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Data Repository

TABLE DR1 SHRIMP U-PB DATA FOR IGNEOUS ZIRCON IN WM5

TABLE DR2 SHRIMP U-PB DATA FOR IGNEOUS MONAZITE IN WM5

TABLE DR3 SHRIMP U-PB DATA FOR MONAZITE IN MUSCOVITE SCHIST SAMPLE K89

TABLE DR4 SHRIMP U-PB DATA FOR MONAZITE IN MUSCOVITE SCHIST SAMPLE K96

TABLE DR5 SHRIMP U-PB DATA FOR MONAZITE IN MUSCOVITE SCHIST SAMPLE K99

TABLE DR6 SHRIMP U-PB DATA FOR MONAZITE IN MUSCOVITE SCHIST SAMPLE K100

TABLE DR7 SHRIMP U-PB DATA FOR MONAZITE IN BANDED PELITE SAMPLE K101

TABLE S1 SHRIMP OPERATING PARAMETERS FOR ZIRCON AND MONAZITE ANALYSES.

TABLE S2 COMPILATION OF GEOCHRONOLOGY DATA OBTAINED IN THIS STUDY TOGETHER WITH THOSE SELECTED FROM THE LITERATURE. THE CODES IN THIS TABLE CORRESPOND WITH THOSE USED IN FIGURE 10.

SHRIMP U-Th-Pb ANALYSIS

Instrument setup followed protocols for small-spot, in situ analysis of monazite described by Fletcher et al. (2010). A primary beam of O_2^- ions was focused through a 30 or 50 μm Kohler aperture to produce an oval spot of ~10 μm, with a current intensity of 0.2–0.4 nA. The secondary ion system was focused through a 100 μm collector slit onto an electron multiplier to produce mass peaks with flat tops and a mass resolution (M/ΔM at 1% peak height) of >5000 in all sessions. Post-collector retardation lens was activated to reduce stray ion arrivals.

The SHRIMP operating parameters for the various analytical sessions are listed in Table DR1. Monazite was analyzed with a 13-peak run table as defined by Fletcher et al. (2010), which includes mass stations for the estimation of La, Ce and Nd ($REEPO_2^+$), and Y ($YCeO^+$). A 3 min rastering was performed prior to data acquisition of each analysis to remove gold coated on sample surface. Each analysis constituted 8 counting cycles (scans) through the mass species of interest. Counting times per scan for background position 204.045, and Pb isotopes 204, 206, 207 and 208 were, respectively, 10 s, 10 s, 10 s, 30 s and 10 s. Monazite reference materials FRENCH (same as the MAD-1 of Foster et al. (2000)), Z2234 (Stern and Sanborn, 1998) and Z2908 (with moderate U and Th contents, provided by Richard Stern) were analyzed concurrently for Pb/U and Pb/Th calibration (FRENCH), and corrections for instrumental mass fractionation (IMF) and matrix effect required for variable U, Th, Y and Nd contents (Fletcher et al., 2010). Interposed analyses of Z2908 were used to monitor and correct for the IMF in Pb/Pb data for the sample analyses.

There is no analytical bias caused by sample separation procedures or grain selection as all samples were mounted and analyzed in situ in polished thin sections, and the analyzed grains were large enough to accommodate the ~10 μm primary ion beam. Multiple analyses were made on some larger grains, and in a few cases analyses were aborted when observed to show very high common Pb contents.

DATA REDUCTION

Raw data were processed using custom task files for the SQUID2 (v2.50) software (Ludwig, 2009), and plotted using ISOPLOT3 (Ludwig, 2012). Common Pb was corrected from ^{204}Pb measurements following corrections for a 204 isobar using a ThO_2^+ versus 204 isobar relationship (Fletcher et al., 2010). Common Pb composition was calculated adopting the two-stage evolution model of Stacey and Kramers (1975) and using the measured Th/Pb or Pb/Pb age. Corrections for matrix effects in $^{206}Pb/^{238}U$ and $^{208}Pb/^{232}Th$, and for instrumental mass fractionation in $^{207}Pb/^{206}Pb$, were applied to monazite data following protocols established by Fletcher et al. (2010).

