349 | 17094 | 185112 |
| PLES07 | 0.0526 |  | 0.0011 | 0.0537 | 0.0008 | 0.3890 | 0.0082 | 310.9 | 46.91 | 337 | 4.69 | 333.6 | 6.01 | 0 | 7450 | 393 | 198 | 14861 | 172872 |
| PLES08 | 0.0683 |  | 0.0015 | 0.0540 | 0.0008 | 0.5085 | 0.0110 | 876.1 | 44.47 | 339.3 | 4.91 | 417.4 | 7.42 | 0 | 7143 | 490 | 497 | 16857 | 165454 |
| GJ06 | 0.0604 |  | 0.0012 | 0.0983 | 0.0014 | 0.8192 | 0.0162 | 619.5 | 41.42 | 604.5 | 8.13 | 607.6 | 9.04 | 7 | 7817 | 474 | 86 | 3248 | 98682 |
| GJ07 | 0.0600 |  | 0.0012 | 0.0973 | 0.0014 | 0.8041 | 0.0160 | 602.5 | 41.69 | 598.4 | 8.06 | 599.1 | 8.98 | 0 | 7752 | 466 | 89 | 3278 | 98876 |
| GJ08 | 0.0589 |  | 0.0012 | 0.0990 | 0.0014 | 0.8035 | 0.0160 | 563 | 41.98 | 608.4 | 8.17 | 598.8 | 8.98 | 6 | 7900 | 467 | 98 | 3311 | 98997 |
| GJ09 | 0.0581 |  | 0.0012 | 0.0981 | 0.0014 | 0.7860 | 0.0158 | 533.4 | 43.16 | 603.3 | 8.12 | 588.9 | 8.96 | 2 | 7788 | 454 | 90 | 3261 | 98416 |
| GJ10 | 0.0603 |  | 0.0012 | 0.0974 | 0.0014 | 0.8099 | 0.0162 | 615.4 | 41.97 | 599 | 8.08 | 602.4 | 9.07 | 10 | 7594 | 459 | 54 | 3222 | 96671 |
| GJ11 | 0.0604 |  | 0.0012 | 0.0978 | 0.0014 | 0.8144 | 0.0164 | 619.2 | 42.32 | 601.2 | 8.13 | 604.9 | 9.17 | 15 | 7683 | 465 | 85 | 3199 | 97316 |
| PLES09 | 0.0537 |  | 0.0010 | 0.0528 | 0.0007 | 0.3908 | 0.0075 | 357.8 | 42.32 | 331.7 | 4.46 | 335 | 5.48 | 0 | 10328 | 556 | 315 | 22006 | 242335 |
| PLES10 | 0.0524 |  | 0.0011 | 0.0526 | 0.0008 | 0.3793 | 0.0080 | 300.6 | 46.98 | 330.2 | 4.61 | 326.5 | 5.9 | 2 | 9594 | 505 | 285 | 20589 | 227543 |
| PLES11 | 0.0534 |  | 0.0011 | 0.0531 | 0.0008 | 0.3906 | 0.0081 | 344.1 | 45.64 | 333.5 | 4.61 | 334.8 | 5.89 | 0 | 8746 | 468 | 258 | 18020 | 204357 |
| PLES12 | 0.0529 |  | 0.0010 | 0.0529 | 0.0007 | 0.3858 | 0.0077 | 324.2 | 44.01 | 332.3 | 4.52 | 331.3 | 5.65 | 5 | 9115 | 483 | 276 | 19159 | 213125 |
| PLES13 | 0.0537 |  | 0.0010 | 0.0532 | 0.0007 | 0.3937 | 0.0076 | 358.6 | 42.59 | 334 | 4.5 | 337.1 | 5.53 | 6 | 10907 | 599 | 335 | 22123 | 251922 |
| PLES14 | 0.0528 |  | 0.0012 | 0.0535 | 0.0008 | 0.3893 | 0.0085 | 321.4 | 48.69 | 335.7 | 4.72 | 333.9 | 6.18 | 1 | 10296 | 549 | 289 | 20746 | 237768 |
| PLES15 | 0.0526 |  | 0.0011 | 0.0535 | 0.0008 | 0.3876 | 0.0080 | 310.1 | 46.24 | 335.8 | 4.61 | 332.6 | 5.86 | 0 | 11204 | 590 | 337 | 22766 | 256656 |
| PLES16 | 0.0531 |  | 0.0011 | 0.0535 | 0.0008 | 0.3915 | 0.0078 | 332.3 | 44.1 | 335.9 | 4.57 | 335.4 | 5.69 | 10 | 10483 | 561 | 317 | 21247 | 241136 |
| PLES17 | 0.0531 |  | 0.0011 | 0.0529 | 0.0007 | 0.3871 | 0.0077 | 333 | 43.94 | 332.1 | 4.51 | 332.2 | 5.63 | 5 | 11450 | 611 | 318 | 23984 | 266443 |
| GJ12 | 0.0598 |  | 0.0013 | 0.0982 | 0.0014 | 0.8098 | 0.0174 | 596.8 | 46.32 | 603.9 | 8.34 | 602.4 | 9.78 | 16 | 7726 | 464 | 81 | 3153 | 96456 |
| GJ13 | 0.0602 |  | 0.0013 | 0.0980 | 0.0014 | 0.8129 | 0.0176 | 610.7 | 46.5 | 602.4 | 8.33 | 604.1 | 9.85 | 3 | 7508 | 454 | 89 | 3125 | 93966 |
| GJ14 | 0.0603 |  | 0.0013 | 0.0973 | 0.0014 | 0.8090 | 0.0175 | 614.7 | 46.46 | 598.6 | 8.28 | 601.9 | 9.82 | 0 | 7605 | 461 | 92 | 3161 | 95778 |
| GJ15 | 0.0582 |  | 0.0013 | 0.0975 | 0.0014 | 0.7826 | 0.0171 | 537.8 | 47.99 | 599.6 | 8.3 | 587 | 9.71 | 0 | 7665 | 448 | 90 | 3216 | 96348 |
| GJ16 | 0.0600 |  | 0.0013 | 0.0971 | 0.0014 | 0.8028 | 0.0175 | 602.5 | 46.83 | 597.3 | 8.28 | 598.4 | 9.83 | 3 | 7566 | 456 | 83 | 3148 | 95454 |
| **JA15-36** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Isotope ratios and 1σ error (absolute) | | | | | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | | | |
| Analysis |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 208Pb | 232Pb | 238U |
| GJ01 | 0.0590 |  | 0.0011 | 0.1014 | 0.0015 | 0.8256 | 0.0157 | 568.6 | 38.68 | 622.8 | 8.58 | 611.2 | 8.73 | 15 | 10149 | 608 | 108 | 3997 | 131527 |
| GJ02 | 0.0603 |  | 0.0012 | 0.0982 | 0.0014 | 0.8162 | 0.0162 | 613.4 | 40.63 | 604 | 8.47 | 605.9 | 9.08 | 6 | 8928 | 543 | 95 | 3663 | 119565 |
| PLES01 | 0.0524 |  | 0.0010 | 0.0533 | 0.0008 | 0.3853 | 0.0076 | 302.4 | 41.81 | 335 | 4.72 | 330.9 | 5.53 | 0 | 10927 | 578 | 341 | 25319 | 269515 |
| PLES02 | 0.0526 |  | 0.0010 | 0.0528 | 0.0008 | 0.3827 | 0.0076 | 310.1 | 42.62 | 331.8 | 4.7 | 329.1 | 5.6 | 0 | 10573 | 562 | 345 | 24911 | 263402 |
| GJ03 | 0.0602 |  | 0.0011 | 0.0971 | 0.0014 | 0.8058 | 0.0155 | 611.2 | 38.99 | 597.2 | 8.28 | 600.1 | 8.73 | 0 | 10411 | 633 | 143 | 4220 | 141134 |
| GJ04 | 0.0600 |  | 0.0012 | 0.0968 | 0.0014 | 0.8008 | 0.0161 | 603.6 | 41.28 | 595.6 | 8.39 | 597.3 | 9.09 | 9 | 8562 | 518 | 100 | 3523 | 116407 |
| GJ05 | 0.0589 |  | 0.0012 | 0.0971 | 0.0014 | 0.7882 | 0.0161 | 563 | 42.26 | 597.3 | 8.44 | 590.1 | 9.14 | 4 | 8255 | 490 | 92 | 3436 | 111923 |
| GJ06 | 0.0596 |  | 0.0012 | 0.0982 | 0.0015 | 0.8071 | 0.0164 | 588.7 | 41.91 | 604.1 | 8.53 | 600.8 | 9.23 | 4 | 8278 | 497 | 91 | 3395 | 110925 |
| GJ07 | 0.0588 |  | 0.0011 | 0.0973 | 0.0014 | 0.7887 | 0.0153 | 560.7 | 39.65 | 598.3 | 8.31 | 590.4 | 8.69 | 0 | 10366 | 615 | 117 | 4201 | 140331 |
| PLES03 | 0.0529 |  | 0.0010 | 0.0531 | 0.0008 | 0.3871 | 0.0078 | 325.9 | 43.35 | 333.2 | 4.75 | 332.3 | 5.74 | 1 | 10082 | 539 | 326 | 23479 | 250324 |
| PLES04 | 0.0519 |  | 0.0011 | 0.0525 | 0.0008 | 0.3752 | 0.0080 | 278.7 | 46.45 | 329.8 | 4.77 | 323.5 | 5.88 | 19 | 9939 | 522 | 315 | 23224 | 248899 |
| PLES05 | 0.0528 |  | 0.0010 | 0.0530 | 0.0008 | 0.3855 | 0.0078 | 320.8 | 42.94 | 332.6 | 4.73 | 331.1 | 5.68 | 0 | 9903 | 527 | 314 | 23231 | 246308 |
| PLES06 | 0.0523 |  | 0.0010 | 0.0529 | 0.0008 | 0.3813 | 0.0078 | 296.9 | 43.79 | 332.4 | 4.74 | 328 | 5.7 | 3 | 10096 | 533 | 329 | 23889 | 251314 |
| PLES07 | 0.0527 |  | 0.0010 | 0.0531 | 0.0008 | 0.3859 | 0.0074 | 316.6 | 40.67 | 333.6 | 4.69 | 331.4 | 5.45 | 0 | 11926 | 632 | 398 | 27284 | 296379 |
| PLES08 | 0.0537 |  | 0.0011 | 0.0550 | 0.0008 | 0.4070 | 0.0089 | 358.3 | 47.25 | 345 | 5.06 | 346.7 | 6.4 | 14 | 10595 | 572 | 382 | 23618 | 254518 |
| PLES09 | 0.0528 |  | 0.0009 | 0.0529 | 0.0008 | 0.3848 | 0.0073 | 318.3 | 40.04 | 332.4 | 4.66 | 330.6 | 5.37 | 0 | 11345 | 602 | 360 | 26244 | 282881 |
| PLES10 | 0.0536 |  | 0.0011 | 0.0530 | 0.0008 | 0.3914 | 0.0081 | 352.9 | 44.55 | 332.9 | 4.8 | 335.4 | 5.93 | 5 | 10637 | 571 | 332 | 24740 | 265285 |
| GJ08 | 0.0609 |  | 0.0013 | 0.0979 | 0.0015 | 0.8216 | 0.0178 | 634.6 | 44.74 | 602.2 | 8.72 | 609 | 9.92 | 0 | 7844 | 478 | 92 | 3247 | 105901 |
| GJ09 | 0.0602 |  | 0.0013 | 0.0981 | 0.0015 | 0.8140 | 0.0178 | 610.2 | 45.41 | 603.3 | 8.76 | 604.7 | 9.96 | 0 | 7661 | 462 | 91 | 3121 | 103230 |
| GJ10 | 0.0605 |  | 0.0013 | 0.0972 | 0.0015 | 0.8110 | 0.0177 | 621.8 | 45.37 | 598.1 | 8.7 | 603 | 9.95 | 19 | 7659 | 464 | 86 | 3120 | 104156 |
| GJ11 | 0.0600 |  | 0.0013 | 0.0991 | 0.0015 | 0.8194 | 0.0180 | 601.7 | 45.57 | 609.4 | 8.85 | 607.7 | 10.02 | 0 | 7784 | 467 | 100 | 3105 | 103822 |
| GJ12 | 0.0604 |  | 0.0013 | 0.0962 | 0.0015 | 0.8011 | 0.0180 | 617.3 | 46.75 | 592.3 | 8.69 | 597.4 | 10.12 | 12 | 7064 | 427 | 84 | 2906 | 97072 |
| GJ13 | 0.0620 |  | 0.0013 | 0.0973 | 0.0015 | 0.8317 | 0.0182 | 674.1 | 44.99 | 598.5 | 8.72 | 614.5 | 10.08 | 6 | 7752 | 481 | 84 | 3167 | 105379 |
| PLES11 | 0.0546 |  | 0.0012 | 0.0531 | 0.0008 | 0.3994 | 0.0086 | 394.6 | 46.11 | 333.5 | 4.89 | 341.2 | 6.27 | 0 | 10481 | 574 | 335 | 24187 | 261058 |
| PLES12 | 0.0540 |  | 0.0011 | 0.0537 | 0.0008 | 0.3994 | 0.0085 | 368.9 | 45.84 | 337.2 | 4.91 | 341.2 | 6.18 | 2 | 10281 | 555 | 337 | 23430 | 253292 |
| PLES13 | 0.0546 |  | 0.0011 | 0.0536 | 0.0008 | 0.4038 | 0.0085 | 396.9 | 44.28 | 336.7 | 4.87 | 344.4 | 6.12 | 0 | 9650 | 528 | 308 | 21975 | 237803 |
| PLES14 | 0.0528 |  | 0.0011 | 0.0529 | 0.0008 | 0.3854 | 0.0083 | 321.5 | 46.77 | 332.4 | 4.86 | 331 | 6.11 | 0 | 10111 | 534 | 332 | 23103 | 252861 |
| PLES15 | 0.0533 |  | 0.0012 | 0.0532 | 0.0008 | 0.3906 | 0.0086 | 339.9 | 48.04 | 334.1 | 4.93 | 334.8 | 6.31 | 19 | 10388 | 552 | 341 | 23598 | 258722 |
| PLES16 | 0.0524 |  | 0.0011 | 0.0532 | 0.0008 | 0.3843 | 0.0080 | 301.8 | 45.02 | 334.3 | 4.83 | 330.2 | 5.89 | 8 | 10723 | 561 | 341 | 24899 | 266675 |
| PLES17 | 0.0540 |  | 0.0011 | 0.0532 | 0.0008 | 0.3958 | 0.0081 | 370.8 | 43.33 | 333.9 | 4.79 | 338.6 | 5.87 | 0 | 11226 | 607 | 347 | 25946 | 279258 |
| PLES18 | 0.0523 |  | 0.0011 | 0.0528 | 0.0008 | 0.3811 | 0.0080 | 299.2 | 45.05 | 331.9 | 4.8 | 327.8 | 5.86 | 2 | 11233 | 587 | 345 | 26380 | 281486 |
| PLES19 | 0.0539 |  | 0.0011 | 0.0532 | 0.0008 | 0.3956 | 0.0082 | 367.3 | 44.21 | 334.2 | 4.83 | 338.4 | 5.97 | 23 | 11217 | 605 | 445 | 32684 | 279339 |
| GJ14 | 0.0577 |  | 0.0012 | 0.0989 | 0.0015 | 0.7864 | 0.0173 | 518.2 | 46.58 | 607.7 | 8.82 | 589.1 | 9.83 | 0 | 7996 | 461 | 93 | 3307 | 107106 |
| GJ15 | 0.0596 |  | 0.0014 | 0.0980 | 0.0015 | 0.8055 | 0.0189 | 589 | 49.31 | 602.9 | 9 | 599.9 | 10.61 | 0 | 7728 | 459 | 74 | 3190 | 104497 |
| GJ16 | 0.0602 |  | 0.0014 | 0.0971 | 0.0015 | 0.8051 | 0.0187 | 609.2 | 48.52 | 597.3 | 8.88 | 599.7 | 10.49 | 0 | 8266 | 496 | 98 | 3433 | 112886 |
| GJ17 | 0.0600 |  | 0.0014 | 0.0975 | 0.0015 | 0.8063 | 0.0185 | 603.8 | 47.97 | 599.5 | 8.87 | 600.4 | 10.39 | 0 | 8937 | 535 | 103 | 3596 | 121589 |
| GJ18 | 0.0594 |  | 0.0014 | 0.0970 | 0.0015 | 0.7948 | 0.0185 | 582.7 | 49.03 | 596.9 | 8.89 | 593.9 | 10.48 | 9 | 8433 | 499 | 96 | 3466 | 115283 |