A minimum spot-to-spot external precision of 1% (1σ) was assumed for standard analyses in all sessions and propagated to U-Pb measurements on all samples. Uncertainties related to matrix correction are negligible compared with uncertainties from other sources. Analyses that recorded high common ^{206}Pb (e.g., f_{206} ≥1%) or large discordance (>5%) were considered not reliable and hence disregarded in age determinations.

DATA PRESENTATION

The following notes apply to all data tables (Tables DR1–DR7):

1. Analysis identification is nnnnA.p-q where nnnn is the mount number, A is a polished thin section plug in the mount, p is the zircon grain within that plug, and q is the analysis spot within that grain.

2. f_{206} is the proportion of common Pb in ^{206}Pb, determined using the measured ^{204}Pb/^{206}Pb and a common Pb composition from the Stacey-Kramers (1975) model at the approximate age of the sample.

3. All listed Pb isotope data and t[^{207}Pb*/^{206}Pb*] have been corrected for common Pb.

4. Listed uncertainties are 1σ and include all components of statistical precision.

5. Disc. is apparent discordance, defined as 100(t[^{207}Pb*/^{206}Pb*] - t[^{206}Pb*/^{238}U]) / t[^{207}Pb*/^{206}Pb*]).

6. Analyses are sorted by descending ^{207}Pb*/^{206}Pb* age, except those rejected due to high common Pb or large discordance.

The ages quoted below are weighted mean ^{207}Pb/^{206}Pb ages (rounded off to 1 Ma), with 95% confidence limits (rounded up to ± 1 Ma and to include the rounding in the weighted mean). Data ellipses illustrated in concordia plots are 1σ errors.

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DETAILED DESCRIPTION OF RESULTS

WM 5; Zircon

Data were acquired in two analytical sessions (Sessions 1 and 2; Table S1).

A total of 22 analyses were taken from 10 grains (Table DR1). The U and Th contents are highly consistent, suggesting a single population of zircons. Three analyses have >1% common ^{206}Pb and are not considered for age determination. Two others, one of them with 0.9% common ^{206}Pb, are >5% (reversely) discordant; these are also discounted. These exclusions are justified only by the data being deemed less reliable; they are actually quite consistent with the other data. Their inclusion would make no significant difference to the calculated age, partly because most of them have appreciably poorer precision in $^{207}Pb/^{206}Pb$ than the main data group.

The 17 analyses, from nine grains, in the main group have a weighted mean $^{207}Pb/^{206}Pb$ age of 1387 ± 10 Ma (MSWD = 0.8).

WM 5; Monazite

Data were acquired in two analytical sessions (Sessions 3 and 4; Table S1).

Twenty-seven analyses were collected from five grains. All results are within 5% (and all within 1σ) of apparent concordance (Table DR2). All have significant common Pb (average ~0.5% common Pb in ^{206}Pb) but only one with unusually high common Pb has been excluded from age consideration. The uniformity of the U and Th contents implies that the data represent a single generation of monazite, but there is minor excess scatter amongst the remaining $^{207}Pb/^{206}Pb$ data (MSWD = 1.5). Given the almost symmetric distribution of $^{207}Pb/^{206}Pb$ we consider that data culling is not justified. The 26 analyses give a weighted mean $^{207}Pb/^{206}Pb$ age of 1391 ± 10 Ma.

K96; Monazite

Data were acquired in two analytical sessions (sessions 3 and 5; Table S1).

Of 24 analyses, from five grains (Table DR3), four cannot be used because of data instability (poor precision) or very high (>3%) common Pb. One other has >5% apparent discordance and four have >1% common ^{206}Pb but these are still consistent with the main data group of 14 analyses and there is no correlation between common Pb contents and corrected $^{207}Pb/^{206}Pb$. The uniformity of U and Th contents suggests that these grains are from a single generation of monazite, but probably different from WM 5. The weighted mean $^{207}Pb/^{206}Pb$ age from the 14 results in the main group is 1374 ± 13 Ma (MSWD = 0.73). Different data selections (e.g., restricting to <0.5% common ^{206}Pb or including results with higher common Pb) produces weighted mean $^{207}Pb/^{206}Pb$ within 1 Ma of this result and are not justified. The weighted mean $^{206}Pb/^{238}U$ date of 1370 ± 21 Ma derived from the same cluster of analyses is less precise and shows a large MSWD of 3.1, which likely indicates excess scattering of the data, or alternatively, reflects an underestimation of the error in Pb/U calibration.

K99

Analyzed in Session 6 (Table S1).

Six analyses were taken from individual grains (Table DR4). U and Th contents are high and variable (up to 1% and 20% respectively) and Y is also high (4%–5%). There are also complications due to the size of the grains. Occasionally, the primary ion beam overlaps the grain edge, and some grains have visible inclusions that cannot be avoided. Consequently, the accuracy of Pb/U and Pb/Th is unreliable due to extreme matrix effects (possibly including some from intrinsic elements not previously investigated, and from false element data due to the inclusions), and possible edge effects. The discordant analyses form an array intercepting the concordia curve at a high angle, implying effect of geologically recent Pb loss. $^{207}Pb/^{206}Pb$ may have been degraded by Pb loss at grain edges in the smallest grains and there could be mixing with Pb from inclusions. Interpretation is further limited by the small size of the data set. These data may indicate the timing of events but cannot providing rigorous chronology.

It is assumed that Pb/Pb characteristics are preserved and only the Pb/U calibration is deficient, i.e., that the $^{207}Pb/^{206}Pb$ dates are valid. Grain 0911K is distinctively different in crystal morphology, Th-U chemistry and age compared with other grains from this sample, thus it is excluded from the main group. The weighted mean $^{207}Pb/^{206}Pb$ age defined by the remaining five analyses is 1408 ± 22 Ma, with MSWD = 2.6. There is one distinct outlier (4σ) in $^{207}Pb/^{206}Pb$. If this point is omitted, the weighted mean becomes 1401 ± 10 Ma, and MSWD comes down to 0.12. This age is compatible with the ages from WM 5 though not a robust age determination.

K100

Sample K100 contains two visibly different generations of monazite: small (~10 – 20 μm) grains similar to those in K99, and a large, inclusion-rich cumulate grain.

Mount 09–11, discs A, C, H, J, L – small grains

Analyzed in Session 6 (Table S1).

Eleven analyses were taken from eight discrete, small grains but three had low (<50%) Ce count rates, implying inadequate monazite within the analytical spot; these are not reported. The remaining eight results (Table DR5) share the chemical characteristics and Pb/U calibration limitations of the small grains in K 99. The data are all discordant (Table DR5) but five of them are well-grouped in $^{207}Pb/^{206}Pb$ (MSWD = 1.6) and give a weighted mean $^{207}Pb/^{206}Pb$ age of 1391 ± 20 Ma. However, one analysis (0911A.1–1) is from a monazite rim which yielded a younger date. Excluding this one, the rest define a weighted mean of 1403 ± 15 Ma (n = 4, MSWD = 0.64). As with K 99, this is compatible with the age of WM 5. The array suggests possible disturbance of the U–Pb systems at ~1 Ga but this is not definitive.

Mount 09–11, disc M – large skeletal grain

Analyzed in Session 6 (Table S1).

Six analyses were taken from scattered locations in the one large composite grain (Table DR5). They are chemically very different from those from the discrete small grains in K100, notably with much lower U and Th contents. Partly because of this (due to the lower ^{207}Pb count rates) the precision of the individual analyses is also poorer. Two of the analyses have >1% common Pb and are not used for chronology. The other four give a weighted mean $^{207}Pb/^{206}Pb$

date of 1325 ± 80 Ma (rounded off; MSWD = 1.8). If the youngest analysis is omitted, the weighted mean date becomes 1345 ± 43 Ma with MSWD of 0.99. Assuming the younger rim of grain 0911A formed during the same metamorphic-thermal event as the skeletal monazite, they combine to give a appreciably improved weighted mean $^{207}Pb/^{206}Pb$ date of 1375 ± 15 Ma (2σ, MSWD = 1.4), considered the best estimate of the growth event.

Despite the limited number of data set, these results suggest that the skeletal monazite grain must be substantially younger than the smaller grains in the same rock.

K89; Monazite in Metasediments (Large Aggregate Grains)

Analyzed in Session 7 (Table S1).