Supplementary Table S6. Individual U–Pb ages for all unknown zircon samples.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **JA15-08** |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | |  |  | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | ρ\* | Concordance (%) | | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 208Pb | 232Pb | 238U |
| JA0801A | 0.0679 | 0.0017 | 0.1382 | 0.0022 | 1.2930 | 0.0315 | 0.3132 | | 99 | 864.9 | 50.34 | 834.4 | 12.56 | 842.6 | 13.93 | 0 | 11270 | 783 | 2215 | 61784 | 105244 |
| JA0802A | 0.0762 | 0.0023 | 0.1358 | 0.0025 | 1.4261 | 0.0416 | 0.2402 | | 91 | 1100.3 | 59.82 | 820.7 | 13.99 | 899.9 | 17.41 | 16 | 6261 | 491 | 554 | 11434 | 59658 |
| JA0803A | 0.0674 | 0.0015 | 0.1332 | 0.0020 | 1.2379 | 0.0268 | 0.3488 | | 99 | 851.1 | 44.25 | 805.8 | 11.45 | 817.9 | 12.16 | 1 | 4996 | 343 | 930 | 27188 | 47813 |
| JA0804A | 0.0937 | 0.0035 | 0.1402 | 0.0030 | 1.8104 | 0.0620 | 0.1833 | | 81 | 1501.2 | 68.16 | 845.9 | 16.78 | 1049.2 | 22.42 | 36 | 3818 | 363 | 1287 | 31015 | 34809 |
| JA0805A | 0.0763 | 0.0024 | 0.1419 | 0.0026 | 1.4920 | 0.0445 | 0.2257 | | 92 | 1102.8 | 61.39 | 855.1 | 14.74 | 927.1 | 18.14 | 0 | 2482 | 193 | 701 | 18426 | 22403 |
| JA0806A | 0.0810 | 0.0027 | 0.1406 | 0.0027 | 1.5691 | 0.0488 | 0.2189 | | 89 | 1220.6 | 63.15 | 848 | 15.43 | 958 | 19.28 | 12 | 7274 | 625 | 3172 | 85635 | 67977 |
| JA0807A | 0.0781 | 0.0020 | 0.1367 | 0.0023 | 1.4720 | 0.0364 | 0.2876 | | 90 | 1149 | 49.7 | 826.1 | 12.8 | 918.9 | 14.95 | 0 | 3031 | 241 | 1237 | 33995 | 28267 |
| JA0808A | 0.0658 | 0.0013 | 0.1369 | 0.0020 | 1.2420 | 0.0247 | 0.3944 | | 101 | 800.5 | 40.29 | 827 | 11.22 | 819.8 | 11.19 | 23 | 7806 | 520 | 2059 | 61181 | 72269 |
| JA0809A | 0.0669 | 0.0013 | 0.1367 | 0.0020 | 1.2602 | 0.0253 | 0.3856 | | 100 | 833.6 | 40.53 | 826 | 11.3 | 828 | 11.37 | 0 | 6696 | 455 | 1190 | 35405 | 62264 |
| JA0810A | 0.0665 | 0.0015 | 0.1368 | 0.0021 | 1.2540 | 0.0276 | 0.3466 | | 100 | 822.1 | 45.22 | 826.4 | 11.73 | 825.2 | 12.43 | 10 | 4789 | 324 | 677 | 19762 | 44508 |
| JA0811A | 0.0673 | 0.0015 | 0.1360 | 0.0021 | 1.2620 | 0.0282 | 0.3367 | | 99 | 847 | 45.95 | 822 | 11.78 | 828.8 | 12.66 | 0 | 4456 | 305 | 1216 | 35468 | 41642 |
| JA0812A | 0.0697 | 0.0013 | 0.1371 | 0.0020 | 1.3165 | 0.0251 | 0.4134 | | 97 | 917.9 | 37.61 | 828.3 | 11.14 | 853 | 10.99 | 3 | 7805 | 553 | 2968 | 85924 | 72278 |
| JA0813A | 0.0681 | 0.0016 | 0.1365 | 0.0021 | 1.2812 | 0.0302 | 0.3172 | | 98 | 871.5 | 48.64 | 824.6 | 12.15 | 837.4 | 13.42 | 7 | 3670 | 254 | 1027 | 29097 | 34177 |
| JA0814A | 0.0662 | 0.0009 | 0.1344 | 0.0018 | 1.2268 | 0.0192 | 0.5318 | | 100 | 812.7 | 29.41 | 813 | 10.22 | 812.9 | 8.76 | 3 | 40850 | 2749 | 5597 | 163460 | 386110 |
| JA0815A | 0.0660 | 0.0013 | 0.1378 | 0.0020 | 1.2540 | 0.0244 | 0.4066 | | 101 | 806.7 | 39.23 | 832.2 | 11.23 | 825.2 | 11.01 | 11 | 7856 | 527 | 1821 | 53133 | 72431 |
| JA0816A | 0.0676 | 0.0013 | 0.1379 | 0.0020 | 1.2853 | 0.0249 | 0.4127 | | 99 | 856.6 | 38.58 | 832.7 | 11.28 | 839.2 | 11.06 | 0 | 10646 | 733 | 997 | 26998 | 98694 |
| JA0817A | 0.0671 | 0.0009 | 0.1260 | 0.0017 | 1.1652 | 0.0177 | 0.5520 | | 98 | 840.4 | 28 | 764.9 | 9.56 | 784.4 | 8.3 | 2 | 87768 | 5983 | 787741 | 25781400 | 884864 |
| JA0818A | 0.0695 | 0.0017 | 0.1412 | 0.0022 | 1.3521 | 0.0319 | 0.3154 | | 98 | 912 | 48.4 | 851.5 | 12.6 | 868.4 | 13.78 | 11 | 5420 | 383 | 2449 | 56826 | 49118 |
| JA0819A | 0.0800 | 0.0017 | 0.1455 | 0.0022 | 1.6043 | 0.0345 | 0.3567 | | 90 | 1195.8 | 41.94 | 875.9 | 12.59 | 971.9 | 13.44 | 0 | 5283 | 430 | 616 | 10132 | 46345 |
| JA0820A | 0.0718 | 0.0014 | 0.1376 | 0.0020 | 1.3624 | 0.0274 | 0.3859 | | 95 | 980.1 | 39.77 | 831.3 | 11.43 | 872.9 | 11.76 | 8 | 6470 | 471 | 1026 | 27675 | 59688 |
| JA0821A | 0.0673 | 0.0013 | 0.1372 | 0.0020 | 1.2734 | 0.0258 | 0.3868 | | 99 | 847.6 | 40.96 | 828.8 | 11.37 | 833.9 | 11.54 | 4 | 6648 | 454 | 2347 | 69855 | 61519 |
| JA0822A | 0.0693 | 0.0013 | 0.1359 | 0.0020 | 1.2989 | 0.0253 | 0.4111 | | 97 | 908.3 | 38.49 | 821.5 | 11.18 | 845.2 | 11.17 | 2 | 13994 | 988 | 2917 | 83473 | 131903 |
| JA0823A | 0.0711 | 0.0015 | 0.1379 | 0.0021 | 1.3504 | 0.0292 | 0.3588 | | 96 | 958.9 | 43.48 | 832.5 | 11.88 | 867.7 | 12.63 | 5 | 9469 | 688 | 2358 | 64787 | 88167 |
| JA0824A | 0.0694 | 0.0018 | 0.1356 | 0.0022 | 1.2979 | 0.0330 | 0.2816 | | 97 | 911 | 52.65 | 819.9 | 12.58 | 844.8 | 14.58 | 10 | 3925 | 277 | 983 | 28779 | 36978 |
| JA0825A | 0.0703 | 0.0018 | 0.1409 | 0.0023 | 1.3650 | 0.0349 | 0.2835 | | 97 | 935.7 | 52.43 | 850 | 13.1 | 874 | 14.98 | 17 | 5006 | 357 | 872 | 26242 | 45421 |
| JA0826A | 0.0684 | 0.0013 | 0.1382 | 0.0020 | 1.3027 | 0.0258 | 0.3917 | | 99 | 880.6 | 39.69 | 834.2 | 11.32 | 846.9 | 11.39 | 0 | 8322 | 576 | 2344 | 69529 | 76322 |
| JA0827A | 0.0653 | 0.0011 | 0.1395 | 0.0019 | 1.2569 | 0.0217 | 0.4718 | | 102 | 785.1 | 33.76 | 842 | 10.85 | 826.5 | 9.76 | 6 | 19698 | 1307 | 2283 | 67927 | 179198 |
| JA0828A | 0.0689 | 0.0017 | 0.1395 | 0.0022 | 1.3247 | 0.0322 | 0.3038 | | 98 | 895.1 | 50.14 | 841.8 | 12.61 | 856.6 | 14.05 | 23 | 4504 | 315 | 1364 | 38680 | 41247 |
| JA0829A | 0.0709 | 0.0016 | 0.1391 | 0.0021 | 1.3605 | 0.0307 | 0.3312 | | 96 | 955.1 | 45.81 | 839.8 | 12.11 | 872.1 | 13.2 | 4 | 4589 | 329 | 1356 | 37289 | 41776 |
| JA0830A | 0.0685 | 0.0013 | 0.1390 | 0.0020 | 1.3128 | 0.0251 | 0.4134 | | 99 | 884.2 | 37.94 | 838.9 | 11.21 | 851.4 | 11.02 | 13 | 10682 | 741 | 3909 | 114113 | 97337 |
| JA0831A | 0.0790 | 0.0033 | 0.1371 | 0.0031 | 1.4919 | 0.0586 | 0.1523 | | 89 | 1170.8 | 81.32 | 828 | 17.47 | 927.1 | 23.88 | 0 | 1263 | 101 | 307 | 9193 | 11777 |
| JA0832A | 0.0699 | 0.0018 | 0.1370 | 0.0022 | 1.3201 | 0.0332 | 0.2873 | | 97 | 925.9 | 52.01 | 827.4 | 12.62 | 854.6 | 14.54 | 0 | 3772 | 267 | 1634 | 48859 | 35045 |
| JA0833A | 0.0809 | 0.0022 | 0.1418 | 0.0024 | 1.5804 | 0.0419 | 0.2604 | | 89 | 1218 | 53.18 | 854.6 | 13.73 | 962.5 | 16.5 | 15 | 3401 | 278 | 1094 | 27993 | 30615 |
| JA0834A | 0.0692 | 0.0017 | 0.1462 | 0.0023 | 1.3957 | 0.0335 | 0.3062 | | 99 | 906 | 49.5 | 879.6 | 13.02 | 887.1 | 14.22 | 4 | 4392 | 308 | 1132 | 29809 | 38180 |
| JA0835A | 0.0680 | 0.0015 | 0.1410 | 0.0021 | 1.3215 | 0.0283 | 0.3525 | | 99 | 867.6 | 43.57 | 850.5 | 11.87 | 855.2 | 12.37 | 0 | 6317 | 434 | 1186 | 32345 | 56702 |
| JA0836A | 0.0702 | 0.0015 | 0.1389 | 0.0021 | 1.3446 | 0.0293 | 0.3461 | | 97 | 934.2 | 44.16 | 838.6 | 11.85 | 865.2 | 12.7 | 8 | 5677 | 403 | 1140 | 32295 | 51716 |
| JA0837A | 0.0657 | 0.0015 | 0.1387 | 0.0021 | 1.2563 | 0.0279 | 0.3394 | | 101 | 796.1 | 45.89 | 837.6 | 11.88 | 826.2 | 12.56 | 0 | 6494 | 432 | 1568 | 46808 | 59463 |
| JA0838A | 0.0668 | 0.0014 | 0.1433 | 0.0021 | 1.3187 | 0.0284 | 0.3552 | | 101 | 830.7 | 44.13 | 863 | 12.04 | 853.9 | 12.44 | 14 | 6430 | 434 | 1330 | 37996 | 56797 |
| JA0839A | 0.0681 | 0.0018 | 0.1472 | 0.0024 | 1.3814 | 0.0359 | 0.2770 | | 100 | 871 | 54.22 | 885.2 | 13.52 | 881 | 15.29 | 13 | 3148 | 216 | 827 | 22237 | 27064 |
| JA0840A | 0.0666 | 0.0014 | 0.1342 | 0.0020 | 1.2322 | 0.0253 | 0.3745 | | 100 | 825.9 | 41.74 | 811.5 | 11.13 | 815.3 | 11.51 | 0 | 8323 | 560 | 2198 | 65960 | 78490 |
| JA0841A | 0.0703 | 0.0016 | 0.1437 | 0.0022 | 1.3934 | 0.0321 | 0.3167 | | 98 | 937.8 | 47 | 865.7 | 12.52 | 886.1 | 13.62 | 5 | 4708 | 334 | 1599 | 44317 | 41443 |
| JA0842A | 0.0656 | 0.0017 | 0.1416 | 0.0023 | 1.2806 | 0.0323 | 0.2811 | | 102 | 793.3 | 53.01 | 853.8 | 12.78 | 837.1 | 14.37 | 7 | 3668 | 243 | 1407 | 40914 | 32759 |
| JA0843A | 0.0688 | 0.0016 | 0.1629 | 0.0025 | 1.5442 | 0.0347 | 0.3345 | | 103 | 891.2 | 45.96 | 973 | 13.76 | 948.2 | 13.86 | 6 | 5431 | 377 | 719 | 19828 | 42159 |
| JA0844A | 0.0674 | 0.0012 | 0.1351 | 0.0019 | 1.2551 | 0.0238 | 0.4117 | | 99 | 849.7 | 37.74 | 817 | 10.85 | 825.7 | 10.72 | 0 | 15024 | 1023 | 1275 | 38651 | 140614 |
| JA0845A | 0.0689 | 0.0023 | 0.1397 | 0.0026 | 1.3264 | 0.0417 | 0.2133 | | 98 | 894.8 | 66.33 | 843 | 14.48 | 857.3 | 18.18 | 10 | 5549 | 385 | 1603 | 45370 | 50855 |
| JA0846A | 0.0676 | 0.0019 | 0.1409 | 0.0024 | 1.3135 | 0.0353 | 0.2618 | | 100 | 856.6 | 56.47 | 849.9 | 13.27 | 851.7 | 15.48 | 4 | 2865 | 195 | 848 | 24928 | 25703 |
| JA0847A | 0.0690 | 0.0016 | 0.1396 | 0.0021 | 1.3282 | 0.0300 | 0.3283 | | 98 | 898.8 | 46.26 | 842.5 | 12.05 | 858.1 | 13.1 | 3 | 5458 | 380 | 1145 | 32237 | 49422 |
| JA0848A | 0.0931 | 0.0031 | 0.1509 | 0.0029 | 1.9366 | 0.0603 | 0.1960 | | 83 | 1490.4 | 61.51 | 906 | 16.17 | 1093.8 | 20.83 | 20 | 3717 | 348 | 915 | 17908 | 30738 |
| JA0849A | 0.0810 | 0.0026 | 0.1331 | 0.0024 | 1.4855 | 0.0457 | 0.1934 | | 87 | 1220.2 | 62.55 | 805.6 | 13.81 | 924.5 | 18.68 | 5 | 5749 | 467 | 1540 | 36897 | 53561 |
| JA0850A | 0.0686 | 0.0016 | 0.1415 | 0.0022 | 1.3386 | 0.0306 | 0.3197 | | 99 | 887.7 | 47 | 853 | 12.12 | 862.6 | 13.26 | 22 | 10703 | 739 | 3181 | 89488 | 94651 |
| **JA15-09** |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | |  | |  | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | ρ\* | | Concordance (%) | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 208Pb | 232Pb | 238U |
| JA0901A | 0.0668 | 0.0010 | 0.1410 | 0.0020 | 1.2990 | 0.0212 | 0.8653 | | 102 | 831.5 | 29.35 | 850.5 | 11.23 | 845.3 | 9.35 | 0 | 26831 | 1808 | 5842 | 175553 | 255781 |
| JA0902A | 0.0669 | 0.0009 | 0.1392 | 0.0019 | 1.2852 | 0.0195 | 0.9140 | | 101 | 836 | 26.28 | 840.3 | 10.89 | 839.2 | 8.66 | 9 | 41932 | 2850 | 6481 | 192649 | 404162 |
| JA0904A | 0.0681 | 0.0009 | 0.1375 | 0.0019 | 1.2910 | 0.0202 | 0.8935 | | 95 | 872 | 27.46 | 830.4 | 10.86 | 841.8 | 8.94 | 20 | 27527 | 1903 | 7149 | 210895 | 268734 |
| JA0905A | 0.0895 | 0.0018 | 0.1485 | 0.0023 | 1.8332 | 0.0367 | 0.7739 | | 63 | 1415.1 | 36.97 | 892.8 | 12.9 | 1057.4 | 13.15 | 48 | 21081 | 1979 | 2393 | 26240 | 189131 |
| JA0906A | 0.0706 | 0.0009 | 0.1387 | 0.0019 | 1.3497 | 0.0207 | 0.9063 | | 89 | 945.1 | 26.33 | 837.3 | 10.9 | 867.4 | 8.95 | 8 | 39100 | 2796 | 6986 | 198493 | 378658 |
| JA0907A | 0.0673 | 0.0009 | 0.1380 | 0.0019 | 1.2804 | 0.0201 | 0.8887 | | 98 | 847.4 | 27.65 | 833.1 | 10.9 | 837 | 8.93 | 9 | 27562 | 1883 | 3544 | 109289 | 268211 |
| JA0908A | 0.0667 | 0.0009 | 0.1355 | 0.0019 | 1.2458 | 0.0194 | 0.8962 | | 99 | 827.9 | 27.47 | 819.1 | 10.71 | 821.5 | 8.77 | 6 | 30071 | 2037 | 4182 | 130970 | 297920 |
| JA0909A | 0.0671 | 0.0012 | 0.1418 | 0.0021 | 1.3114 | 0.0245 | 0.7892 | | 102 | 840 | 35.81 | 854.9 | 11.78 | 850.8 | 10.76 | 14 | 7994 | 544 | 420 | 10852 | 75676 |
| JA0910A | 0.0758 | 0.0013 | 0.1394 | 0.0021 | 1.4579 | 0.0271 | 0.7954 | | 77 | 1090.6 | 34.38 | 841.5 | 11.68 | 913.1 | 11.19 | 0 | 7402 | 570 | 966 | 23763 | 71262 |
| JA0911A | 0.0694 | 0.0009 | 0.1374 | 0.0019 | 1.3147 | 0.0195 | 0.9269 | | 91 | 910.4 | 25.04 | 830 | 10.71 | 852.2 | 8.56 | 8 | 73427 | 5173 | 15176 | 445596 | 717301 |
| JA0912A | 0.0777 | 0.0011 | 0.1444 | 0.0021 | 1.5479 | 0.0252 | 0.8711 | | 76 | 1139.9 | 28.1 | 869.7 | 11.53 | 949.7 | 10.05 | 17 | 22697 | 1787 | 2859 | 57354 | 211567 |
| JA0913A | 0.0669 | 0.0009 | 0.1370 | 0.0019 | 1.2644 | 0.0204 | 0.8753 | | 99 | 835.8 | 28.87 | 827.7 | 10.92 | 829.9 | 9.13 | 1 | 25307 | 1719 | 4308 | 130745 | 248355 |
| JA0914A | 0.0678 | 0.0010 | 0.1396 | 0.0020 | 1.3051 | 0.0223 | 0.8377 | | 98 | 862.5 | 31.53 | 842.5 | 11.29 | 848 | 9.83 | 22 | 13420 | 923 | 2070 | 57433 | 129038 |
| JA0915A | 0.0767 | 0.0013 | 0.1372 | 0.0020 | 1.4511 | 0.0270 | 0.7916 | | 74 | 1113.8 | 34.4 | 828.7 | 11.48 | 910.3 | 11.18 | 40 | 20531 | 1600 | 1722 | 31311 | 200150 |
| JA0916A | 0.0745 | 0.0012 | 0.1412 | 0.0020 | 1.4507 | 0.0250 | 0.8357 | | 81 | 1054.5 | 31.19 | 851.7 | 11.49 | 910.2 | 10.34 | 2 | 19945 | 1507 | 2809 | 72697 | 190066 |
| JA0917A | 0.0970 | 0.0062 | 0.1954 | 0.0067 | 2.6134 | 0.1517 | 0.5881 | | 73 | 1566.6 | 115.48 | 1150.8 | 35.94 | 1304.4 | 42.62 | 10 | 972 | 94 | 254 | 3450 | 6626 |
| JA0918A | 0.0676 | 0.0010 | 0.1456 | 0.0021 | 1.3574 | 0.0233 | 0.8318 | | 102 | 856.6 | 31.67 | 876.4 | 11.73 | 870.8 | 10.04 | 13 | 14316 | 978 | 1835 | 51181 | 132056 |
| JA0919A | 0.1037 | 0.0016 | 0.1406 | 0.0020 | 2.0096 | 0.0342 | 0.8489 | | 50 | 1690.7 | 27.84 | 848 | 11.45 | 1118.8 | 11.53 | 72 | 36296 | 3782 | 8858 | 174449 | 347335 |
| JA0920A | 0.0695 | 0.0013 | 0.1360 | 0.0021 | 1.3019 | 0.0258 | 0.7606 | | 90 | 912.2 | 38.29 | 821.8 | 11.62 | 846.6 | 11.39 | 12 | 6563 | 460 | 532 | 14789 | 64841 |
| JA0921A | 0.0668 | 0.0008 | 0.1421 | 0.0020 | 1.3077 | 0.0198 | 0.9124 | | 103 | 830 | 26.09 | 856.4 | 11.07 | 849.1 | 8.7 | 0 | 68331 | 4617 | 16014 | 468676 | 645700 |
| JA0922A | 0.0963 | 0.0014 | 0.1444 | 0.0021 | 1.9175 | 0.0313 | 0.8728 | | 56 | 1553.8 | 26.9 | 869.5 | 11.62 | 1087.2 | 10.91 | 27 | 15827 | 1544 | 3003 | 51825 | 147241 |
| JA0923A | 0.1856 | 0.0038 | 0.1914 | 0.0032 | 4.8972 | 0.0993 | 0.8242 | | 42 | 2703.2 | 33.44 | 1129.2 | 17.32 | 1801.8 | 17.1 | 92 | 10985 | 2091 | 4430 | 25551 | 76785 |
| JA0924A | 0.0666 | 0.0009 | 0.1378 | 0.0019 | 1.2657 | 0.0196 | 0.8966 | | 101 | 825.3 | 26.99 | 832.4 | 10.83 | 830.5 | 8.76 | 29 | 53931 | 3625 | 11768 | 362709 | 525546 |
| JA0925A | 0.0864 | 0.0016 | 0.1548 | 0.0023 | 1.8432 | 0.0357 | 0.7818 | | 69 | 1346.7 | 34.95 | 927.6 | 13.08 | 1061 | 12.73 | 8 | 10022 | 870 | 1951 | 35955 | 87184 |
| JA0926A | 0.0687 | 0.0013 | 0.1493 | 0.0023 | 1.4135 | 0.0285 | 0.7507 | | 101 | 889.5 | 39.24 | 896.8 | 12.66 | 894.6 | 12 | 0 | 6379 | 441 | 1200 | 30889 | 57370 |
| JA0927A | 0.0672 | 0.0010 | 0.1438 | 0.0020 | 1.3325 | 0.0221 | 0.8525 | | 103 | 843.8 | 30 | 866.3 | 11.45 | 860 | 9.6 | 6 | 26225 | 1778 | 3825 | 108373 | 244812 |
| JA0928A | 0.0722 | 0.0014 | 0.1354 | 0.0020 | 1.3474 | 0.0267 | 0.7569 | | 83 | 990.7 | 37.67 | 818.8 | 11.52 | 866.4 | 11.54 | 19 | 69486 | 5123 | 12485 | 358964 | 689865 |
| JA0929A | 0.0731 | 0.0014 | 0.1389 | 0.0021 | 1.4006 | 0.0274 | 0.7667 | | 82 | 1017.3 | 36.61 | 838.6 | 11.79 | 889.2 | 11.57 | 29 | 13209 | 976 | 2199 | 58525 | 127893 |
| JA0930A | 0.0667 | 0.0012 | 0.1420 | 0.0021 | 1.3052 | 0.0249 | 0.7701 | | 103 | 827.2 | 36.75 | 856.1 | 11.82 | 848 | 10.99 | 16 | 83580 | 5655 | 13689 | 421306 | 791186 |
| JA0931A | 0.1079 | 0.0022 | 0.1549 | 0.0024 | 2.3052 | 0.0482 | 0.7407 | | 53 | 1764.9 | 36.5 | 928.5 | 13.41 | 1213.9 | 14.81 | 103 | 34335 | 3728 | 9566 | 163994 | 299078 |
| JA0932A | 0.0701 | 0.0011 | 0.1324 | 0.0019 | 1.2798 | 0.0220 | 0.8322 | | 86 | 931.5 | 31.11 | 801.6 | 10.75 | 836.8 | 9.78 | 0 | 23449 | 1649 | 1243 | 29556 | 237884 |
| JA0933A | 0.0843 | 0.0019 | 0.1421 | 0.0022 | 1.6512 | 0.0371 | 0.6995 | | 66 | 1299.7 | 42.18 | 856.3 | 12.6 | 990 | 14.19 | 47 | 38791 | 3268 | 7690 | 177575 | 367040 |
| JA0934A | 0.0678 | 0.0011 | 0.1366 | 0.0020 | 1.2760 | 0.0234 | 0.7937 | | 96 | 860.8 | 34.68 | 825.5 | 11.3 | 835.1 | 10.45 | 9 | 11803 | 804 | 1401 | 41622 | 116024 |
| JA0935A | 0.0689 | 0.0011 | 0.1386 | 0.0020 | 1.3165 | 0.0227 | 0.8280 | | 93 | 896.1 | 31.57 | 836.5 | 11.22 | 853 | 9.96 | 22 | 48678 | 3385 | 9333 | 276901 | 472630 |
| JA0936A | 0.0681 | 0.0011 | 0.1407 | 0.0020 | 1.3222 | 0.0231 | 0.8204 | | 97 | 872.7 | 32.36 | 848.9 | 11.41 | 855.5 | 10.12 | 21 | 17822 | 1223 | 2925 | 82965 | 170024 |
| JA0937A | 0.0676 | 0.0010 | 0.1367 | 0.0019 | 1.2739 | 0.0210 | 0.8535 | | 96 | 856.8 | 29.58 | 825.7 | 10.91 | 834.1 | 9.36 | 0 | 43047 | 2927 | 7568 | 234516 | 423190 |
| JA0938A | 0.0691 | 0.0013 | 0.1363 | 0.0020 | 1.2995 | 0.0255 | 0.7576 | | 91 | 902.9 | 37.66 | 823.9 | 11.51 | 845.5 | 11.28 | 15 | 77487 | 5433 | 16343 | 493737 | 764214 |
| JA0939A | 0.0679 | 0.0010 | 0.1338 | 0.0019 | 1.2519 | 0.0212 | 0.8370 | | 94 | 864.5 | 30.97 | 809.5 | 10.81 | 824.3 | 9.58 | 7 | 27262 | 1862 | 4673 | 145042 | 273599 |
| JA0940A | 0.0703 | 0.0011 | 0.1369 | 0.0020 | 1.3273 | 0.0227 | 0.8331 | | 88 | 937.5 | 30.98 | 827.2 | 11.06 | 857.7 | 9.9 | 0 | 24617 | 1742 | 4985 | 145794 | 241411 |
| JA0941A | 0.0766 | 0.0013 | 0.1327 | 0.0019 | 1.4018 | 0.0251 | 0.8112 | | 72 | 1111 | 32.3 | 803.3 | 10.96 | 889.7 | 10.62 | 17 | 15611 | 1198 | 2250 | 61252 | 158070 |