Twenty analyses were taken from these three aggregate grains (Table DR6) but one with >25% common ^{206}Pb and low (<50%) Ce count rate is not reported. U (and Th) contents are quite variable and also low, leading to poor precision in $^{207}Pb/^{206}Pb$. Only five analyses have <1% common ^{206}Pb and are within 5% of apparent concordance. These give a weighted mean $^{207}Pb/^{206}Pb$ age of 1369 ± 34 Ma but they have considerably more scatter in $^{206}Pb/^{238}U$ than in $^{207}Pb/^{206}Pb$. Four other results are only slightly poorer in apparent quality (common Pb; discordance). If these are included, the weighted mean $^{207}Pb/^{206}Pb$ age becomes 1379 ± 27 Ma (MSWD = 1.1). Although this is compatible with data from WM5, it is not a robust age determination given the scatter in $^{206}Pb/^{238}U$ amongst these data and the disturbance obvious in the other data. The overall data array suggests a possible U–Pb disturbance or resetting (or additional monazite growth) at ~1 Ga.

K101; Younger Monazite in Metasediments

Mount BR08–19, discs B, C

Analyzed in Session 5 (Table S1).

Fourteen analyses were taken from these five grains (Table DR7). The U (and Th) contents are substantial, leading to reasonably good precision in $^{207}Pb/^{206}Pb$ despite the young ages.

All data show appreciable levels of common Pb, but none are >1% common ^{206}Pb. Ten points are within 5% (and within 1σ) of concordance. These give a weighted mean $^{207}Pb/^{206}Pb$ age of 991 ± 16 Ma (MSWD = 0.84). The corresponding $^{206}Pb/^{238}U$ dates necessarily (because of the concordance criterion) agree closely with this, giving 991 ± 14 Ma (including calibration uncertainties in standard) with MSWD = 1.3. The independently-calibrated weighted mean $^{208}Pb/^{232}Th$ age for the same analyses is 988 ± 31 Ma. Although not highly precise, this indicates that there is no significant unsupported ^{206}Pb in theses grains. If data with 5%–8% apparent discordance are included in the weighted mean $^{207}Pb/^{206}Pb$ age, this changes to 997 ± 13 Ma (MSWD = 1.0).

Given the sensitivity of SIMS data to analytical limitations in this age range (the 'crossover' area where t[$^{207}Pb/^{206}Pb$] becomes highly sensitive to small errors in measured ratios and their corrections as age decreases, and where t[$^{206}Pb/^{238}U$] and t[$^{208}Pb/^{232}Th$] become unacceptably imprecise, in absolute age, as age increases), as well as to data selection criteria, we use a more conservative age of 991 ± 16 Ma for these monazites.

TABLE S1 SHRIMP OPERATING PARAMETERS FOR ZIRCON AND MONAZITE ANALYSES.

Session	Mount	Sample	Mineral	Kohler aperture (μm)	Spot size (μm)	O_2^- primary (nA)	M/ΔM (1% height)	Number of standards[†] Pb/U	1σ external precision[§] (%) Pb/U
1	BR08-23	WM5	Zircon	50	~12	0.3	4800	7 of 9	3.1%
2	BR08-23	WM5	Zircon	50	~12	0.4	5000	6	2.6%
3*	BR08-14	WM5, K96	Monazite	50	~12	0.4	5000	18	1.6%
4*	BR08-14	WM5	Monazite	30	~10	0.2	5200	15	1.0%
5*	BR08-19	K96, K101	Monazite	30	~10	0.2	5000	22 of 23	1.2%
6*	BR09-11	K99, K100	Monazite	30	~10	0.2	5200	10 of 13	1.8%
7*	BR09-08	K89	Monazite	30	~10	0.2	5100	14	1.1%

Notes:

* Retardation lens activated.

[†] Number of reference measurements used for element ratio calibration.

[§] External precision (reproducibility) of element ration calibration.

TABLE S2 COMPILATION OF GEOCHRONOLOGY DATA OBTAINED IN THIS STUDY TOGETHER WITH THOSE SELECTED FROM THE LITERATURE. THE CODES IN THIS TABLE CORRESPOND WITH THOSE USED IN FIGURE 10.

Code	Sample ID	Locality	Lithology	Age/Ma	Error/Ma	Method	Source
1	K101	Kabanga upper	banded pelite	991	14	U-Pb monazite	this study
2	K100-low Th	Kabanga upper	muscovite schist	1375	15	U-Pb monazite	this study
3	K99	Kabanga upper	muscovite schist	1378	10	U-Pb monazite	this study
4	K96	MNB	muscovite schist	1374	13	U-Pb monazite	this study
5	K89	Nyanzali	muscovite schist	1379	27	U-Pb monazite	this study
6	K100-hi Th	Kabanga upper	muscovite schist	1403	15	U-Pb monazite	this study
7	K99	Kabanga upper	muscovite schist	1401	10	U-Pb monazite	this study
8	WM5	Kabanga	gabbronorite	1395	22	U-Pb zircon	this study
9	WM5	Kabanga	gabbronorite	1395	13	U-Pb monazite	this study
10	Kab-1	Kabanga North	mafic intrusion	1403	14	U-Pb	Maier et al 2007
11	W-1	Kapalagulu	mafic intrusion	1392	26	U-Pb	Maier et al 2007
12	DB1	Musongati	Amphibole norite	1374	14	U-Pb zircon	Tack et al 2010
13	63,865	Rumeza Gr 1	S-type granite	1383	17	U-Pb zircon	Tack et al 2010
14	Ki6684	Mugere Gr 2	S-type granite	1379	10	U-Pb zircon	Tack et al 2010
15	Ki1	Kiganda Gr 3	S-type granite	1371	7	U-Pb zircon	Tack et al 2010
16	Ki14	Muramba	S-type granite	1380	6	U-Pb zircon	Tack et al 2010
17	Ki20	Kilimbi-Muzimu	S-type granite	1373	6	U-Pb zircon	Tack et al 2010
18	Ki21	Mugere	migmatitic paragneiss	1380	12	U-Pb zircon	Tack et al 2010
19	A114	Rutovu	hornblende granophyre	1368	18	Ar-Ar	Tack et al 2010
20	DB1	Musongati	Amphibole norite	1365	2	Ar-Ar	Tack et al 2010
21	Mo92	Kavumwe	mafic sill	1360	20	Ar-Ar	Deblond et al 2001
22	Mo92	Kavumwe	mafic sill	1340	9	Ar-Ar	Deblond et al 2001
23	Mo89	Bukoba Sandstone	mafic sill	1379	10	Ar-Ar	Deblond et al 2001
24	Mo89	Bukoba Sandstone	mafic sill	1355	10	Ar-Ar	Deblond et al 2001
25	1021	Uganda (W of Masaka)	dolerite dyke	1368	41	Sm-Nd isochron	Makitie et al 2014
26	1186	Uganda (SE of Mubende)	dolerite dyke	1374	42	Sm-Nd isochron	Makitie et al 2014
27	LT7	Bukirasazi Gr 4	A-type granite	1205	19	U-Pb	Tack et al 2010
28	Ki22	Kasika	tin granite	986	10	U-Pb	Tack et al 2010