| JA0942A | 0.1465 | 0.0030 | 0.1285 | 0.0020 | 2.5953 | 0.0554 | 0.7322 | | 34 | 2305.1 | 35.26 | 779.5 | 11.49 | 1299.3 | 15.65 | 345 | 58270 | 8733 | 21837 | 346281 | 610574 |
| JA0943A | 0.0681 | 0.0010 | 0.1385 | 0.0020 | 1.2998 | 0.0220 | 0.8369 | | 96 | 870.7 | 30.74 | 836.2 | 11.12 | 845.6 | 9.71 | 23 | 34263 | 2343 | 7075 | 211637 | 332228 |
| JA0944A | 0.0740 | 0.0018 | 0.1422 | 0.0023 | 1.4499 | 0.0354 | 0.6692 | | 82 | 1041.3 | 48.05 | 856.8 | 13.08 | 909.8 | 14.66 | 19 | 22952 | 1701 | 2819 | 72899 | 217633 |
| JA0945A | 0.0663 | 0.0010 | 0.1466 | 0.0021 | 1.3399 | 0.0222 | 0.8518 | | 108 | 815.5 | 30.07 | 881.9 | 11.61 | 863.2 | 9.64 | 11 | 60730 | 4045 | 18694 | 543750 | 556238 |
| JA0946A | 0.0704 | 0.0013 | 0.1387 | 0.0021 | 1.3460 | 0.0258 | 0.7722 | | 89 | 939.4 | 36.2 | 837.4 | 11.61 | 865.8 | 11.15 | 5 | 10985 | 775 | 961 | 26399 | 106460 |
| JA0947A | 0.0676 | 0.0012 | 0.1382 | 0.0020 | 1.2871 | 0.0241 | 0.7818 | | 98 | 854.6 | 35.46 | 834.5 | 11.45 | 840 | 10.68 | 2 | 58818 | 4012 | 11116 | 341143 | 572389 |
| JA0948A | 0.0735 | 0.0013 | 0.1426 | 0.0021 | 1.4444 | 0.0273 | 0.7761 | | 84 | 1027.2 | 34.97 | 859.2 | 11.81 | 907.5 | 11.33 | 16 | 32147 | 2359 | 5911 | 158509 | 303362 |
| JA0949A | 0.0795 | 0.0016 | 0.1426 | 0.0022 | 1.5626 | 0.0326 | 0.7421 | | 73 | 1184 | 39.31 | 859.4 | 12.44 | 955.5 | 12.93 | 1 | 7902 | 633 | 764 | 15141 | 74605 |
| JA0950A | 0.0664 | 0.0010 | 0.1394 | 0.0020 | 1.2748 | 0.0215 | 0.8383 | | 103 | 817.7 | 30.8 | 841 | 11.15 | 834.6 | 9.6 | 8 | 59017 | 3927 | 12884 | 390879 | 568858 |
| **JA15-26** |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | |  | |  | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | ρ\* | | Concordance (%) | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 208Pb | 232Pb | 238U |
| JA0826A | 0.0708 | 0.0018 | 0.1543 | 0.0025 | 1.5054 | 0.0379 | 0.2775 | | 99 | 951.4 | 52.13 | 924.8 | 13.89 | 932.6 | 15.35 | 0 | 3170 | 225 | 452 | 13415 | 25520 |
| JA0827A | 0.0719 | 0.0020 | 0.1498 | 0.0025 | 1.4840 | 0.0394 | 0.2518 | | 97 | 982.2 | 55.09 | 899.8 | 13.95 | 923.9 | 16.11 | 15 | 2826 | 203 | 604 | 16159 | 23378 |
| JA0828A | 0.0686 | 0.0014 | 0.1459 | 0.0021 | 1.3799 | 0.0276 | 0.3687 | | 100 | 886.7 | 40.47 | 878 | 11.73 | 880.4 | 11.77 | 15 | 7259 | 499 | 1211 | 33481 | 61506 |
| JA0829A | 0.0842 | 0.0022 | 0.1570 | 0.0026 | 1.8217 | 0.0461 | 0.2699 | | 89 | 1296.5 | 50.32 | 940 | 14.49 | 1053.3 | 16.61 | 8 | 7169 | 611 | 1103 | 21036 | 57232 |
| JA0830A | 0.0701 | 0.0015 | 0.1531 | 0.0023 | 1.4796 | 0.0319 | 0.3358 | | 100 | 931.6 | 43.88 | 918.2 | 12.71 | 922.1 | 13.06 | 0 | 5978 | 422 | 914 | 23086 | 48471 |
| JA0831A | 0.0881 | 0.0026 | 0.1607 | 0.0028 | 1.9502 | 0.0545 | 0.2239 | | 87 | 1383.6 | 55.54 | 960.6 | 15.78 | 1098.5 | 18.75 | 1 | 3287 | 288 | 771 | 13091 | 25103 |
| JA0832A | 0.0678 | 0.0014 | 0.1509 | 0.0022 | 1.4107 | 0.0288 | 0.3607 | | 101 | 862.4 | 41.55 | 906.1 | 12.25 | 893.5 | 12.14 | 6 | 8130 | 556 | 1117 | 29446 | 67190 |
| JA0833A | 0.0687 | 0.0015 | 0.1477 | 0.0022 | 1.3982 | 0.0294 | 0.3413 | | 100 | 889.1 | 42.88 | 887.9 | 12.12 | 888.2 | 12.44 | 4 | 6776 | 468 | 1174 | 32966 | 56788 |
| JA0834A | 0.0672 | 0.0013 | 0.1447 | 0.0020 | 1.3397 | 0.0257 | 0.3933 | | 101 | 842.4 | 38.66 | 871.3 | 11.43 | 863.1 | 11.13 | 5 | 12043 | 814 | 1543 | 41920 | 103043 |
| JA0835A | 0.0737 | 0.0019 | 0.1480 | 0.0024 | 1.5035 | 0.0366 | 0.2784 | | 95 | 1033.3 | 49.78 | 889.5 | 13.21 | 931.8 | 14.85 | 9 | 3993 | 296 | 797 | 20813 | 33528 |
| JA0836A | 0.0684 | 0.0015 | 0.1473 | 0.0022 | 1.3894 | 0.0297 | 0.3380 | | 100 | 880.9 | 43.85 | 885.9 | 12.21 | 884.4 | 12.64 | 7 | 7266 | 501 | 1709 | 47506 | 61204 |
| JA0837A | 0.0710 | 0.0018 | 0.1483 | 0.0023 | 1.4523 | 0.0353 | 0.2844 | | 98 | 958.5 | 50.1 | 891.4 | 13.12 | 910.8 | 14.6 | 11 | 3914 | 280 | 637 | 17200 | 32730 |
| JA0838A | 0.0675 | 0.0014 | 0.1479 | 0.0022 | 1.3762 | 0.0290 | 0.3402 | | 101 | 853.7 | 43.3 | 889 | 12.14 | 878.8 | 12.4 | 6 | 7538 | 513 | 1285 | 35250 | 63197 |
| JA0839A | 0.0678 | 0.0014 | 0.1460 | 0.0021 | 1.3647 | 0.0277 | 0.3613 | | 101 | 862.8 | 41.38 | 878.4 | 11.81 | 873.9 | 11.9 | 0 | 10148 | 694 | 2391 | 65518 | 86145 |
| JA0840A | 0.0672 | 0.0016 | 0.1390 | 0.0021 | 1.2886 | 0.0293 | 0.3098 | | 100 | 844.9 | 47.22 | 839.2 | 11.88 | 840.7 | 12.99 | 5 | 5463 | 370 | 747 | 22285 | 48669 |
| JA0841A | 0.0783 | 0.0025 | 0.1374 | 0.0025 | 1.4820 | 0.0448 | 0.2048 | | 90 | 1153.4 | 62.07 | 829.7 | 14.25 | 923 | 18.32 | 0 | 1966 | 155 | 226 | 6095 | 17788 |
| JA0842A | 0.0678 | 0.0016 | 0.1503 | 0.0023 | 1.4038 | 0.0332 | 0.2912 | | 101 | 861.4 | 49.33 | 902.4 | 12.99 | 890.5 | 14.03 | 4 | 4963 | 339 | 1056 | 28311 | 40903 |
| JA0843A | 0.0721 | 0.0017 | 0.1457 | 0.0022 | 1.4490 | 0.0336 | 0.2983 | | 96 | 989.9 | 47.51 | 876.8 | 12.61 | 909.5 | 13.94 | 0 | 3814 | 276 | 778 | 20420 | 32267 |
| JA0844A | 0.0678 | 0.0018 | 0.1182 | 0.0019 | 1.1043 | 0.0286 | 0.2620 | | 95 | 862.4 | 54.47 | 720 | 11.01 | 755.4 | 13.8 | 0 | 12881 | 886 | 2770 | 180680 | 136394 |
| JA0845A | 0.0698 | 0.0023 | 0.1460 | 0.0027 | 1.4048 | 0.0441 | 0.1956 | | 99 | 923 | 66.56 | 878.2 | 14.94 | 891 | 18.63 | 1 | 2798 | 195 | 436 | 12014 | 23569 |
| JA0846A | 0.0667 | 0.0014 | 0.1438 | 0.0021 | 1.3227 | 0.0283 | 0.3285 | | 101 | 829.2 | 44.3 | 866 | 11.84 | 855.7 | 12.37 | 2 | 6370 | 427 | 1188 | 30846 | 54482 |
| JA0847A | 0.0692 | 0.0018 | 0.1300 | 0.0021 | 1.2398 | 0.0311 | 0.2673 | | 96 | 904.4 | 52.47 | 787.7 | 11.77 | 818.8 | 14.12 | 0 | 4469 | 311 | 808 | 30071 | 42449 |
| JA0848A | 0.0676 | 0.0014 | 0.1379 | 0.0020 | 1.2853 | 0.0270 | 0.3457 | | 99 | 856.3 | 43.15 | 832.9 | 11.36 | 839.2 | 11.98 | 3 | 9052 | 617 | 887 | 24332 | 81049 |
| JA0849A | 0.0664 | 0.0015 | 0.1373 | 0.0021 | 1.2566 | 0.0283 | 0.3175 | | 100 | 819.3 | 46.85 | 829.1 | 11.7 | 826.4 | 12.72 | 15 | 14307 | 962 | 1115 | 32903 | 130177 |
| JA0850A | 0.0719 | 0.0017 | 0.1421 | 0.0022 | 1.4080 | 0.0331 | 0.2943 | | 96 | 982.6 | 48.22 | 856.4 | 12.42 | 892.3 | 13.97 | 0 | 10069 | 734 | 1614 | 45043 | 88564 |
| JA2601A | 0.0696 | 0.0016 | 0.1467 | 0.0023 | 1.4082 | 0.0321 | 0.3240 | | 99 | 917.4 | 46.57 | 882.5 | 12.65 | 892.4 | 13.53 | 0 | 4353 | 304 | 993 | 27243 | 37291 |
| JA2602A | 0.0698 | 0.0017 | 0.1483 | 0.0023 | 1.4263 | 0.0338 | 0.3082 | | 99 | 922.2 | 48.76 | 891.2 | 13.07 | 900 | 14.15 | 1 | 3705 | 259 | 732 | 19234 | 31420 |
| JA2604A | 0.0755 | 0.0020 | 0.1455 | 0.0024 | 1.5138 | 0.0380 | 0.2797 | | 94 | 1081.6 | 50.94 | 875.5 | 13.42 | 936 | 15.34 | 16 | 3117 | 236 | 529 | 14176 | 26974 |
| JA2605A | 0.0716 | 0.0019 | 0.1458 | 0.0024 | 1.4381 | 0.0371 | 0.2719 | | 97 | 973.7 | 53.18 | 877.2 | 13.48 | 904.9 | 15.44 | 0 | 3308 | 237 | 638 | 17399 | 28507 |
| JA2606A | 0.0685 | 0.0014 | 0.1512 | 0.0022 | 1.4265 | 0.0299 | 0.3647 | | 101 | 882.1 | 42.39 | 907.6 | 12.48 | 900.1 | 12.49 | 0 | 5968 | 410 | 831 | 27110 | 49586 |
| JA2607A | 0.0719 | 0.0019 | 0.1450 | 0.0024 | 1.4374 | 0.0366 | 0.2781 | | 96 | 983.1 | 52.33 | 872.9 | 13.32 | 904.6 | 15.24 | 0 | 3560 | 257 | 691 | 19011 | 30895 |
| JA2608A | 0.0685 | 0.0018 | 0.1451 | 0.0023 | 1.3698 | 0.0343 | 0.2865 | | 100 | 882.7 | 52 | 873.6 | 13.1 | 876.1 | 14.68 | 6 | 3694 | 254 | 675 | 19101 | 32006 |
| JA2609A | 0.0690 | 0.0017 | 0.1437 | 0.0022 | 1.3657 | 0.0322 | 0.3060 | | 99 | 897.3 | 48.52 | 865.4 | 12.62 | 874.3 | 13.8 | 5 | 4180 | 290 | 664 | 18131 | 36553 |
| JA2610A | 0.0696 | 0.0014 | 0.1481 | 0.0022 | 1.4199 | 0.0292 | 0.3662 | | 99 | 915.5 | 41.35 | 890.1 | 12.19 | 897.3 | 12.25 | 11 | 7108 | 498 | 1029 | 30231 | 60312 |
| JA2611A | 0.0680 | 0.0019 | 0.1477 | 0.0025 | 1.3850 | 0.0370 | 0.2629 | | 101 | 869.4 | 56 | 887.9 | 13.74 | 882.6 | 15.75 | 3 | 3100 | 211 | 498 | 13900 | 26340 |
| JA2612A | 0.0763 | 0.0022 | 0.1477 | 0.0026 | 1.5538 | 0.0427 | 0.2442 | | 93 | 1102.9 | 56.26 | 888.2 | 14.36 | 952 | 16.99 | 0 | 2801 | 214 | 471 | 12151 | 23818 |
| JA2613A | 0.0694 | 0.0016 | 0.1488 | 0.0023 | 1.4248 | 0.0331 | 0.3169 | | 99 | 911.8 | 47.71 | 894.5 | 12.91 | 899.4 | 13.86 | 3 | 4155 | 289 | 595 | 16670 | 34978 |
| JA2614A | 0.0680 | 0.0016 | 0.1452 | 0.0023 | 1.3601 | 0.0321 | 0.3060 | | 100 | 867.5 | 48.93 | 873.8 | 12.73 | 871.9 | 13.82 | 7 | 3915 | 267 | 775 | 21271 | 33839 |
| JA2615A | 0.0678 | 0.0012 | 0.1480 | 0.0021 | 1.3835 | 0.0251 | 0.4376 | | 101 | 863.5 | 35.82 | 889.5 | 11.54 | 881.9 | 10.71 | 7 | 12581 | 857 | 3792 | 105228 | 106583 |
| JA2616A | 0.0674 | 0.0014 | 0.1536 | 0.0023 | 1.4279 | 0.0302 | 0.3542 | | 102 | 850.9 | 43.1 | 921.2 | 12.66 | 900.7 | 12.62 | 3 | 6682 | 453 | 660 | 17673 | 54524 |
| JA2617A | 0.0695 | 0.0019 | 0.1471 | 0.0024 | 1.4085 | 0.0365 | 0.2705 | | 99 | 912.7 | 53.93 | 884.5 | 13.53 | 892.5 | 15.37 | 3 | 2650 | 184 | 374 | 10328 | 22523 |
| JA2618A | 0.0681 | 0.0013 | 0.1386 | 0.0020 | 1.3000 | 0.0256 | 0.3839 | | 99 | 870.5 | 39.61 | 836.5 | 11.24 | 845.7 | 11.3 | 0 | 7792 | 533 | 1013 | 29325 | 70333 |
| JA2619A | 0.0701 | 0.0017 | 0.1448 | 0.0023 | 1.3991 | 0.0330 | 0.3073 | | 98 | 930.9 | 48.57 | 871.8 | 12.71 | 888.5 | 13.98 | 0 | 3695 | 259 | 679 | 18174 | 31826 |
| JA2620A | 0.0703 | 0.0015 | 0.1496 | 0.0022 | 1.4498 | 0.0311 | 0.3462 | | 99 | 937.4 | 43.44 | 898.6 | 12.51 | 909.8 | 12.89 | 6 | 4860 | 343 | 1014 | 26539 | 40680 |
| JA2621A | 0.0753 | 0.0016 | 0.1364 | 0.0020 | 1.4150 | 0.0301 | 0.3416 | | 92 | 1075.7 | 42.31 | 824.2 | 11.52 | 895.2 | 12.65 | 13 | 6345 | 478 | 1251 | 35395 | 57888 |
| JA2622A | 0.0675 | 0.0011 | 0.1394 | 0.0019 | 1.2961 | 0.0227 | 0.4547 | | 100 | 852.2 | 34.22 | 841.1 | 10.79 | 844 | 10.02 | 13 | 15962 | 1084 | 1163 | 33570 | 143259 |
| JA2623A | 0.0699 | 0.0016 | 0.1438 | 0.0022 | 1.3858 | 0.0317 | 0.3162 | | 98 | 926.2 | 46.81 | 865.9 | 12.43 | 882.9 | 13.48 | 7 | 4664 | 328 | 857 | 22981 | 40589 |
| JA2624A | 0.0684 | 0.0014 | 0.1479 | 0.0021 | 1.3940 | 0.0281 | 0.3762 | | 100 | 879.6 | 40.64 | 889.3 | 12 | 886.4 | 11.91 | 5 | 8123 | 558 | 2333 | 64135 | 68685 |
| JA2625A | 0.0669 | 0.0014 | 0.1484 | 0.0022 | 1.3692 | 0.0295 | 0.3439 | | 102 | 835.2 | 44.2 | 892.1 | 12.35 | 875.8 | 12.62 | 7 | 5456 | 367 | 1221 | 33806 | 45895 |
| **JA15-36** |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | |  | |  | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | ρ\* | | Concordance (%) | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 208Pb | 232Pb | 238U |
| JA3601A | 0.0932 | 0.0038 | 0.1397 | 0.0033 | 1.7944 | 0.0655 | 0.1559 | | 81 | 1492 | 74.57 | 842.8 | 18.78 | 1043.4 | 23.81 | 13 | 5566 | 615 | 2088 | 34725 | 51519 |
| JA3602A | 0.0703 | 0.0012 | 0.1431 | 0.0021 | 1.3862 | 0.0255 | 0.4707 | | 98 | 936.8 | 34.97 | 861.9 | 11.65 | 883.1 | 10.83 | 1 | 15619 | 1111 | 1086 | 25174 | 143576 |
| JA3603A | 0.0675 | 0.0013 | 0.1374 | 0.0020 | 1.2773 | 0.0250 | 0.4262 | | 99 | 851.9 | 38.52 | 829.6 | 11.47 | 835.7 | 11.16 | 15 | 13195 | 900 | 1224 | 33880 | 126231 |
| JA3604A | 0.0804 | 0.0025 | 0.1424 | 0.0027 | 1.5788 | 0.0464 | 0.2435 | | 89 | 1207.4 | 59.39 | 858.2 | 14.93 | 961.9 | 18.26 | 21 | 3929 | 321 | 724 | 20431 | 36107 |
| JA3605A | 0.0734 | 0.0012 | 0.1093 | 0.0016 | 1.1052 | 0.0195 | 0.4923 | | 88 | 1023.7 | 32.46 | 668.6 | 9.07 | 755.9 | 9.42 | 15 | 18883 | 1399 | 956 | 27812 | 227612 |
| JA3606A | 0.0708 | 0.0012 | 0.1279 | 0.0018 | 1.2488 | 0.0219 | 0.4945 | | 94 | 952.4 | 32.84 | 775.8 | 10.41 | 822.8 | 9.9 | 12 | 14827 | 1065 | 1068 | 27705 | 152598 |
| JA3607A | 0.0704 | 0.0015 | 0.1429 | 0.0022 | 1.3858 | 0.0299 | 0.3919 | | 98 | 939 | 42.51 | 860.9 | 12.4 | 882.9 | 12.73 | 7 | 21700 | 1535 | 1546 | 39612 | 201938 |
| JA3608A | 0.0734 | 0.0015 | 0.1420 | 0.0022 | 1.4378 | 0.0304 | 0.3921 | | 95 | 1026.1 | 41.4 | 856.1 | 12.33 | 904.8 | 12.67 | 11 | 4918 | 365 | 824 | 25327 | 45618 |
| JA3609A | 0.0689 | 0.0012 | 0.1512 | 0.0022 | 1.4358 | 0.0273 | 0.4523 | | 100 | 895.1 | 36.71 | 907.7 | 12.38 | 904 | 11.39 | 0 | 10581 | 733 | 3413 | 93193 | 92267 |
| JA3610A | 0.0695 | 0.0015 | 0.1505 | 0.0023 | 1.4415 | 0.0314 | 0.3836 | | 100 | 913.5 | 43.35 | 903.5 | 13.03 | 906.4 | 13.04 | 0 | 5741 | 401 | 1020 | 27794 | 50322 |
| JA3611A | 0.0689 | 0.0012 | 0.1302 | 0.0019 | 1.2378 | 0.0228 | 0.4783 | | 96 | 896.9 | 34.98 | 789.2 | 10.73 | 817.9 | 10.34 | 15 | 20072 | 1389 | 1460 | 37457 | 203991 |
| JA3612A | 0.0706 | 0.0014 | 0.1516 | 0.0023 | 1.4745 | 0.0307 | 0.4020 | | 99 | 945 | 40.96 | 909.7 | 12.88 | 920 | 12.62 | 0 | 6853 | 486 | 1925 | 53035 | 59647 |
| JA3613A | 0.0743 | 0.0018 | 0.1504 | 0.0025 | 1.5407 | 0.0369 | 0.3396 | | 95 | 1049.6 | 47.53 | 903.3 | 13.71 | 946.8 | 14.75 | 0 | 7751 | 578 | 1968 | 57282 | 68475 |
| JA3614A | 0.0767 | 0.0013 | 0.0897 | 0.0013 | 0.9478 | 0.0175 | 0.4740 | | 82 | 1112 | 34.01 | 553.8 | 7.7 | 677 | 9.11 | 19 | 21667 | 1667 | 1263 | 29376 | 319982 |
| JA3615A | 0.0791 | 0.0016 | 0.0969 | 0.0015 | 1.0561 | 0.0222 | 0.3808 | | 81 | 1174.7 | 40.39 | 595.9 | 8.7 | 731.9 | 10.95 | 27 | 14946 | 1200 | 2425 | 91884 | 202149 |
| JA3616A | 0.0713 | 0.0016 | 0.1350 | 0.0021 | 1.3266 | 0.0297 | 0.3614 | | 95 | 965.1 | 44.71 | 816.5 | 11.91 | 857.4 | 12.96 | 17 | 16073 | 1151 | 1449 | 38534 | 155814 |
| JA3617A | 0.0739 | 0.0014 | 0.1345 | 0.0020 | 1.3691 | 0.0263 | 0.4047 | | 93 | 1037.9 | 37.88 | 813.3 | 11.36 | 875.8 | 11.28 | 62 | 27255 | 2216 | 2831 | 56120 | 262565 |
| JA3618A | 0.0701 | 0.0029 | 0.1305 | 0.0029 | 1.2602 | 0.0496 | 0.1605 | | 95 | 931 | 83.39 | 790.4 | 16.24 | 828 | 22.26 | 23 | 6898 | 496 | 709 | 16429 | 69529 |
| JA3619A | 0.0720 | 0.0015 | 0.1378 | 0.0021 | 1.3671 | 0.0296 | 0.3746 | | 95 | 985.3 | 42.96 | 832.1 | 12.06 | 874.9 | 12.71 | 14 | 8489 | 621 | 1418 | 49232 | 80854 |
| JA3620A | 0.0705 | 0.0018 | 0.1549 | 0.0026 | 1.5060 | 0.0373 | 0.3213 | | 99 | 944.2 | 50.32 | 928.1 | 14.23 | 932.8 | 15.11 | 3 | 4082 | 289 | 606 | 16292 | 34796 |
| JA3620B | 0.0787 | 0.0023 | 0.1507 | 0.0027 | 1.6352 | 0.0459 | 0.2688 | | 92 | 1165.2 | 56.46 | 904.7 | 15.19 | 983.9 | 17.67 | 9 | 2501 | 198 | 392 | 9909 | 21917 |
| JA3621A | 0.0781 | 0.0021 | 0.1474 | 0.0025 | 1.5871 | 0.0408 | 0.3000 | | 92 | 1149.3 | 51.27 | 886.4 | 14.12 | 965.2 | 16.02 | 0 | 3305 | 259 | 554 | 13922 | 29602 |
| JA3622A | 0.0972 | 0.0045 | 0.1466 | 0.0036 | 1.9625 | 0.0836 | 0.1457 | | 80 | 1570.8 | 83.92 | 881.8 | 20.49 | 1102.7 | 28.67 | 31 | 12086 | 1220 | 2134 | 47730 | 109662 |
| JA3623A | 0.0671 | 0.0015 | 0.1443 | 0.0022 | 1.3342 | 0.0295 | 0.3712 | | 101 | 840.5 | 44.57 | 868.7 | 12.56 | 860.7 | 12.82 | 6 | 8928 | 602 | 1167 | 33669 | 81641 |
| JA3624A | 0.0710 | 0.0016 | 0.1492 | 0.0024 | 1.4602 | 0.0339 | 0.3498 | | 98 | 956.7 | 46.52 | 896.7 | 13.34 | 914.1 | 13.98 | 7 | 5349 | 381 | 1057 | 29907 | 47344 |
| JA3625A | 0.0706 | 0.0015 | 0.1485 | 0.0023 | 1.4457 | 0.0305 | 0.3954 | | 98 | 946 | 41.49 | 892.7 | 12.69 | 908.1 | 12.64 | 1 | 6632 | 469 | 1471 | 40227 | 59023 |
| JA3626A | 0.0710 | 0.0014 | 0.1474 | 0.0022 | 1.4421 | 0.0297 | 0.4133 | | 98 | 956.7 | 40.11 | 886.2 | 12.48 | 906.6 | 12.35 | 0 | 7444 | 529 | 1501 | 39475 | 66788 |
| JA3627A | 0.0708 | 0.0013 | 0.1433 | 0.0021 | 1.3984 | 0.0276 | 0.4371 | | 97 | 951.4 | 38.01 | 863.2 | 11.98 | 888.3 | 11.68 | 15 | 9355 | 665 | 1275 | 35352 | 86392 |
| JA3628A | 0.0687 | 0.0012 | 0.1437 | 0.0021 | 1.3600 | 0.0259 | 0.4601 | | 99 | 888.6 | 36.66 | 865.4 | 11.82 | 871.9 | 11.16 | 7 | 13189 | 907 | 4689 | 135131 | 121421 |
| JA3629A | 0.0702 | 0.0013 | 0.1468 | 0.0022 | 1.4215 | 0.0274 | 0.4521 | | 98 | 934.8 | 36.98 | 883.2 | 12.12 | 898 | 11.5 | 0 | 11557 | 814 | 3157 | 88015 | 104171 |
| JA3630A | 0.0667 | 0.0012 | 0.1326 | 0.0019 | 1.2202 | 0.0229 | 0.4669 | | 99 | 829.6 | 36.08 | 802.8 | 10.92 | 809.9 | 10.45 | 7 | 16821 | 1124 | 1427 | 41199 | 167791 |
| JA3631A | 0.0737 | 0.0015 | 0.1267 | 0.0019 | 1.2870 | 0.0275 | 0.3962 | | 92 | 1032.9 | 41.44 | 768.9 | 11.09 | 840 | 12.19 | 0 | 9604 | 708 | 967 | 28978 | 100368 |
| JA3632A | 0.0704 | 0.0017 | 0.1467 | 0.0024 | 1.4239 | 0.0347 | 0.3296 | | 98 | 940.4 | 49.21 | 882.4 | 13.39 | 899 | 14.54 | 9 | 4880 | 343 | 604 | 16426 | 44065 |
| JA3633A | 0.0720 | 0.0016 | 0.1427 | 0.0022 | 1.4173 | 0.0321 | 0.3660 | | 96 | 987.2 | 44.54 | 860 | 12.64 | 896.2 | 13.49 | 15 | 7686 | 554 | 1008 | 26245 | 71316 |

\* ρ denotes error correlation between ratios used to construct concordia plot.

Supplementary Table S7. Individual U–Pb ages for monazite standards.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **JA15-04** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 238U |
| 22204 | 0.0551 | 0.0008 | 0.0705 | 0.0010 | 0.5350 | 0.0091 | 415.9 | 31.92 | 439 | 6.02 | 435.1 | 6 | 3 | 30430 | 1696 | 594168 |
| 22205 | 0.0557 | 0.0008 | 0.0681 | 0.0010 | 0.5224 | 0.0088 | 439.4 | 31.07 | 424.6 | 5.83 | 426.7 | 5.84 | 0 | 29386 | 1658 | 594968 |
| 22206 | 0.0570 | 0.0009 | 0.0686 | 0.0010 | 0.5393 | 0.0094 | 491.8 | 33.12 | 427.9 | 5.95 | 437.9 | 6.2 | 5 | 29739 | 1716 | 601438 |
| 22210 | 0.0584 | 0.0011 | 0.0829 | 0.0013 | 0.6666 | 0.0139 | 543.5 | 41.02 | 513.5 | 7.48 | 518.7 | 8.45 | 0 | 22734 | 1345 | 388226 |
| 22226 | 0.0556 | 0.0010 | 0.0687 | 0.0010 | 0.5268 | 0.0102 | 437.6 | 37.06 | 428.3 | 6.15 | 429.7 | 6.75 | 5 | 24301 | 1364 | 500056 |
| 22227 | 0.0569 | 0.0009 | 0.0668 | 0.0010 | 0.5242 | 0.0098 | 487.4 | 36.08 | 417 | 5.93 | 428 | 6.51 | 2 | 26235 | 1503 | 551425 |
| 22228 | 0.0578 | 0.0009 | 0.0749 | 0.0011 | 0.5968 | 0.0105 | 522.8 | 32.67 | 465.6 | 6.52 | 475.2 | 6.64 | 0 | 30505 | 1782 | 571829 |
| STDMAD01 | 0.0604 | 0.0009 | 0.0829 | 0.0012 | 0.6899 | 0.0118 | 617.6 | 31.35 | 513.5 | 7.04 | 532.8 | 7.06 | 0 | 25564 | 1566 | 425055 |
| STDMAD02 | 0.0567 | 0.0008 | 0.0830 | 0.0012 | 0.6485 | 0.0102 | 479.5 | 29.33 | 514 | 6.83 | 507.5 | 6.29 | 4 | 28736 | 1651 | 467763 |
| STDMAD03 | 0.0569 | 0.0008 | 0.0786 | 0.0011 | 0.6160 | 0.0098 | 485.1 | 29.74 | 488 | 6.51 | 487.3 | 6.15 | 0 | 26699 | 1538 | 459189 |
| STDMAD07 | 0.0572 | 0.0007 | 0.0884 | 0.0012 | 0.6961 | 0.0106 | 497.6 | 28.14 | 545.8 | 7.07 | 536.5 | 6.32 | 2 | 31034 | 1800 | 465315 |
| STDMAD08 | 0.0579 | 0.0010 | 0.0833 | 0.0012 | 0.6637 | 0.0125 | 524.1 | 36.35 | 515.6 | 7.27 | 516.9 | 7.61 | 1 | 37500 | 2192 | 629887 |
| STDMAD09 | 0.0564 | 0.0008 | 0.0885 | 0.0012 | 0.6873 | 0.0113 | 465.5 | 30.8 | 546.8 | 7.34 | 531.2 | 6.77 | 1 | 27682 | 1578 | 425637 |
| STDMAD23 | 0.0567 | 0.0008 | 0.0858 | 0.0012 | 0.6699 | 0.0111 | 478.1 | 31.08 | 530.6 | 7.2 | 520.6 | 6.76 | 4 | 28601 | 1636 | 458188 |
| STDMAD24 | 0.0577 | 0.0011 | 0.0815 | 0.0013 | 0.6480 | 0.0141 | 518.7 | 43.21 | 505 | 7.44 | 507.3 | 8.66 | 0 | 36189 | 2089 | 632037 |
| STDMAD25 | 0.0945 | 0.0017 | 0.0847 | 0.0013 | 1.1024 | 0.0217 | 1518.5 | 32.63 | 523.8 | 7.68 | 754.5 | 10.47 | 97 | 38975 | 3714 | 659488 |
| STDMAD29 | 0.0569 | 0.0008 | 0.0833 | 0.0012 | 0.6524 | 0.0111 | 486 | 32.14 | 515.5 | 7.06 | 509.9 | 6.83 | 2 | 27828 | 1597 | 461500 |
| STDMAD30 | 0.0570 | 0.0008 | 0.0811 | 0.0012 | 0.6365 | 0.0109 | 489.8 | 32.3 | 502.6 | 6.91 | 500.2 | 6.77 | 3 | 27365 | 1573 | 467338 |
| **JA15-06** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 238U |
| 22201 | 0.0603 | 0.0015 | 0.0978 | 0.0016 | 0.8126 | 0.0206 | 615.6 | 51.07 | 601.3 | 9.57 | 603.9 | 11.56 | 4 | 7850 | 485 | 119714 |
| 22202 | 0.0593 | 0.0012 | 0.0938 | 0.0015 | 0.7658 | 0.0167 | 576.6 | 41.67 | 577.9 | 8.91 | 577.3 | 9.58 | 0 | 8114 | 489 | 130788 |
| 22203 | 0.0567 | 0.0011 | 0.0708 | 0.0011 | 0.5529 | 0.0121 | 478.3 | 43.04 | 440.9 | 6.89 | 446.9 | 7.9 | 7 | 7314 | 423 | 156950 |
| 22204 | 0.0574 | 0.0011 | 0.0714 | 0.0012 | 0.5649 | 0.0123 | 506.4 | 42.51 | 444.7 | 6.95 | 454.7 | 7.97 | 0 | 7392 | 434 | 157319 |
| 22205 | 0.0559 | 0.0011 | 0.0701 | 0.0011 | 0.5398 | 0.0115 | 446.2 | 40.98 | 436.9 | 6.74 | 438.3 | 7.55 | 0 | 7860 | 449 | 168826 |
| 22206 | 0.0555 | 0.0012 | 0.0734 | 0.0012 | 0.5608 | 0.0132 | 430.4 | 46.84 | 456.4 | 7.3 | 452 | 8.6 | 4 | 7167 | 410 | 149422 |
| 22207 | 0.0560 | 0.0015 | 0.0714 | 0.0012 | 0.5510 | 0.0152 | 450.8 | 57.16 | 444.7 | 7.44 | 445.6 | 9.97 | 0 | 6956 | 399 | 149110 |
| 22208 | 0.0542 | 0.0013 | 0.0730 | 0.0012 | 0.5447 | 0.0138 | 377.9 | 52.19 | 453.9 | 7.37 | 441.5 | 9.07 | 0 | 7403 | 414 | 154427 |
| 22209 | 0.0558 | 0.0013 | 0.0744 | 0.0013 | 0.5722 | 0.0147 | 445.5 | 52.27 | 462.3 | 7.59 | 459.4 | 9.52 | 0 | 7296 | 419 | 150759 |
| STDMAD01 | 0.0565 | 0.0012 | 0.0838 | 0.0014 | 0.6527 | 0.0147 | 472.8 | 45.49 | 518.7 | 8 | 510.1 | 9.04 | 0 | 13241 | 767 | 235167 |
| STDMAD02 | 0.0572 | 0.0011 | 0.0849 | 0.0013 | 0.6698 | 0.0142 | 499.8 | 40.91 | 525.6 | 7.99 | 520.6 | 8.63 | 7 | 13730 | 799 | 240805 |
| STDMAD03 | 0.0575 | 0.0011 | 0.0818 | 0.0013 | 0.6489 | 0.0140 | 511.8 | 42.4 | 507.1 | 7.76 | 507.8 | 8.63 | 2 | 12505 | 732 | 227807 |
| STDMAD04 | 0.0573 | 0.0011 | 0.0845 | 0.0014 | 0.6667 | 0.0145 | 501.3 | 42.32 | 522.8 | 8.21 | 518.7 | 8.85 | 0 | 10175 | 599 | 185173 |
| STDMAD05 | 0.0568 | 0.0011 | 0.0846 | 0.0014 | 0.6622 | 0.0147 | 484 | 43.33 | 523.2 | 8.25 | 515.9 | 8.97 | 13 | 10834 | 632 | 197088 |
| STDMAD06 | 0.0568 | 0.0012 | 0.0822 | 0.0014 | 0.6432 | 0.0148 | 483 | 45.49 | 509 | 8.08 | 504.3 | 9.15 | 0 | 11018 | 642 | 205406 |
| **JA15-40** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 238U |
| 22201 | 0.0568 | 0.0013 | 0.0726 | 0.0012 | 0.5683 | 0.0136 | 484.3 | 48.12 | 451.6 | 7.17 | 456.9 | 8.8 | 1 | 7931 | 456 | 165247 |
| 22202 | 0.0566 | 0.0013 | 0.0725 | 0.0012 | 0.5652 | 0.0140 | 475 | 50.33 | 450.9 | 7.21 | 454.9 | 9.05 | 3 | 8261 | 472 | 172217 |
| 22203 | 0.0576 | 0.0013 | 0.0706 | 0.0012 | 0.5608 | 0.0132 | 514.9 | 47.15 | 439.9 | 6.99 | 452 | 8.61 | 6 | 8902 | 520 | 191062 |
| 22204 | 0.0558 | 0.0012 | 0.0728 | 0.0012 | 0.5594 | 0.0135 | 443.4 | 47.92 | 452.8 | 7.27 | 451.1 | 8.78 | 0 | 10970 | 619 | 231070 |
| 22205 | 0.0577 | 0.0012 | 0.0717 | 0.0012 | 0.5704 | 0.0129 | 519.5 | 43.99 | 446.3 | 7.06 | 458.2 | 8.32 | 0 | 12085 | 707 | 257836 |
| 22206 | 0.0564 | 0.0012 | 0.0714 | 0.0012 | 0.5550 | 0.0134 | 468 | 48.46 | 444.5 | 7.17 | 448.3 | 8.75 | 5 | 12591 | 718 | 271338 |
| 22207 | 0.0565 | 0.0015 | 0.0708 | 0.0012 | 0.5511 | 0.0155 | 470.5 | 58.3 | 441 | 7.41 | 445.7 | 10.15 | 0 | 7954 | 450 | 172914 |
| STDMAD01 | 0.0570 | 0.0013 | 0.0849 | 0.0014 | 0.6676 | 0.0159 | 492.3 | 47.68 | 525.5 | 8.28 | 519.3 | 9.68 | 0 | 13854 | 803 | 245881 |
| STDMAD02 | 0.0565 | 0.0012 | 0.0832 | 0.0014 | 0.6478 | 0.0154 | 471.9 | 48.25 | 515 | 8.11 | 507.1 | 9.5 | 14 | 13141 | 752 | 238102 |
| STDMAD03 | 0.0548 | 0.0012 | 0.0818 | 0.0013 | 0.6174 | 0.0147 | 402.9 | 48.14 | 506.7 | 7.99 | 488.2 | 9.26 | 2 | 13407 | 744 | 247290 |
| STDMAD04 | 0.0571 | 0.0013 | 0.0828 | 0.0014 | 0.6508 | 0.0156 | 492.8 | 47.97 | 512.6 | 8.11 | 508.9 | 9.6 | 2 | 12839 | 743 | 234254 |
| STDMAD05 | 0.0565 | 0.0011 | 0.0858 | 0.0014 | 0.6684 | 0.0147 | 471.8 | 42.42 | 530.8 | 8.36 | 519.7 | 8.92 | 0 | 11513 | 657 | 207749 |
| STDMAD06 | 0.0550 | 0.0015 | 0.0835 | 0.0015 | 0.6327 | 0.0181 | 412.4 | 59.52 | 516.7 | 8.68 | 497.8 | 11.27 | 2 | 11731 | 661 | 214813 |
| STDMAD07 | 0.0572 | 0.0012 | 0.0822 | 0.0014 | 0.6472 | 0.0147 | 497.9 | 43.69 | 508.9 | 8.1 | 506.8 | 9.06 | 4 | 10385 | 598 | 196024 |
| STDMAD08 | 0.0569 | 0.0014 | 0.0834 | 0.0014 | 0.6535 | 0.0172 | 485.4 | 53.16 | 516.4 | 8.58 | 510.6 | 10.58 | 0 | 10100 | 576 | 189714 |
| **JA15-43** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U |  | 204Pb | 206Pb | 207Pb | 238U |
| 22204 | 0.0558 | 0.0009 | 0.0711 | 0.0011 | 0.5471 | 0.0103 | 444.4 | 35.18 | 443 | 6.48 | 443.1 | 6.73 | 6 | 32819 | 1871 | 670246 |
| 22205 | 0.0557 | 0.0009 | 0.0711 | 0.0011 | 0.5456 | 0.0105 | 438.6 | 36.41 | 442.9 | 6.51 | 442.1 | 6.88 | 0 | 28763 | 1636 | 587822 |
| 22206 | 0.0559 | 0.0008 | 0.0698 | 0.0011 | 0.5372 | 0.0095 | 446.4 | 31.76 | 434.9 | 6.3 | 436.5 | 6.24 | 0 | 31176 | 1772 | 650076 |
| 22219 | 0.0570 | 0.0011 | 0.0733 | 0.0012 | 0.5755 | 0.0123 | 491.6 | 40.75 | 455.7 | 7.03 | 461.6 | 7.9 | 1 | 35411 | 2039 | 728987 |
| 22220 | 0.0552 | 0.0012 | 0.0735 | 0.0012 | 0.5594 | 0.0129 | 420.7 | 45.09 | 457.3 | 7.21 | 451.2 | 8.43 | 3 | 29481 | 1645 | 607878 |
| 22221 | 0.0562 | 0.0011 | 0.0734 | 0.0012 | 0.5680 | 0.0126 | 459 | 43.35 | 456.5 | 7.15 | 456.7 | 8.18 | 7 | 27628 | 1572 | 572182 |
| STDMAD01 | 0.0575 | 0.0010 | 0.0845 | 0.0013 | 0.6696 | 0.0130 | 510.9 | 37.2 | 522.8 | 7.66 | 520.5 | 7.93 | 1 | 30609 | 1768 | 527676 |
| STDMAD02 | 0.0570 | 0.0009 | 0.0838 | 0.0013 | 0.6581 | 0.0125 | 489.8 | 36.33 | 518.9 | 7.56 | 513.5 | 7.66 | 3 | 28757 | 1672 | 497853 |
| STDMAD03 | 0.0571 | 0.0010 | 0.0820 | 0.0013 | 0.6454 | 0.0125 | 494.7 | 37.19 | 508.2 | 7.44 | 505.7 | 7.73 | 4 | 25519 | 1488 | 451732 |
| STDMAD14 | 0.0566 | 0.0011 | 0.0884 | 0.0014 | 0.6894 | 0.0153 | 476.5 | 43.82 | 545.8 | 8.39 | 532.4 | 9.18 | 0 | 28113 | 1609 | 476720 |
| STDMAD15 | 0.0681 | 0.0010 | 0.0873 | 0.0014 | 0.8197 | 0.0147 | 870.6 | 29.93 | 539.8 | 8.04 | 607.9 | 8.22 | 23 | 26499 | 1864 | 458331 |
| STDMAD16 | 0.2206 | 0.0031 | 0.1212 | 0.0019 | 3.6725 | 0.0651 | 2984.9 | 22.17 | 737.4 | 10.87 | 1565.4 | 14.15 | 479 | 41928 | 9293 | 526853 |
| STDMAD17 | 0.0587 | 0.0009 | 0.0835 | 0.0013 | 0.6708 | 0.0130 | 555.1 | 33.98 | 517.1 | 7.84 | 521.2 | 7.93 | 0 | 29580 | 1694 | 543605 |
| STDMAD18 | 0.0607 | 0.0015 | 0.0843 | 0.0014 | 0.6901 | 0.0188 | 629.5 | 51.74 | 521.5 | 8.57 | 532.8 | 11.28 | 0 | 28298 | 1585 | 531133 |