TABLE DR1 SHRIMP U-PB DATA FOR IGNEOUS ZIRCON IN WM5

Analysis No.	U (ppm)	Th (ppm)	Th/U	f_{206} (%)	$^{207}Pb^*/^{206}Pb^*$	± 1σ	$^{206}Pb^*/^{238}U$	± 1σ	$^{207}Pb^*/^{235}U$	± 1σ	$^{208}Pb^*/^{232}Th$	± 1σ	Disc. (%)	$^{207}Pb^*/^{206}Pb^*$ Age (Ma)	± 1σ	$^{206}Pb^*/^{238}U$ Age (Ma)	± 1σ
Main group																	
0823B.5-4	533	323	0.63	0.36	0.0871	0.0013	0.239	0.008	2.87	0.11	0.069	0.003	-1	1363	28	1381	41
0823B.6-1	362	224	0.64	0.09	0.0871	0.0011	0.242	0.008	2.91	0.10	0.071	0.003	-3	1364	24	1397	41
0823B.3-1	491	309	0.65	0.25	0.0874	0.0009	0.240	0.006	2.90	0.08	0.071	0.002	-2	1368	19	1387	31
0823B.2-1	459	243	0.55	0.20	0.0874	0.0012	0.247	0.009	2.97	0.11	0.071	0.003	-4	1369	26	1423	46
0823B.5-3	533	322	0.62	0.16	0.0874	0.0010	0.248	0.008	2.99	0.10	0.072	0.003	-4	1370	22	1428	41
0823B.7-2	405	243	0.62	0.09	0.0875	0.0011	0.245	0.008	2.96	0.11	0.071	0.003	-3	1370	24	1413	41
0823B.2-2	534	377	0.73	0.07	0.0875	0.0009	0.252	0.008	3.03	0.10	0.074	0.003	-5	1371	20	1449	41
0823B.2-3	317	192	0.63	0.06	0.0876	0.0012	0.251	0.008	3.03	0.11	0.071	0.003	-5	1375	26	1444	41
0823B.4-1	377	241	0.66	0.04	0.0878	0.0012	0.239	0.007	2.89	0.09	0.068	0.002	0	1377	25	1381	36
0823B.5-1	641	362	0.58	0.09	0.0878	0.0009	0.250	0.008	3.03	0.10	0.071	0.003	-4	1378	19	1438	41
0823B.9-1	535	315	0.61	0.17	0.0878	0.0007	0.243	0.007	2.94	0.08	0.071	0.002	-2	1379	16	1402	36
0823B.9-2	446	274	0.63	0.77	0.0881	0.0015	0.229	0.006	2.78	0.09	0.070	0.003	4	1384	32	1329	31
0823B.7-1	524	316	0.62	0.07	0.0884	0.0009	0.242	0.008	2.95	0.10	0.070	0.003	0	1391	21	1397	41
0823B.5-3	479	304	0.66	0.00	0.0888	0.0006	0.236	0.006	2.88	0.08	0.070	0.002	3	1399	14	1366	31
0823B.10-1	381	235	0.64	0.02	0.0889	0.0007	0.248	0.007	3.04	0.09	0.074	0.002	-2	1403	15	1428	36
0823B.2-6	366	246	0.70	-0.04	0.0891	0.0008	0.243	0.007	2.99	0.09	0.072	0.002	0	1407	17	1402	36
0823B.8-1	455	227	0.51	0.13	0.0898	0.0008	0.234	0.006	2.90	0.08	0.069	0.002	5	1422	17	1355	31
Disc. >5% or f_{206} >1%																	
0823B.5-2	544	354	0.67	0.13	0.0866	0.0010	0.252	0.008	3.01	0.10	0.073	0.003	-7	1352	22	1449	41
0823B.1-1	415	255	0.63	0.88	0.0847	0.0024	0.242	0.008	2.83	0.12	0.071	0.003	-7	1308	56	1397	41
0823B.7-3	501	294	0.61	1.14	0.0879	0.0023	0.239	0.008	2.89	0.12	0.069	0.003	0	1381	50	1381	41
0823B.2-4	355	182	0.53	1.60	0.0901	0.0020	0.251	0.008	3.12	0.12	0.077	0.003	-1	1428	41	1444	41

0823B.2-5	390	209	0.55	3.00	0.0919	0.0056	0.237	0.007	3.00	0.20	0.072	0.007	6	1466	116	1371	36

Note:

Pb* indicate radiogenic Pb

f_{206} is the proportion of common Pb in ^{206}Pb, determined using the measured ^{204}Pb/^{206}Pb and a common Pb composition from the Stacey-Kramers (1975) model at the approximate age of the sample.

All Pb isotope data and t[^{207}Pb*/^{206}Pb*] have been corrected for common Pb.

Disc. is apparent discordance, as 100(t[^{207}Pb*/^{206}Pb*] - t[^{206}Pb*/^{238}U]) / t[^{207}Pb*/^{206}Pb*].

Analyses are sorted by ascending ^{207}Pb*/^{206}Pb* age, except those rejected due to high common Pb or large discordance.

The same footnotes apply to Tables DR2-DR7.