Supplementary Table S8. Individual U–Pb ages for all unknown monazite samples.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **JA15-04** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | |  |  | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U | | ρ\* | Concordance (%) | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U | | 204Pb | 206Pb | 207Pb | 238U |
| 11 | 0.0729 | 0.0010 | 0.1387 | 0.0020 | 1.3931 | 0.0230 | 0.8774 | 106 | 1011.5 | 27.57 | 837.3 | 11.36 | 886 | 9.76 | 7 | 41463 | 3066 | 420130 |
| 12 | 0.0677 | 0.0009 | 0.1427 | 0.0020 | 1.3319 | 0.0206 | 0.9097 | 100 | 860 | 25.7 | 860 | 11.36 | 859.7 | 8.98 | 15 | 71343 | 4886 | 692717 |
| 13 | 0.0668 | 0.0012 | 0.1378 | 0.0021 | 1.2680 | 0.0247 | 0.7772 | 100 | 831.5 | 35.87 | 832.4 | 11.83 | 831.5 | 11.08 | 18 | 69964 | 4787 | 725485 |
| 14 | 0.1652 | 0.0054 | 0.1157 | 0.0025 | 2.6338 | 0.0809 | 0.6893 | 186 | 2509.2 | 54.14 | 705.7 | 14.15 | 1310.1 | 22.61 | 0 | 1291 | 215 | 15340 |
| 15 | 0.0676 | 0.0008 | 0.1439 | 0.0020 | 1.3405 | 0.0202 | 0.9304 | 100 | 856.2 | 24.7 | 866.9 | 11.39 | 863.4 | 8.77 | 5 | 72672 | 4984 | 698659 |
| 16 | 0.0671 | 0.0010 | 0.1351 | 0.0020 | 1.2498 | 0.0218 | 0.8299 | 101 | 841 | 30.92 | 817.1 | 11.12 | 823.3 | 9.86 | 0 | 44446 | 3003 | 458791 |
| 17 | 0.0668 | 0.0009 | 0.1456 | 0.0020 | 1.3391 | 0.0209 | 0.8969 | 98 | 830 | 26.47 | 876.1 | 11.49 | 862.8 | 9.08 | 4 | 64142 | 4322 | 605463 |
| 19 | 0.0669 | 0.0010 | 0.1507 | 0.0022 | 1.3890 | 0.0242 | 0.8466 | 98 | 835.2 | 30.07 | 904.8 | 12.46 | 884.3 | 10.27 | 14 | 106857 | 7249 | 1013791 |
| 20 | 0.0669 | 0.0009 | 0.1408 | 0.0020 | 1.2974 | 0.0204 | 0.9016 | 99 | 833.9 | 26.3 | 849.1 | 11.31 | 844.6 | 9.03 | 6 | 78073 | 5274 | 773754 |
| 22 | 0.0679 | 0.0009 | 0.1380 | 0.0020 | 1.2912 | 0.0209 | 0.8845 | 101 | 864.9 | 27.27 | 833.6 | 11.23 | 841.8 | 9.28 | 1 | 62403 | 4287 | 634590 |
| **JA15-06** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | |  |  | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U | | ρ\* | Concordance (%) | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U | | 204Pb | 206Pb | 207Pb | 238U |
| 3 | 0.0664 | 0.0011 | 0.1364 | 0.0021 | 1.2472 | 0.0236 | 0.8252 | 100 | 817.6 | 32.92 | 824.3 | 12.1 | 822.2 | 10.66 | 0 | 24456 | 1657 | 269318 |
| 4 | 0.0664 | 0.0010 | 0.1351 | 0.0021 | 1.2360 | 0.0226 | 0.8608 | 100 | 819 | 30.74 | 816.8 | 12.09 | 817.1 | 10.28 | 9 | 27624 | 1877 | 312450 |
| 5 | 0.0661 | 0.0010 | 0.1343 | 0.0021 | 1.2229 | 0.0229 | 0.8408 | 100 | 808.6 | 31.98 | 812.4 | 11.99 | 811.1 | 10.44 | 0 | 28881 | 1947 | 325955 |
| 6 | 0.0665 | 0.0011 | 0.1397 | 0.0022 | 1.2801 | 0.0242 | 0.8287 | 99 | 821.6 | 32.66 | 843.1 | 12.42 | 836.9 | 10.78 | 2 | 27132 | 1846 | 293471 |
| 7 | 0.0651 | 0.0010 | 0.1345 | 0.0021 | 1.2065 | 0.0231 | 0.8250 | 99 | 778 | 33.26 | 813.2 | 12.06 | 803.6 | 10.61 | 0 | 24674 | 1642 | 278459 |
| 8 | 0.0649 | 0.0010 | 0.1385 | 0.0022 | 1.2384 | 0.0232 | 0.8368 | 98 | 769.8 | 32.33 | 836.4 | 12.3 | 818.2 | 10.51 | 9 | 32945 | 2188 | 359773 |
| 9 | 0.0659 | 0.0013 | 0.1401 | 0.0023 | 1.2729 | 0.0280 | 0.7356 | 99 | 803 | 40.95 | 845.5 | 12.86 | 833.7 | 12.52 | 0 | 18762 | 1270 | 201911 |
| 10 | 0.0657 | 0.0014 | 0.1407 | 0.0023 | 1.2739 | 0.0294 | 0.7126 | 98 | 797.3 | 43.52 | 848.4 | 13.05 | 834.2 | 13.11 | 1 | 11181 | 751 | 119818 |
| 11 | 0.0665 | 0.0012 | 0.1394 | 0.0022 | 1.2778 | 0.0266 | 0.7687 | 99 | 822.4 | 37.61 | 841.3 | 12.64 | 835.9 | 11.86 | 0 | 28270 | 1926 | 306657 |
| 12 | 0.0662 | 0.0012 | 0.1369 | 0.0022 | 1.2484 | 0.0256 | 0.7818 | 99 | 812.3 | 36.67 | 826.9 | 12.44 | 822.7 | 11.54 | 0 | 25404 | 1728 | 282037 |
| 13 | 0.0660 | 0.0014 | 0.1373 | 0.0023 | 1.2490 | 0.0284 | 0.7200 | 99 | 805.6 | 42.68 | 829.5 | 12.75 | 822.9 | 12.83 | 0 | 27766 | 1890 | 305633 |
| **JA15-40** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | |  |  | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U | | ρ\* | Concordance (%) | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U | | 204Pb | 206Pb | 207Pb | 238U |
| 1 | 0.0677 | 0.0015 | 0.1399 | 0.0023 | 1.3060 | 0.0313 | 0.6953 | 100 | 860.4 | 45.25 | 844.1 | 13.16 | 848.3 | 13.77 | 4 | 10820 | 741 | 116903 |
| 2 | 0.0660 | 0.0015 | 0.1394 | 0.0024 | 1.2681 | 0.0314 | 0.6804 | 99 | 806.4 | 47.54 | 841.2 | 13.28 | 831.5 | 14.06 | 6 | 12700 | 853 | 138325 |
| 3 | 0.0671 | 0.0015 | 0.1383 | 0.0023 | 1.2788 | 0.0313 | 0.6850 | 100 | 840 | 46.59 | 835.2 | 13.14 | 836.3 | 13.95 | 3 | 15220 | 1039 | 167057 |
| 4 | 0.0649 | 0.0011 | 0.1319 | 0.0021 | 1.1793 | 0.0242 | 0.7851 | 99 | 771.3 | 36.69 | 798.4 | 12.08 | 791 | 11.25 | 6 | 13565 | 892 | 157298 |
| 5 | 0.0694 | 0.0015 | 0.1293 | 0.0022 | 1.2374 | 0.0291 | 0.7061 | 104 | 911 | 43.85 | 784.1 | 12.26 | 817.7 | 13.22 | 6 | 12460 | 879 | 146197 |
| 6 | 0.0685 | 0.0014 | 0.1379 | 0.0022 | 1.3024 | 0.0286 | 0.7407 | 102 | 885 | 40.06 | 832.6 | 12.71 | 846.8 | 12.6 | 0 | 15506 | 1084 | 170458 |
| 7 | 0.0675 | 0.0015 | 0.1383 | 0.0023 | 1.2867 | 0.0303 | 0.7008 | 101 | 852.9 | 44.13 | 835.2 | 12.94 | 839.8 | 13.44 | 3 | 21689 | 1485 | 237618 |
| **JA15-43** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Isotope ratios and 1σ error (absolute) | | | | | |  |  | Calculated age in Ma and 1σ error (absolute) | | | | | | Isotope counts | | | |
| Analysis | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U | | ρ\* | Concordance (%) | 207Pb/206Pb | | 206Pb/238U | | 207Pb/235U | | 204Pb | 206Pb | 207Pb | 238U |
| 10 | 0.0686 | 0.0009 | 0.1465 | 0.0022 | 1.3855 | 0.0231 | 0.9056 | 100 | 887.9 | 26.48 | 881.3 | 12.4 | 882.8 | 9.83 | 9 | 104578 | 7229 | 1055776 |
| 11 | 0.0683 | 0.0010 | 0.1375 | 0.0021 | 1.2944 | 0.0232 | 0.8508 | 102 | 878.5 | 30.25 | 830.4 | 11.9 | 843.2 | 10.28 | 4 | 49365 | 3407 | 531075 |
| 13 | 0.0661 | 0.0009 | 0.1417 | 0.0021 | 1.2906 | 0.0215 | 0.8983 | 99 | 809.7 | 27.52 | 854.1 | 11.95 | 841.6 | 9.53 | 6 | 158327 | 10692 | 1635157 |

\* ρ denotes error correlation between ratios used to construct concordia plot.

Supplementary Table S9. Results of Lu-Hf isotopic analyses.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **OM14-37** | |  |  |  |  |  |  |  |  |  |
| Analysis | 176Hf/177Hf | 2σ error | 176Lu/177Hf | 176Yb/177Yb | U/Pb Age | Hfi | Epsilon Value | 1σ error | T(DM) | T(DM) (crustal) |
| O1437-04 | 0.28163 | 0.00042 | 0.00082 | 0.02543 | 843 | 0.28161 | -22.7 | 14.7 | 2.27 | 3.09 |
| O1437-07 | 0.28251 | 0.00005 | 0.00136 | 0.04504 | 873 | 0.28248 | 8.8 | 1.8 | 1.07 | 1.18 |
| O1437-18 | 0.28243 | 0.00011 | 0.00268 | 0.07129 | 830 | 0.28239 | 4.6 | 3.7 | 1.22 | 1.41 |
| O1437-20 | 0.28254 | 0.00002 | 0.00023 | 0.00815 | 840 | 0.28253 | 9.9 | 0.8 | 0.99 | 1.09 |
| O1437-23 | 0.28248 | 0.00006 | 0.00137 | 0.04161 | 827 | 0.28246 | 7.0 | 2.0 | 1.10 | 1.26 |
| O1437-27 | 0.28253 | 0.00006 | 0.00234 | 0.07030 | 855 | 0.28250 | 8.9 | 2.3 | 1.05 | 1.16 |
| O1437-44 | 0.28240 | 0.00002 | 0.00045 | 0.01097 | 865 | 0.28239 | 5.3 | 0.7 | 1.19 | 1.39 |
| **JA15-33** | |  |  |  |  |  |  |  |  |  |
| Analysis | 176Hf/177Hf | 2σ error | 176Lu/177Hf | 176Yb/177Yb | U/Pb Age | Hfi | Epsilon Value | 1σ error | T(DM) | T(DM) (crustal) |
| JA1533-04 | 0.28241 | 0.00002 | 0.00035 | 0.01062 | 900 | 0.28241 | 6.8 | 0.7 | 1.17 | 1.33 |
| JA1533-07 | 0.28243 | 0.00004 | 0.00063 | 0.01818 | 835 | 0.28242 | 5.8 | 1.4 | 1.15 | 1.34 |
| JA1533-08 | 0.28234 | 0.00005 | 0.00159 | 0.04949 | 851 | 0.28231 | 2.3 | 1.9 | 1.31 | 1.57 |
| JA1533-19 | 0.28245 | 0.00003 | 0.00057 | 0.01694 | 787 | 0.28245 | 5.6 | 1.1 | 1.12 | 1.32 |
| JA1533-21 | 0.28243 | 0.00002 | 0.00076 | 0.02270 | 835 | 0.28241 | 5.5 | 0.8 | 1.16 | 1.36 |
| JA1533-24 | 0.28252 | 0.00007 | 0.00202 | 0.05512 | 794 | 0.28249 | 7.2 | 2.4 | 1.07 | 1.22 |
| JA1533-30 | 0.28253 | 0.00003 | 0.00066 | 0.01774 | 874 | 0.28252 | 10.2 | 1.2 | 1.01 | 1.10 |
| JA1533-31 | 0.28254 | 0.00008 | 0.00282 | 0.06779 | 835 | 0.28250 | 8.5 | 2.7 | 1.06 | 1.17 |
| JA1533-36 | 0.28243 | 0.00003 | 0.00163 | 0.05182 | 853 | 0.28241 | 5.7 | 1.2 | 1.18 | 1.36 |
| JA1533-37 | 0.28240 | 0.00004 | 0.00090 | 0.02485 | 835 | 0.28239 | 4.6 | 1.5 | 1.20 | 1.42 |
| JA1533-38 | 0.28238 | 0.00003 | 0.00046 | 0.01293 | 805 | 0.28237 | 3.4 | 1.2 | 1.21 | 1.46 |
| **JA15-08** | |  |  |  |  |  |  |  |  |  |
| Analysis | 176Hf/177Hf | 2σ error | 176Lu/177Hf | 176Yb/177Yb | U/Pb Age | Hfi | Epsilon Value | 1σ error | T(DM) | T(DM) (crustal) |
| Ja1508-3 | 0.28243 | 0.00004 | 0.00119 | 0.03542 | 805.8 | 0.28242 | 5.0 | 1.5 | 1.16 | 1.37 |
| Ja1508-8 | 0.28251 | 0.00005 | 0.00188 | 0.06431 | 827 | 0.28248 | 7.9 | 1.7 | 1.07 | 1.20 |
| Ja1508-10 | 0.28244 | 0.00005 | 0.00098 | 0.03285 | 826.4 | 0.28243 | 5.8 | 1.6 | 1.14 | 1.33 |
| Ja1508-11 | 0.28241 | 0.00007 | 0.00165 | 0.05266 | 822 | 0.28239 | 4.3 | 2.4 | 1.21 | 1.42 |
| Ja1508-12 | 0.28227 | 0.00023 | 0.00208 | 0.06350 | 828.3 | 0.28224 | -0.8 | 8.0 | 1.43 | 1.75 |
| Ja1508-13 | 0.28248 | 0.00015 | 0.00243 | 0.08933 | 824.6 | 0.28244 | 6.4 | 5.4 | 1.13 | 1.29 |
| Ja1508-14 | 0.28246 | 0.00006 | 0.00160 | 0.04909 | 813 | 0.28244 | 5.9 | 2.2 | 1.14 | 1.32 |
| Ja1508-15 | 0.28244 | 0.00006 | 0.00186 | 0.05562 | 832.2 | 0.28241 | 5.3 | 2.1 | 1.18 | 1.37 |
| Ja1508-16 | 0.28239 | 0.00012 | 0.00087 | 0.03025 | 832.7 | 0.28238 | 4.3 | 4.1 | 1.21 | 1.43 |
| Ja1508-21 | 0.28247 | 0.00007 | 0.00069 | 0.02094 | 828.8 | 0.28246 | 7.0 | 2.3 | 1.10 | 1.26 |
| Ja1508-22 | 0.28241 | 0.00007 | 0.00165 | 0.05266 | 821.5 | 0.28239 | 4.3 | 2.4 | 1.21 | 1.42 |
| Ja1508-26 | 0.28245 | 0.00008 | 0.00172 | 0.05265 | 834.2 | 0.28243 | 6.0 | 2.6 | 1.15 | 1.33 |
| Ja1508-29 | 0.28248 | 0.00008 | 0.00277 | 0.08126 | 839.8 | 0.28244 | 6.4 | 2.9 | 1.15 | 1.30 |
| Ja1508-34 | 0.28246 | 0.00004 | 0.00112 | 0.03706 | 879.6 | 0.28244 | 7.6 | 1.4 | 1.12 | 1.26 |
| **JA15-09** | |  |  |  |  |  |  |  |  |  |
| Analysis | 176Hf/177Hf | 2σ error | 176Lu/177Hf | 176Yb/177Yb | U/Pb Age | Hfi | Epsilon Value | 1σ error | T(DM) | T(DM) (crustal) |
| Ja1509-01a | 0.28254 | 0.00009 | 0.00276 | 0.09137 | 850.5 | 0.28249 | 8.6 | 3.1 | 1.06 | 1.18 |
| Ja1509-02a | 0.28256 | 0.00007 | 0.00382 | 0.10873 | 840.3 | 0.28250 | 8.8 | 2.4 | 1.06 | 1.16 |
| Ja1509-04a | 0.28247 | 0.00006 | 0.00196 | 0.05965 | 830.4 | 0.28244 | 6.3 | 2.2 | 1.14 | 1.30 |
| Ja1509-07a | 0.28250 | 0.00003 | 0.00137 | 0.03927 | 833.1 | 0.28248 | 7.9 | 1.2 | 1.07 | 1.21 |
| Ja1509-09a | 0.28248 | 0.00003 | 0.00025 | 0.00764 | 854.9 | 0.28248 | 8.3 | 0.9 | 1.07 | 1.20 |
| Ja1509-11a | 0.28259 | 0.00009 | 0.00625 | 0.18122 | 830 | 0.28249 | 8.1 | 3.0 | 1.09 | 1.19 |
| Ja1509-12a | 0.28257 | 0.00018 | 0.00613 | 0.18638 | 869.7 | 0.28247 | 8.2 | 6.5 | 1.12 | 1.22 |
| Ja1509-18a | 0.28250 | 0.00002 | 0.00123 | 0.03347 | 876.4 | 0.28248 | 8.7 | 0.9 | 1.08 | 1.19 |
| Ja1509-24a | 0.28252 | 0.00005 | 0.00172 | 0.05163 | 832.4 | 0.28249 | 8.2 | 1.8 | 1.06 | 1.18 |
| Ja1509-26a | 0.28252 | 0.00005 | 0.00103 | 0.02882 | 896.8 | 0.28250 | 10.0 | 1.6 | 1.04 | 1.13 |
| Ja1509-30a | 0.28245 | 0.00020 | 0.00449 | 0.14235 | 856.1 | 0.28237 | 4.6 | 7.0 | 1.26 | 1.43 |
| Ja1509-36a | 0.28250 | 0.00004 | 0.00136 | 0.04404 | 848.9 | 0.28248 | 8.1 | 1.4 | 1.08 | 1.21 |
| Ja1509-37a | 0.28252 | 0.00009 | 0.00286 | 0.08235 | 825.7 | 0.28247 | 7.5 | 3.3 | 1.09 | 1.23 |
| Ja1509-39a | 0.28252 | 0.00008 | 0.00266 | 0.07867 | 809.5 | 0.28248 | 7.2 | 2.9 | 1.09 | 1.23 |
| Ja1509-40a | 0.28247 | 0.00004 | 0.00146 | 0.04381 | 827.2 | 0.28244 | 6.4 | 1.3 | 1.13 | 1.30 |
| **JA15-26** | |  |  |  |  |  |  |  |  |  |
| Analysis | 176Hf/177Hf | 2σ error | 176Lu/177Hf | 176Yb/177Yb | U/Pb Age | Hfi | Epsilon Value | 1σ error | T(DM) | T(DM) (crustal) |
| Ja1526-01 | 0.28246 | 0.00004 | 0.00112 | 0.03706 | 882.5 | 0.28244 | 7.6 | 1.4 | 1.12 | 1.26 |
| Ja1526-02 | 0.28257 | 0.00005 | 0.00162 | 0.04767 | 891.2 | 0.28254 | 11.3 | 1.6 | 0.98 | 1.04 |
| Ja1526-04 | 0.28252 | 0.00005 | 0.00130 | 0.03647 | 875.5 | 0.28249 | 9.3 | 1.7 | 1.05 | 1.15 |
| Ja1526-07 | 0.28256 | 0.00005 | 0.00129 | 0.04005 | 872.9 | 0.28254 | 10.8 | 1.8 | 0.99 | 1.05 |
| Ja1526-11 | 0.28259 | 0.00006 | 0.00173 | 0.05926 | 887.9 | 0.28256 | 12.0 | 2.2 | 0.96 | 0.99 |
| Ja1526-12 | 0.28252 | 0.00006 | 0.00138 | 0.04277 | 888.2 | 0.28250 | 9.6 | 2.0 | 1.05 | 1.14 |
| Ja1526-17 | 0.28256 | 0.00005 | 0.00130 | 0.04127 | 884.5 | 0.28254 | 10.9 | 1.8 | 0.99 | 1.06 |
| Ja1526-26 | 0.28249 | 0.00005 | 0.00111 | 0.03468 | 924.8 | 0.28248 | 9.7 | 1.8 | 1.08 | 1.16 |
| Ja1526-27 | 0.28257 | 0.00004 | 0.00093 | 0.02970 | 899.8 | 0.28256 | 12.0 | 1.4 | 0.96 | 1.00 |
| Ja1526-35 | 0.28255 | 0.00006 | 0.00237 | 0.06790 | 889.5 | 0.28251 | 10.3 | 2.3 | 1.03 | 1.10 |
| Ja1526-36 | 0.28259 | 0.00018 | 0.00431 | 0.16119 | 885.9 | 0.28252 | 10.3 | 6.2 | 1.03 | 1.10 |
| Ja1526-37 | 0.28259 | 0.00005 | 0.00197 | 0.06277 | 891.4 | 0.28256 | 11.8 | 1.8 | 0.96 | 1.01 |
| Ja1526-39 | 0.28255 | 0.00008 | 0.00311 | 0.09891 | 878.4 | 0.28250 | 9.6 | 2.6 | 1.05 | 1.14 |
| Ja1526-43 | 0.28256 | 0.00005 | 0.00132 | 0.04256 | 876.8 | 0.28254 | 10.8 | 1.7 | 0.99 | 1.06 |
| Ja1526-45 | 0.28252 | 0.00005 | 0.00168 | 0.05308 | 878.2 | 0.28249 | 9.3 | 1.7 | 1.05 | 1.15 |
| Ja1526-46 | 0.28257 | 0.00005 | 0.00199 | 0.06017 | 866 | 0.28254 | 10.7 | 1.9 | 0.99 | 1.06 |
| **JA15-36** | |  |  |  |  |  |  |  |  |  |
| Analysis | 176Hf/177Hf | 2σ error | 176Lu/177Hf | 176Yb/177Yb | U/Pb Age | Hfi | Epsilon Value | 1σ error | T(DM) | T(DM) (crustal) |
| Ja1536-03a | 0.28256 | 0.00013 | 0.00151 | 0.05065 | 829.6 | 0.28254 | 9.7 | 4.4 | 1.00 | 1.09 |
| Ja1536-07a | 0.28252 | 0.00010 | 0.00147 | 0.04820 | 860.9 | 0.28249 | 9.0 | 3.4 | 1.05 | 1.16 |
| Ja1536-08a | 0.28254 | 0.00009 | 0.00285 | 0.09050 | 856.1 | 0.28249 | 8.9 | 3.3 | 1.06 | 1.17 |
| Ja1536-09a | 0.28255 | 0.00008 | 0.00328 | 0.10673 | 907.7 | 0.28250 | 10.1 | 2.9 | 1.05 | 1.13 |
| Ja1536-10a | 0.28257 | 0.00007 | 0.00242 | 0.08242 | 903.5 | 0.28253 | 11.1 | 2.3 | 1.01 | 1.06 |
| Ja1536-11a | 0.28254 | 0.00008 | 0.00198 | 0.05933 | 789.2 | 0.28251 | 8.1 | 2.7 | 1.03 | 1.16 |
| Ja1536-12a | 0.28254 | 0.00008 | 0.00198 | 0.05933 | 909.7 | 0.28251 | 10.6 | 2.7 | 1.03 | 1.10 |
| Ja1536-13a | 0.28259 | 0.00007 | 0.00193 | 0.06114 | 903.3 | 0.28256 | 12.2 | 2.5 | 0.96 | 0.99 |
| Ja1536-20a | 0.28253 | 0.00004 | 0.00101 | 0.03195 | 928.1 | 0.28252 | 11.2 | 1.5 | 1.02 | 1.07 |
| Ja1536-23a | 0.28259 | 0.00005 | 0.00128 | 0.04060 | 868.7 | 0.28257 | 11.9 | 1.8 | 0.94 | 0.99 |
| Ja1536-24a | 0.28262 | 0.00008 | 0.00159 | 0.05165 | 896.7 | 0.28259 | 13.2 | 2.7 | 0.91 | 0.92 |
| Ja1536-25a | 0.28252 | 0.00013 | 0.00231 | 0.08108 | 892.7 | 0.28248 | 9.2 | 4.6 | 1.08 | 1.17 |
| Ja1536-26a | 0.28263 | 0.00008 | 0.00199 | 0.06144 | 886.2 | 0.28260 | 13.3 | 2.8 | 0.90 | 0.91 |
| Ja1536-27a | 0.28252 | 0.00007 | 0.00209 | 0.06989 | 863.2 | 0.28249 | 8.8 | 2.5 | 1.06 | 1.17 |
| Ja1536-30a | 0.28253 | 0.00005 | 0.00177 | 0.05369 | 802.8 | 0.28250 | 7.9 | 1.9 | 1.05 | 1.18 |

**S3. Geochemical data**

Supplementary Table S10. Major element geochemical data for samples collected from Jebel Ja’alan.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample id. | Sample wt. | Flux wt. | LOI (XRF) | Sum | SiO2 | TiO2 | Al2O3 | Fe2O3 | MnO | MgO | CaO | Na2O | K2O | P2O5 | SO3 | Cl |
| Units | (g) | (g) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (ppm) |
| JA15-17 | 1.0008 | 4.0011 | 1.5 | 98.5 | 55.6 | 1.97 | 15.3 | 10.3 | 0.15 | 2.79 | 5.32 | 4.11 | 2.31 | 0.65 | 0.01 | 42 |
| JA15-19 | 1.0021 | 4.0051 | 0.6 | 99.4 | 62.6 | 0.85 | 17.4 | 5.4 | 0.08 | 2.07 | 3.59 | 4.83 | 2.35 | 0.31 | 0.02 | <10 |
| JA15-20 | 1.0046 | 4.0017 | 0.4 | 99.6 | 53.7 | 1.41 | 16.6 | 10.2 | 0.17 | 4.79 | 6.64 | 4.60 | 1.22 | 0.27 | 0.03 | 79 |
| JA15-30 | 1.0011 | 4.0024 | 0.8 | 99.2 | 61.3 | 1.29 | 16.0 | 7.5 | 0.11 | 2.05 | 4.28 | 4.62 | 1.71 | 0.32 | <0.0005 | 14 |
| JA15-25 | 1.0096 | 4.0026 | 0.4 | 99.6 | 45.8 | 2.22 | 14.0 | 11.1 | 0.13 | 11.68 | 10.6 | 2.54 | 1.38 | 0.06 | 0.03 | 453 |
| JA15-21 | 1.0041 | 4.0093 | 1.8 | 98.1 | 58.8 | 1.25 | 13.9 | 10.8 | 0.23 | 1.25 | 3.64 | 4.08 | 3.74 | 0.47 | 0.04 | 24 |
| JA15-18 | 1.0037 | 4.0052 | 1.7 | 98.3 | 69.1 | 0.21 | 15.7 | 1.3 | 0.03 | 0.77 | 1.52 | 5.09 | 4.52 | 0.12 | 0.01 | 21 |
| JA15-14 | 1.0040 | 4.0062 | 0.4 | 99.6 | 48.5 | 1.32 | 17.4 | 11.3 | 0.18 | 7.55 | 9.76 | 3.00 | 0.52 | 0.14 | 0.01 | 35 |
| JA15-38 | 1.0020 | 4.0027 | -0.9 | 100 | 45.8 | 2.06 | 16.6 | 14.9 | 0.38 | 8.42 | 7.22 | 2.59 | 1.64 | 0.34 | 0.08 | 289 |
| JA15-42 | 1.0004 | 4.0022 | 2.4 | 97.6 | 48.8 | 3.14 | 13.6 | 15.7 | 0.21 | 3.29 | 7.70 | 2.19 | 1.42 | 1.37 | 0.13 | 33 |
| JA15-46 | 1.0020 | 4.0060 | 0.8 | 99.2 | 67.3 | 0.52 | 16.5 | 3.5 | 0.05 | 1.21 | 2.40 | 4.79 | 2.75 | 0.17 | <0.0005 | <10 |
| JA15-47 | 1.0009 | 4.0079 | 2.0 | 98.1 | 65.8 | 0.56 | 16.2 | 3.7 | 0.06 | 1.16 | 3.13 | 4.92 | 2.31 | 0.16 | <0.0005 | <10 |
| JA15-49 | 1.0021 | 4.0045 | 1.2 | 98.8 | 52.3 | 2.51 | 13.2 | 14.1 | 0.203 | 2.37 | 8.18 | 4.31 | 0.32 | 1.04 | 0.28 | 58 |
| JA15-50 | 1.0038 | 4.0016 | 1.5 | 98.5 | 50.6 | 2.05 | 15.7 | 11.8 | 0.18 | 5.42 | 7.71 | 3.31 | 1.24 | 0.45 | 0.03 | 16 |
| O14-35 | 1.0034 | 4.0066 | 1.3 | 98.7 | 75.2 | 0.12 | 14.3 | 1.0 | 0.04 | 0.26 | 1.33 | 4.43 | 1.95 | 0.08 | 0.01 | <10 |
| O14-37 | 1.0020 | 4.0032 | 1.4 | 98.6 | 67.6 | 0.23 | 16.4 | 1.7 | 0.04 | 0.72 | 1.97 | 5.54 | 4.25 | 0.14 | <0.0005 | 25 |
| JA15-16 | 1.0094 | 4.0042 | 0.9 | 99.1 | 53.3 | 1.64 | 15.9 | 11.4 | 0.20 | 4.24 | 7.21 | 3.94 | 0.94 | 0.29 | 0.00 | 92 |
| JA15-13 | 1.0034 | 4.0082 | 1.8 | 98.2 | 50.6 | 2.86 | 13.9 | 13.6 | 0.22 | 3.73 | 7.70 | 2.91 | 1.52 | 1.17 | 0.14 | 38 |
| JA15-26 | 1.0065 | 4.0004 | 0.6 | 99.4 | 65.1 | 0.65 | 16.6 | 4.5 | 0.10 | 1.71 | 3.60 | 4.88 | 2.16 | 0.24 | 0.00 | 18 |
| JA15-12 | 1.0022 | 4.0066 | 1.6 | 98.4 | 48.3 | 1.52 | 19.6 | 12.2 | 0.25 | 2.80 | 7.15 | 3.48 | 2.23 | 0.75 | 0.02 | 503 |
| JA15-23 | 1.0040 | 4.0117 | 2.2 | 97.8 | 61.8 | 0.88 | 13.2 | 10.3 | 0.25 | 0.67 | 2.78 | 4.28 | 3.41 | 0.24 | 0.00 | <10 |
| JA15-22 | 1.0030 | 4.0029 | -0.3 | 100.2 | 51.8 | 1.21 | 16.6 | 10.3 | 0.18 | 7.16 | 8.49 | 3.14 | 1.13 | 0.15 | 0.06 | 50 |
| JA15-10A | 1.0008 | 4.0094 | 1.9 | 98.1 | 75.5 | 0.25 | 11.4 | 2.6 | 0.05 | 1.34 | 0.48 | 3.48 | 3.00 | 0.04 | <0.0005 | <10 |
| JA15-31 | 1.0052 | 4.0074 | 1.8 | 98.2 | 48.8 | 0.52 | 7.4 | 10.3 | 0.16 | 19.31 | 9.82 | 1.20 | 0.55 | 0.13 | 0.04 | 302 |
| JA15-32 | 1.0032 | 4.0004 | 7.1 | 92.9 | 49.9 | 2.11 | 13.4 | 11.6 | 0.20 | 3.12 | 5.51 | 4.17 | 1.88 | 0.88 | 0.04 | 689 |
| JA15-33 | 1.0008 | 4.0024 | 1.2 | 98.8 | 69.2 | 0.21 | 16.0 | 1.4 | 0.03 | 0.71 | 1.43 | 4.92 | 4.77 | 0.14 | 0.00 | 32 |
| JA15-34 | 1.0011 | 4.0007 | 0.7 | 99.3 | 52.7 | 2.59 | 14.4 | 13.7 | 0.24 | 3.5 | 5.72 | 3.99 | 1.99 | 0.39 | 0.01 | 150 |
| JA15-36 | 1.0004 | 4.0041 | 2.4 | 97.6 | 77.0 | 0.25 | 10.8 | 2.9 | 0.06 | 1.8 | 0.16 | 0.73 | 3.93 | 0.02 | 0.01 | <10 |

Supplementary Table S11. Trace element geochemical data for Ja’alan Granite sample JA15-03 and Kamil Granodiorite sample JA15-08 and JA15-09.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Sample | | |
| Element | Units | JA15-03 | JA15-08 | JA15-09 |
| Fe | % | 1.03 | 5.97 | 7.24 |
| SiO2 | % | 74.76 | 58.31 | 54.96 |
| Al2O3 | % | 13.75 | 18.57 | 18.54 |
| TiO2 | % | 0.03 | 0.91 | 1.22 |
| MnO | % | 0.11 | 0.22 | 0.36 |
| CaO | % | 1.09 | 3.53 | 2.94 |
| P XRF | % | 0.028 | 0.147 | 0.23 |
| S XRF | % | 0.005 | 0.01 | 0.012 |
| MgO | % | 0.1 | 1.92 | 2.8 |
| K2O | % | 4.39 | 2.93 | 2.62 |
| Zn | % | 0.002 | 0.011 | 0.008 |
| Pb | % | 0.004 | 0.004 | 0.002 |
| Cu | % | -0.001 | 0.003 | -0.001 |
| Ba | % | 0.068 | 0.165 | 0.079 |
| V | % | -0.001 | 0.009 | 0.01 |
| Na2O | % | 3.469 | 3.216 | 3.117 |
| Cr | % | -0.001 | 0.004 | -0.001 |
| Cl | % | 0.006 | 0.015 | 0.01 |
| As | % | -0.001 | -0.001 | -0.001 |
| Ni | % | 0.001 | 0.002 | 0.002 |
| Co | % | 0.004 | 0.004 | 0.003 |
| Sn | % | 0.001 | -0.001 | -0.001 |
| Sr | % | 0.02 | 0.041 | 0.044 |
| Zr | % | 0.009 | 0.059 | 0.04 |
| LOI1000 | % | 0.65 | 1.16 | 2.35 |
| Ag\_LA | ppm | 0.1 | -0.1 | -0.1 |
| As\_LA | ppm | 1.6 | -0.2 | -0.2 |
| Ba\_LA | ppm | 639 | 1530 | 730 |
| Be\_LA | ppm | 2.2 | 1.8 | 1.4 |
| Bi\_LA | ppm | 0.54 | 0.14 | 0.06 |
| Cd\_LA | ppm | 1.2 | 0.3 | 0.2 |
| Ce\_LA | ppm | 37.9 | 132 | 46.3 |
| Co\_LA | ppm | 24.7 | 21.6 | 22.4 |
| Cs\_LA | ppm | 0.98 | 5.99 | 2.1 |
| Cu\_LA | ppm | 4 | 14 | 6 |
| Dy\_LA | ppm | 2.01 | 16.2 | 11.6 |
| Er\_LA | ppm | 0.92 | 13.6 | 9.23 |
| Eu\_LA | ppm | 0.74 | 2.69 | 1.51 |
| Ga\_LA | ppm | 13.6 | 22.1 | 19.3 |
| Gd\_LA | ppm | 2.88 | 11 | 8.11 |
| Hf\_LA | ppm | 3.4 | 14.5 | 8.66 |
| Ho\_LA | ppm | 0.34 | 4.07 | 2.94 |
| In\_LA | ppm | -0.05 | 0.1 | -0.05 |
| La\_LA | ppm | 18.6 | 65 | 20.5 |
| Lu\_LA | ppm | 0.19 | 1.93 | 1.52 |
| Mn\_LA | ppm | 918 | 1740 | 2820 |
| Mo\_LA | ppm | 0.4 | 1 | -0.2 |
| Nb\_LA | ppm | 1.68 | 12 | 11.8 |
| Nd\_LA | ppm | 18.2 | 63.1 | 27.1 |
| Ni\_LA | ppm | 4 | 16 | 6 |
| Pb\_LA | ppm | 31 | 18 | 5 |
| Pr\_LA | ppm | 5.01 | 16.8 | 6.37 |
| Rb\_LA | ppm | 82 | 105 | 110 |
| Re\_LA | ppm | -0.01 | -0.01 | 0.01 |
| Sb\_LA | ppm | 0.8 | 0.3 | 0.3 |
| Sc\_LA | ppm | 2.7 | 17.1 | 14 |
| Se\_LA | ppm | -5 | -5 | -5 |
| Sm\_LA | ppm | 4.22 | 11.4 | 6.67 |
| Sn\_LA | ppm | 1 | 2.4 | 1.8 |
| Sr\_LA | ppm | 173 | 384 | 436 |
| Ta\_LA | ppm | 0.17 | 0.69 | 0.7 |
| Tb\_LA | ppm | 0.41 | 2.14 | 1.57 |
| Te\_LA | ppm | 0.2 | -0.2 | -0.2 |
| Th\_LA | ppm | 12.7 | 18.3 | 4.07 |
| Tl\_LA | ppm | 0.2 | 0.4 | 0.6 |
| Tm\_LA | ppm | 0.18 | 1.97 | 1.38 |
| U\_LA | ppm | 2.58 | 1.88 | 1.53 |
| V\_LA | ppm | 1.4 | 96.2 | 106 |
| W\_LA | ppm | 179 | 63.4 | 70.6 |
| Y\_LA | ppm | 11 | 110 | 81.8 |
| Yb\_LA | ppm | 1.29 | 14.3 | 9.88 |
| Zn\_LA | ppm | 50 | 90 | 70 |
| Zr\_LA | ppm | 80 | 568 | 364 |
| C | % | 0.1 | 0.06 | 0.06 |

Supplementary Table S12. Whole rock geochemistry for Al Wafi Schist sample JA15-04, which was used for calculation of phase diagrams.

|  |  |
| --- | --- |
|  | JA15-04 |
| LOI | 4.73 |
| Total | 97.22 |
| SiO2 | 60.53 |
| TiO2 | 0.91 |
| Al2O3 | 16.79 |
| Fe2O3 | - |
| Fe | 6.33 |
| MnO | 0.08 |
| MgO | 1.62 |
| CaO | 1.95 |
| Na2O | 0.817 |
| K2O | 3.46 |
| P2O5 | - |
| SO3 | - |
| Cl | - |

Supplementary Table S13 **(See excel spreadsheet)**. Mineral chemistry data for Al Wafi Schist samples JA15-04, JA15-41, JA15-43.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | gt | gt | gt | gt | gt | gt | gt | gt | gt |
| **Analysis** | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 36.8581 | 36.2142 | 35.746 | 36.0838 | 36.4492 | 36.4891 | 37.3736 | 35.8209 | 36.4717 |
| TiO2 | 0.00207 | 0 | 0.010686 | 0 | 0 | 0.010767 | 0.01228 | 0.009179 | 0.023338 |
| Al2O3 | 20.9539 | 20.5831 | 20.2737 | 20.4859 | 20.9152 | 20.7342 | 21.7252 | 20.3876 | 20.6163 |
| Cr2O3 | 0.01605 | 0.030854 | 0.013757 | 0.00899 | 0.027576 | 0.039151 | 0.00828 | 0.021163 | 0.037014 |
| FeO | 29.6723 | 30.1153 | 29.9315 | 30.5147 | 30.5375 | 30.4766 | 30.2289 | 30.5784 | 30.151 |
| MnO | 9.46169 | 8.65913 | 8.00626 | 8.08174 | 8.29498 | 8.17961 | 8.05419 | 8.20001 | 8.34571 |
| MgO | 2.16123 | 2.35804 | 2.35857 | 2.42643 | 2.48248 | 2.43038 | 2.50733 | 2.32836 | 2.40836 |
| ZnO | 0 | 0.005192 | 0 | 0 | 0.009828 | 0.002316 | 0 | 0.024294 | 0.017191 |
| CaO | 0.824056 | 0.797329 | 0.759256 | 0.790081 | 0.774764 | 0.78996 | 0.77291 | 0.807228 | 0.782824 |
| Na2O | 0.00112 | 0.009044 | 0.024797 | 0.012993 | 0 | 0.019878 | 0.051327 | 0.032634 | 0.004212 |
| K2O | 0 | 0.000362 | 0.000215 | 0.006161 | 0 | 0.004116 | 0.018804 | 0.007849 | 0 |
| Cl | 0 | 0 | 0.00092 | 0 | 0 | 0.003605 | 0.013343 | 0.003823 | 0.008967 |
| F | 0.033398 | 0.045873 | 0.016902 | 0.039487 | 0.016643 | 0.044037 | 0.070525 | 0.082464 | 0.028982 |
| Total | 99.97 | 98.80 | 97.14 | 98.43 | 99.50 | 99.20 | 100.80 | 98.27 | 98.88 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | - | - | - | - | - | - | - | - |
| ca(pl, ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| k(pl) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| y(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(gt) | 0.885066 | 0.875037 | 0.87495 | 0.872859 | 0.870775 | 0.874103 | 0.871171 | 0.876564 | 0.874725 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | gt | gt | gt | gt | gt | gt | mu | mu | mu |
| **Analysis** | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 1 Garnet traverse | JA15-43 Area 2 Muscovite | JA15-43 Area 2 Muscovite | JA15-43 Area 2 Muscovite |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 36.2985 | 36.2121 | 36.3421 | 36.5266 | 36.6046 | 36.4128 | 47.7697 | 46.9922 | 46.8127 |
| TiO2 | 0.001945 | 0.000362 | 0.007256 | 0.016535 | 0.000748 | 0.009393 | 0.233443 | 0.232242 | 0.069574 |
| Al2O3 | 20.7314 | 20.5044 | 20.5773 | 20.5982 | 20.8076 | 20.6263 | 37.2876 | 36.345 | 37.6001 |
| Cr2O3 | 0.009985 | 0.008102 | 0.026119 | 0.006602 | 0.038743 | 0.023539 | 0.034183 | 0 | 0.039861 |
| FeO | 30.8305 | 30.0432 | 30.3746 | 30.3058 | 30.122 | 29.8058 | 1.35673 | 1.27406 | 1.08262 |
| MnO | 8.25208 | 8.23834 | 8.44551 | 8.57882 | 9.00029 | 9.32993 | 0 | 0.011986 | 0.012156 |
| MgO | 2.41422 | 2.36234 | 2.36763 | 2.36027 | 2.27563 | 2.07323 | 0.690172 | 0.913138 | 0.644617 |
| ZnO | 0 | 0 | 0 | 0.062243 | 0 | 0.023051 | 0.008637 | 0 | 0 |
| CaO | 0.76832 | 0.762433 | 0.764417 | 0.795637 | 0.840049 | 0.845711 | 0.009603 | 0.043141 | 0.024684 |
| Na2O | 0.030718 | 0.016952 | 0 | 0.023728 | 0.005921 | 0.014783 | 0.387702 | 0.326642 | 0.442842 |
| K2O | 0.001501 | 0.000021 | 0.000313 | 0.005863 | 0.005805 | 0.001826 | 8.00553 | 7.76122 | 8.186 |
| Cl | 0 | 0.002719 | 0 | 0 | 0 | 0 | 0 | 0.01386 | 0.011614 |
| F | 0.087816 | 0.054733 | 0.030707 | 0 | 0.050898 | 0.083318 | 0 | 0.042525 | 0.005689 |
| Total | 99.39 | 98.18 | 98.92 | 99.28 | 99.73 | 99.21 | 95.78 | 93.93 | 94.93 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | - | - | - | - | - | - | - | - |
| ca(pl, ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| k(pl) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | -- | -- | -- | -- | -- | -- | 0.524396 | 0.439017 | 0.485068 |
| y(mu) | -- | -- | -- | -- | -- | -- | 0.859195 | 0.838923 | 0.876995 |
| x(gt) | 0.874343 | 0.876559 | 0.87603 | 0.875523 | 0.879722 | 0.888806 | -- | -- | -- |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | mu | bi | bi | bi | bi | pl | pl | pl | pl |
| **Analysis** | JA15-43 Area 2 Muscovite | JA15-43 Area 2 Biotite | JA15-43 Area 2 Biotite | JA15-43 Area 2 Biotite | JA15-43 Area 2 Biotite | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 48.0109 | 33.4392 | 34.7782 | 35.9968 | 33.4918 | 64.1277 | 63.4194 | 62.1339 | 62.0866 |
| TiO2 | 0.162081 | 2.6192 | 2.61852 | 2.27468 | 2.82671 | 0 | 0.007628 | 0.002971 | 0.001599 |
| Al2O3 | 35.8094 | 19.828 | 20.7432 | 24.1027 | 18.2635 | 21.0048 | 22.6427 | 23.4076 | 23.322 |
| Cr2O3 | 0.028459 | 0.050226 | 0.030128 | 0.026481 | 0.045878 | 0.014473 | 0.000532 | 0.019778 | 0.016863 |
| FeO | 1.74824 | 19.8795 | 19.2676 | 17.8536 | 22.1207 | 0.00087 | 0 | 0.022537 | 0 |
| MnO | 0.009164 | 0.207546 | 0.128737 | 0.171321 | 0.192283 | 0 | 0.017817 | 0 | 0.008147 |
| MgO | 1.14169 | 6.42063 | 6.69245 | 5.87039 | 7.53049 | 0 | 0.00167 | 0 | 0 |
| ZnO | 0 | 0.031817 | 0 | 0.069859 | 0 | 0.097845 | 0.022646 | 0.043247 | 0 |
| CaO | 0.040495 | 0.068962 | 0.068375 | 0.049663 | 0.005713 | 2.02568 | 3.19236 | 4.03792 | 4.19346 |
| Na2O | 0.303377 | 0.136516 | 0.126695 | 0.111499 | 0.150725 | 10.835 | 10.0935 | 9.76398 | 9.5244 |
| K2O | 7.95312 | 6.98149 | 7.13628 | 5.25349 | 8.76525 | 0.214306 | 0.134884 | 0.215424 | 0.29374 |
| Cl | 0.026048 | 0.041 | 0.034932 | 0.026602 | 0.038868 | 0.018951 | 0.000039 | 0.003999 | 0 |
| F | 0.016699 | 0.197427 | 0.19122 | 0.166444 | 0.2878 | 0 | 0 | 0 | 0 |
| Total | 95.24 | 89.81 | 91.73 | 91.90 | 93.59 | 98.34 | 99.53 | 99.65 | 99.45 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | 0.550182 | 0.604744 | 0.861211 | 0.33215 | - | - | - | - |
| ca(pl, ksp) | -- | -- | -- | -- | -- | 0.092547 | 0.147669 | 0.183847 | 0.192549 |
| k(pl) | -- | -- | -- | -- | -- | 0.011658 | 0.007429 | 0.011678 | 0.016059 |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | 0.462041 | -- | -- | -- | -- | -- | -- | -- | -- |
| y(mu) | 0.792617 | -- | -- | -- | -- | -- | -- | -- | -- |
| x(gt) | -- | -- | -- | -- | -- | -- | -- | -- | -- |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | pl | pl | pl | pl | pl | pl | pl | pl | pl |
| **Analysis** | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 62.1456 | 68.0832 | 62.3543 | 62.8565 | 62.2967 | 54.7725 | 64.56 | 67.552 | 63.5012 |
| TiO2 | 0.004789 | 0.001616 | 0.013129 | 0.004794 | 0 | 0.100582 | 0.011526 | 0 | 0.010806 |
| Al2O3 | 23.511 | 23.368 | 26.5122 | 25.6405 | 23.3678 | 30.1874 | 24.6135 | 22.96 | 23.6078 |
| Cr2O3 | 0.011802 | 0 | 0.011688 | 0.015356 | 0.021964 | 0.004668 | 0.007237 | 0.00845 | 0.012346 |
| FeO | 0 | 0.041967 | 0.237656 | 0.251466 | 0.001396 | 0.340439 | 0.081248 | 0.025283 | 0.194108 |
| MnO | 0 | 0.010167 | 0.005003 | 0 | 0.030982 | 0.226423 | 0 | 0.005927 | 0.015516 |
| MgO | 0.013137 | 0.039234 | 0.199179 | 0.150415 | 0 | 0.117245 | 0.120989 | 0.016611 | 0.192639 |
| ZnO | 0.002267 | 0 | 0 | 0 | 0.059106 | 0 | 0.010858 | 0 | 0.0116 |
| CaO | 4.08359 | 1.30522 | 0.437418 | 1.94487 | 4.13024 | 0.728065 | 2.04679 | 0.68571 | 1.53038 |
| Na2O | 9.48021 | 11.3702 | 8.20883 | 9.06184 | 9.4976 | 4.76253 | 9.65829 | 11.0588 | 9.34705 |
| K2O | 0.281362 | 0.476371 | 3.17888 | 2.25237 | 0.248884 | 5.63554 | 1.08246 | 0.758916 | 1.388 |
| Cl | 0.001659 | 0.01678 | 0.007718 | 0.005279 | 0.00526 | 0.016773 | 0.011717 | 0.012188 | 0.000979 |
| F | 0 | 0 | 0 | 0.000779 | 0 | 0 | 0 | 0 | 0.001162 |
| Total | 99.54 | 104.71 | 101.16 | 102.18 | 99.66 | 96.89 | 102.20 | 103.08 | 99.81 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | - | - | - | - | - | - | - | - |
| ca(pl, ksp) | 0.189282 | 0.058144 | 0.022929 | 0.092502 | 0.191095 | 0.045344 | 0.09834 | 0.031744 | 0.076147 |
| k(pl) | 0.015528 | 0.025267 | 0.198402 | 0.127552 | 0.013711 | 0.417902 | 0.061923 | 0.041831 | 0.08223 |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| y(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(gt) | -- | -- | -- | -- | -- | -- | -- | -- | -- |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | pl | pl | pl | pl | pl | pl | mu | mu | mu |
| **Analysis** | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Plag traverse | JA15-43 Area 3 Muscovite | JA15-43 Area 3 Muscovite | JA15-43 Area 4 Muscovite |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 63.0258 | 62.5866 | 63.6309 | 66.0313 | 64.6947 | 65.4442 | 46.3257 | 66.9517 | 45.589 |
| TiO2 | 0.009984 | 0.005353 | 0.003874 | 0.003161 | 0.000835 | 0 | 0.009086 | 0.002092 | 0.947449 |
| Al2O3 | 25.4323 | 24.0558 | 24.4247 | 23.7765 | 25.2488 | 23.2489 | 35.9956 | 23.605 | 37.1302 |
| Cr2O3 | 0.005491 | 0.006791 | 0.003093 | 0 | 0 | 0.005296 | 0 | 0.019304 | 0.059555 |
| FeO | 0.120307 | 0.099457 | 0.057109 | 0.064168 | 0.037383 | 0.126766 | 1.66301 | 0.442616 | 1.22813 |
| MnO | 0 | 0 | 0.010026 | 0 | 0.004555 | 0 | 0.030287 | 0.020297 | 0 |
| MgO | 0.072515 | 0.034203 | 0.031046 | 0.218065 | 0.062932 | 0.077246 | 0.97537 | 0.099916 | 0.504597 |
| ZnO | 0 | 0.048441 | 0.006018 | 0 | 0.003343 | 0 | 0.009134 | 0 | 0.015771 |
| CaO | 1.42419 | 3.01935 | 2.34661 | 0.981229 | 1.21214 | 0.447646 | 0.02955 | 0.398945 | 0.090657 |
| Na2O | 8.98105 | 9.41854 | 9.71933 | 10.0551 | 9.23602 | 9.82257 | 0.455896 | 0.387884 | 0.455928 |
| K2O | 2.17779 | 0.498233 | 1.1239 | 1.37663 | 1.93393 | 1.39453 | 7.7319 | 5.90264 | 8.21495 |
| Cl | 0.01202 | 0.002723 | 0.013022 | 0.02219 | 0.001435 | 0.019009 | 0.0109 | 0.00332 | 0 |
| F | 0 | 0 | 0 | 0 | 0 | 0 | 0.038086 | 0 | 0 |
| Total | 101.26 | 99.77 | 101.37 | 102.52 | 102.44 | 100.58 | 93.26 | 97.83 | 94.24 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | - | - | - | - | - | - | - | - |
| ca(pl, ksp) | 0.070263 | 0.146169 | 0.110309 | 0.047138 | 0.059923 | 0.022514 | -- | -- | -- |
| k(pl) | 0.127927 | 0.028719 | 0.062905 | 0.078741 | 0.113832 | 0.083508 | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | -- | -- | -- | -- | -- | -- | 0.488836 | 0.71303 | 0.577192 |
| y(mu) | -- | -- | -- | -- | -- | -- | 0.807784 | 0.967367 | 0.881243 |
| x(gt) | -- | -- | -- | -- | -- | -- | -- | -- | -- |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | mu | mu | mu | bi | bi | bi | bi | bi | bi |
| **Analysis** | JA15-43 Area 4 Muscovite | JA15-43 Area 4 Muscovite | JA15-43 Area 4 Muscovite | JA15-43 Area 4 Biotite | JA15-43 Area 4 Biotite | JA15-43 Area 4 Biotite | JA15-43 Area 4 Biotite | JA15-43 Area 4 Biotite | JA15-43 Area 4 Biotite |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 45.6938 | 46.9605 | 46.4136 | 25.0309 | 24.2593 | 24.4525 | 24.9249 | 26.7171 | 32.7952 |
| TiO2 | 0.187529 | 0.386305 | 1.27531 | 2.7735 | 0.211559 | 0.216076 | 1.03072 | 0.486164 | 1.75786 |
| Al2O3 | 36.9965 | 38.727 | 37.0829 | 22.1985 | 22.1322 | 22.0586 | 22.4515 | 21.4027 | 19.4081 |
| Cr2O3 | 0.025895 | 0.028825 | 0.023219 | 0.05104 | 0.015981 | 0.028509 | 0.01462 | 0.029617 | 0.049312 |
| FeO | 1.19448 | 1.00111 | 1.00731 | 24.0126 | 27.8961 | 27.7911 | 27.422 | 26.6368 | 21.6326 |
| MnO | 0 | 0 | 0 | 0.263721 | 0.364689 | 0.386588 | 0.306025 | 0.306417 | 0.191873 |
| MgO | 0.519018 | 0.34201 | 0.570536 | 9.37005 | 11.615 | 11.0066 | 11.4497 | 11.2557 | 8.99584 |
| ZnO | 0.0109 | 0 | 0 | 0.022533 | 0.054958 | 0.013811 | 0.020097 | 0 | 0.026056 |
| CaO | 0.025553 | 0.029765 | 0 | 0.050941 | 0.001752 | 0.007531 | 0.009272 | 0.061609 | 0.168224 |
| Na2O | 0.39821 | 0.564625 | 0.588188 | 0.023322 | 0.034958 | 0.011753 | 0.003538 | 0.060732 | 0.07658 |
| K2O | 8.46369 | 8.3691 | 7.59806 | 0.059672 | 0.102388 | 0.028107 | 0.046554 | 0.784228 | 5.09327 |
| Cl | 0.010877 | 0.00366 | 0 | 0.01709 | 0.017679 | 0.011405 | 0.012541 | 0.009257 | 0.051442 |
| F | 0.001532 | 0 | 0 | 0.072188 | 0.041785 | 0.053348 | 0.065083 | 0.121309 | 0.187241 |
| Total | 93.52 | 96.41 | 94.56 | 83.91 | 86.73 | 86.04 | 87.73 | 87.82 | 90.34 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | - | - | 0.396974 | 0.287628 | 0.322783 | 0.2971 | 0.322684 | 0.433225 |
| ca(pl, ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| k(pl) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | 0.56348 | 0.621471 | 0.497558 | -- | -- | -- | -- | -- | -- |
| y(mu) | 0.881079 | 0.912977 | 0.888784 | -- | -- | -- | -- | -- | -- |
| x(gt) | -- | -- | -- | -- | -- | -- | -- | -- | -- |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | mu | mu | mu | mu | mu | bi | bi | bi | bi |
| **Analysis** | JA15-04 Area 1 Muscovite | JA15-04 Area 1 Muscovite | JA15-04 Area 1 Muscovite | JA15-04 Area 1 Muscovite | JA15-04 Area 1 Muscovite | JA15-04 Area 1 Biotite | JA15-04 Area 1 Biotite | JA15-04 Area 1 Biotite | JA15-04 Area 1 Biotite |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 46.7625 | 46.5749 | 46.2321 | 47.5583 | 55.5953 | 33.3892 | 33.8192 | 34.0545 | 33.9383 |
| TiO2 | 0.210291 | 0.661557 | 0.622797 | 0.266358 | 0.016417 | 2.43173 | 2.52926 | 2.53894 | 2.53701 |
| Al2O3 | 38.2884 | 37.5351 | 37.7691 | 38.0804 | 25.5903 | 18.9203 | 19.0755 | 19.0691 | 19.1396 |
| Cr2O3 | 0 | 0.020453 | 0.016636 | 0.035891 | 0.003135 | 0.031653 | 0.022019 | 0.007474 | 0.026367 |
| FeO | 0.853261 | 0.929975 | 0.93769 | 0.897884 | 0.095836 | 21.7897 | 22.0532 | 21.9806 | 21.4804 |
| MnO | 0 | 0 | 0 | 0 | 0.008768 | 0.20118 | 0.19065 | 0.228012 | 0.176637 |
| MgO | 0.332769 | 0.501645 | 0.555696 | 0.556887 | 0.055359 | 6.96526 | 7.03378 | 7.22743 | 7.13531 |
| ZnO | 0 | 0 | 0 | 0 | 0.059046 | 0.0221 | 0.046208 | 0.068479 | 0.063173 |
| CaO | 0.021918 | 0 | 0.008926 | 0.007352 | 4.44781 | 0.028739 | 0.06074 | 0.010576 | 0.003913 |
| Na2O | 0.927633 | 0.990993 | 0.9228 | 1.0792 | 8.0922 | 0.314137 | 0.39431 | 0.358841 | 0.315902 |
| K2O | 8.26836 | 8.21022 | 7.53519 | 7.62876 | 0.190735 | 8.90834 | 8.76984 | 9.24242 | 9.04562 |
| Cl | 0.019101 | 0 | 0.019987 | 0.030345 | 0.040813 | 0.035457 | 0.044771 | 0.017403 | 0.027315 |
| F | 0 | 0 | 0 | 0.002334 | 0 | 0.299163 | 0.27691 | 0.260786 | 0.26864 |
| Total | 95.68 | 95.42 | 94.62 | 96.14 | 94.19 | 93.20 | 94.19 | 94.95 | 94.04 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | - | - | - | - | 0.399552 | 0.397522 | 0.387359 | 0.411081 |
| ca(pl, ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| k(pl) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | 0.58986 | 0.509758 | 0.486246 | 0.474884 | 0.492643 | -- | -- | -- | -- |
| y(mu) | 0.921245 | 0.900262 | 0.89412 | 0.897943 | 0.986127 | -- | -- | -- | -- |
| x(gt) | -- | -- | -- | -- | -- | -- | -- | -- | -- |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | bi | sil | sil | sil | mu | mu | mu | mu | mu |
| **Analysis** | JA15-04 Area 1 Biotite | JA15-04 Area 1 Sillimanite | JA15-04 Area 1 Sillimanite | JA15-04 Area 1 Sillimanite | JA15-04 Area 2 Muscovite | JA15-04 Area 2 Muscovite | JA15-04 Area 2 Muscovite | JA15-04 Area 2 Muscovite | JA15-04 Area 2 Muscovite |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 34.0476 | 29.9617 | 30.4764 | 27.1539 | 46.749 | 45.736 | 39.4298 | 46.0554 | 46.1961 |
| TiO2 | 2.54321 | 0.054394 | 0.129043 | 0.236703 | 0.191814 | 0.192059 | 0.103896 | 0.125111 | 0.092514 |
| Al2O3 | 19.2066 | 26.4254 | 26.6214 | 25.52 | 37.8031 | 38.7965 | 43.4295 | 38.2133 | 38.4621 |
| Cr2O3 | 0.049468 | 0 | 0.000456 | 0.01754 | 0.035551 | 0.009477 | 0.050456 | 0 | 0.035212 |
| FeO | 21.5053 | 12.8639 | 2.51756 | 24.0709 | 0.903207 | 0.749915 | 0.813741 | 0.78473 | 0.820448 |
| MnO | 0.156409 | 0.119231 | 0 | 0.301629 | 0 | 0 | 0.025539 | 0 | 0 |
| MgO | 7.1144 | 5.00672 | 1.12522 | 9.09113 | 0.44199 | 0.390422 | 0.460336 | 0.310313 | 0.298196 |
| ZnO | 0 | 0 | 0 | 0.0068 | 0 | 0.003714 | 0 | 0 | 0 |
| CaO | 0.011646 | 0.068058 | 0.989494 | 0.012547 | 0.008806 | 0.054143 | 0.129733 | 0.015176 | 0.013357 |
| Na2O | 0.287032 | 0.087273 | 0.060592 | 0.059111 | 0.862936 | 1.0234 | 0.952002 | 0.926687 | 0.957144 |
| K2O | 8.94906 | 0.061766 | 0.059374 | 0.037338 | 7.99489 | 8.01883 | 7.33487 | 7.99096 | 8.42323 |
| Cl | 0.024677 | 0.315616 | 0.373292 | 0.042607 | 0.005464 | 0.042617 | 0.038063 | 0.02385 | 0.016323 |
| F | 0.236295 | 0 | 0 | 0.02712 | 0.012363 | 0 | 0 | 0 | 0 |
| Total | 94.03 | 74.89 | 62.27 | 86.56 | 95.00 | 95.01 | 92.76 | 94.44 | 95.31 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | 0.420603 | - | - | - | - | - | - | - | - |
| ca(pl, ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| k(pl) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | -- | -- | -- | -- | 0.534056 | 0.518617 | 0.497864 | 0.586503 | 0.606798 |
| y(mu) | -- | -- | -- | -- | 0.907426 | 0.920542 | 0.906313 | 0.926307 | 0.925983 |
| x(gt) | -- | -- | -- | -- | -- | -- | -- | -- | -- |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | sil | bi | bi | bi | bi | bi | sil | sil | sil |
| **Analysis** | JA15-04 Area 2 Sillimanite | JA15-04 Area 2 Biotite | JA15-04 Area 2 Biotite | JA15-04 Area 2 Biotite | JA15-04 Area 2 Biotite | JA15-04 Area 2 Biotite | JA15-04 Area 3 Sillimanite | JA15-04 Area 3 Sillimanite | JA15-04 Area 3 Sillimanite |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 45.3993 | 32.7701 | 34.0752 | 33.8517 | 33.5337 | 33.8977 | 44.7189 | 38.3049 | 44.5323 |
| TiO2 | 0 | 2.73116 | 2.6524 | 2.50912 | 2.40095 | 2.59514 | 0.027019 | 0.065833 | 0.062727 |
| Al2O3 | 39.0976 | 18.4 | 19.0801 | 19.1341 | 19.0275 | 19.195 | 38.3578 | 33.0698 | 36.4575 |
| Cr2O3 | 0.035108 | 0.080258 | 0.010493 | 0.033245 | 0.026891 | 0.027241 | 0.009152 | 0.00742 | 0.038435 |
| FeO | 0.170473 | 21.502 | 21.5755 | 21.7736 | 21.8634 | 21.7256 | 2.31762 | 5.91443 | 0.455584 |
| MnO | 0 | 0.162907 | 0.136267 | 0.177208 | 0.190694 | 0.179432 | 0 | 0.073263 | 0.022034 |
| MgO | 0.351561 | 6.71833 | 7.11457 | 7.09131 | 6.95508 | 7.12837 | 0.391581 | 2.48341 | 0.366296 |
| ZnO | 0 | 0 | 0.054952 | 0.016696 | 0.031647 | 0.040649 | 0 | 0 | 0.03676 |
| CaO | 0.111298 | 0.029497 | 0.026689 | 0.018229 | 0.047353 | 0.006244 | 0.107135 | 0.114478 | 0.085369 |
| Na2O | 0.098045 | 0.423863 | 0.361786 | 0.364661 | 0.364321 | 0.302663 | 0.155196 | 0.132877 | 0.081012 |
| K2O | 0.24148 | 9.06652 | 9.09757 | 9.23273 | 8.98662 | 9.28552 | 0.096638 | 0.072657 | 0.079935 |
| Cl | 0.115288 | 0.046388 | 0.044952 | 0.046123 | 0.07871 | 0.012182 | 0.063179 | 0.053397 | 0.068397 |
| F | 0.049174 | 0.327917 | 0.258739 | 0.293067 | 0.269479 | 0.219056 | 0 | 0 | 0.020462 |
| Total | 85.62 | 92.11 | 94.37 | 94.41 | 93.65 | 94.52 | 86.23 | 80.28 | 82.28 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | 0.366313 | 0.402762 | 0.398645 | 0.402628 | 0.402475 | - | - | - |
| ca(pl, ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| k(pl) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| y(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(gt) | -- | -- | -- | -- | -- | -- | -- | -- | -- |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | gt | gt | gt | gt | gt | gt | gt | gt | gt |
| **Analysis** | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 35.3024 | 36.4846 | 36.4178 | 36.3079 | 31.9538 | 36.4612 | 36.368 | 36.2657 | 36.4852 |
| TiO2 | 0.016101 | 0.014345 | 0.011702 | 0.035302 | 0.021349 | 0.020574 | 0.027824 | 0.016343 | 0.015453 |
| Al2O3 | 20.5053 | 20.7654 | 21.0181 | 20.8283 | 21.8515 | 20.672 | 20.7247 | 20.5981 | 20.7458 |
| Cr2O3 | 0 | 0 | 0.005585 | 0.012773 | 0 | 0.016307 | 0.017254 | 0.016 | 0.009121 |
| FeO | 33.5394 | 33.5027 | 33.9965 | 33.6949 | 30.3072 | 33.7699 | 33.9181 | 34.0697 | 34.2909 |
| MnO | 5.22114 | 4.95735 | 4.82391 | 4.76738 | 3.40493 | 4.66812 | 4.5658 | 4.50572 | 4.36703 |
| MgO | 2.42076 | 2.51727 | 2.57097 | 2.58085 | 2.30119 | 2.56224 | 2.49207 | 2.6497 | 2.61404 |
| ZnO | 0 | 0 | 0.038373 | 0.043295 | 0.003203 | 0 | 0.002848 | 0.023809 | 0 |
| CaO | 0.83905 | 0.858641 | 0.88168 | 0.888776 | 0.79756 | 0.931109 | 0.901236 | 0.817751 | 0.822242 |
| Na2O | 0.153737 | 0.072211 | 0.016062 | 0.006155 | 0.252672 | 0.013191 | 0.010091 | 0.019166 | 0.016128 |
| K2O | 0.030472 | 0.013607 | 0 | 0 | 0.105475 | 0.000843 | 0 | 0 | 0.003699 |
| Cl | 0.073037 | 0.022517 | 0.003488 | 0 | 0.070197 | 0.004019 | 0 | 0.008453 | 0.006229 |
| F | 0.028223 | 0.03599 | 0.04021 | 0.077224 | 0 | 0.047896 | 0.033691 | 0.015485 | 0.052498 |
| Total | 98.10 | 99.22 | 99.81 | 99.21 | 91.05 | 99.15 | 99.05 | 99.00 | 99.40 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | - | - | - | - | - | - | - | - |
| ca(pl, ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| k(pl) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| y(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(gt) | 0.8778 | 0.879773 | 0.878086 | 0.877983 | 0.873405 | 0.879236 | 0.882511 | 0.874824 | 0.878301 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | gt | gt | gt | gt | gt | gt | gt | gt | gt |
| **Analysis** | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse | JA15-41 Area 1 Garnet Traverse |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 27.3233 | 26.7318 | 33.3901 | 36.4813 | 36.4857 | 36.5266 | 36.4359 | 36.7788 | 38.59 |
| TiO2 | 0.066662 | 0 | 0.182933 | 0.032493 | 0.006334 | 0.0126 | 0.021011 | 0.012121 | 0.022583 |
| Al2O3 | 34.6365 | 18.4482 | 21.959 | 20.7965 | 20.813 | 20.9178 | 20.7647 | 20.8898 | 30.774 |
| Cr2O3 | 0.014934 | 0 | 0 | 0 | 0.022985 | 0.002903 | 0 | 0.009814 | 0.00923 |
| FeO | 24.966 | 29.2871 | 32.9233 | 34.2547 | 33.8628 | 34.0857 | 33.318 | 33.6791 | 6.91834 |
| MnO | 3.05748 | 2.94251 | 3.8832 | 4.46746 | 4.9547 | 5.41782 | 5.57219 | 5.86486 | 0.060565 |
| MgO | 1.92986 | 2.20462 | 2.56643 | 2.63596 | 2.58772 | 2.4819 | 2.33919 | 2.34447 | 1.00025 |
| ZnO | 0 | 0 | 0 | 0 | 0 | 0 | 0.016857 | 0.085775 | 0 |
| CaO | 0.80325 | 0.704038 | 0.914912 | 0.873989 | 0.815214 | 0.84091 | 0.816777 | 0.823055 | 0.128352 |
| Na2O | 0.27479 | 0.368417 | 0.578589 | 0 | 0.022107 | 0.01106 | 0.004092 | 0.007026 | 0.411488 |
| K2O | 0.186874 | 0.093137 | 0.063696 | 0.003681 | 0.00538 | 0.001742 | 0 | 0.002699 | 5.89022 |
| Cl | 0.091082 | 0.217595 | 0.324619 | 0.000349 | 0.004848 | 0.001561 | 0.003005 | 0 | 0.084121 |
| F | 0 | 0.02652 | 0.076794 | 0.022765 | 0.031309 | 0.055315 | 0.070672 | 0.052 | 0 |
| Total | 93.33 | 80.96 | 96.76 | 99.56 | 99.60 | 100.33 | 99.33 | 100.53 | 83.87 |
| **Compositional Variables** |  |  |  |  |  |  |  |  |  |
| y(bi) | - | - | - | - | - | - | - | - | - |
| ca(pl, ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| k(pl) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| na(ksp) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| y(mu) | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| x(gt) | 0.872332 | 0.85243 | 0.861604 | 0.876614 | 0.877252 | 0.881321 | 0.887715 | 0.887274 | 0.795059 |

**S4. Supplementary pseudosections**

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Supplementary Figure S3. *T–M*O pseudosection for sample JA15-04 (and by proxy JA15-43). Compositions given are in mol%. The red line for JA15-04 represents the Fe2O3 value used for *P–T* modelling of sample JA15-04, while the blue line represents the Fe2O3 value used for *P–T* modelling of sample JA15-43.

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Supplementary Figure S4. *T–M*H2O pseudosection calculated for samples JA15-04. Compositions given are in mol%. The red line represents the H2O value used for *P–T* modelling of sample JA15-04. Abundance contours for muscovite and biotite are plotted within the interpreted peak field, and show that this assemblage is compositionally relatively insensitive to the amount of H2O present.

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Supplementary Figure S5. *T–M*H2O pseudosection calculated for samples JA15-43. Compositions given are in mol%. The red line represents the H2O value used for *P–T* modelling of sample JA15-43.

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Supplementary Figure S6. Calculated *P–T* pseudosection for sample JA15-04 from the Al Wafi Schist. The bulk composition used for modelling is given in the top of the diagram and expressed as molar percent. The field muscovite–biotite–ilmenite–plagioclase–magnetite–sillimanite–quartz –H2O corresponds to the peak assemblage and occurs within the *P–T* range of c. 570–700 °C at 2.8–6.3 kbar. Interpreted prograde and retrograde *P–T* paths are shown by the grey arrows, the dashed grey line highlights uncertainties in path trajectory. Dashed coloured lines represent compositional variable contours of muscovite (green: *x*(mu) = Fe2+/(Fe2+ + Mg); purple: *y*(mu) (= AlVI)) and biotite (red: *y*(bi) = (=AlVI)).