TABLE DR2 SHRIMP U-PB DATA FOR IGNEOUS MONAZITE IN WM5

Analysis No.	U (ppm)	Th (ppm)	Th/U	f_{206} (%)	$^{207}Pb^{*}/^{206}Pb^{*}$	± 1σ	$^{206}Pb^{*}/^{238}U$	± 1σ	$^{207}Pb^{*}/^{235}U$	± 1σ	$^{208}Pb^{*}/^{232}Th$	± 1σ	Disc. (%)	$^{207}Pb^{*}/^{206}Pb^{*}$ Age (Ma)	± 1σ	$^{206}Pb^{*}/^{238}U$ Age (Ma)	± 1σ
Main group																	
0814D.1-7	559	30219	54	0.61	0.0856	0.0015	0.234	0.004	2.76	0.07	0.070	0.004	-2	1328	33	1354	21
0814D.2-4	1358	37813	28	0.48	0.0863	0.0009	0.239	0.003	2.84	0.05	0.074	0.003	-3	1345	19	1379	16
0814D.1-5	532	26805	50	0.70	0.0868	0.0016	0.246	0.003	2.94	0.07	0.075	0.003	-5	1355	35	1417	16
0814K.1-2	965	38662	40	0.47	0.0869	0.0010	0.242	0.003	2.90	0.05	0.077	0.003	-3	1357	21	1399	17
0814D.3-4	628	32285	51	0.63	0.0869	0.0014	0.241	0.003	2.89	0.06	0.073	0.003	-3	1359	32	1393	16
0814F.1-2	686	41786	61	0.62	0.0874	0.0010	0.247	0.004	2.97	0.06	0.073	0.004	-4	1368	22	1421	23
0814D.1-4	539	17552	33	0.64	0.0874	0.0012	0.235	0.003	2.83	0.05	0.081	0.003	1	1369	26	1360	14
0814K.1-4	887	40622	46	0.50	0.0875	0.0010	0.243	0.003	2.93	0.05	0.076	0.003	-2	1371	22	1403	15
0814F.1-3	707	38459	54	0.74	0.0875	0.0014	0.243	0.003	2.94	0.06	0.076	0.003	-2	1372	30	1404	16
0814D.2-2	780	34927	45	0.40	0.0878	0.0006	0.238	0.005	2.88	0.06	0.070	0.005	0	1378	12	1376	23
0814D.2-1	1103	36875	33	0.37	0.0881	0.0005	0.244	0.004	2.96	0.06	0.072	0.004	-2	1384	10	1407	23
0814D.1-3	873	32082	37	0.33	0.0883	0.0005	0.245	0.005	2.98	0.06	0.073	0.005	-2	1389	11	1411	24
0814D.2-7	1193	36692	31	0.32	0.0883	0.0009	0.235	0.003	2.86	0.04	0.070	0.003	2	1390	19	1361	14
0814D.2-6	1103	34529	31	0.39	0.0884	0.0009	0.245	0.003	2.99	0.05	0.076	0.003	-1	1392	19	1413	17
0814D.3-2	560	28356	51	0.45	0.0885	0.0017	0.234	0.003	2.86	0.07	0.073	0.003	3	1394	36	1357	15
0814F.1-1	632	35950	57	0.56	0.0885	0.0007	0.243	0.004	2.96	0.06	0.074	0.004	0	1394	15	1401	23
0814D.2-3	1053	36579	35	0.27	0.0886	0.0006	0.237	0.005	2.90	0.06	0.069	0.005	2	1396	12	1373	23
0814K.1-1	825	42102	51	0.36	0.0887	0.0006	0.247	0.005	3.02	0.06	0.073	0.005	-2	1398	12	1420	23
0814D.1-2	561	28785	51	0.43	0.0887	0.0010	0.251	0.004	3.07	0.07	0.075	0.004	-3	1398	23	1445	23
0814D.2-5	846	32136	38	0.37	0.0890	0.0010	0.240	0.003	2.94	0.05	0.073	0.003	1	1403	22	1386	18
0814D.1-1	572	27791	49	0.36	0.0890	0.0006	0.243	0.004	2.98	0.06	0.073	0.004	0	1403	14	1402	23
0814D.1-6	623	28800	46	0.46	0.0891	0.0012	0.246	0.003	3.02	0.05	0.076	0.003	-1	1405	25	1418	16

0814F.1-4	726	38272	53	0.57	0.0894	0.0012	0.251	0.003	3.10	0.06	0.077	0.003	-2	1413	25	1445	15
0814D.3-5	625	29112	47	0.44	0.0894	0.0011	0.240	0.003	2.96	0.05	0.071	0.003	2	1414	25	1386	15
0814K.1-3	1121	48384	43	0.26	0.0901	0.0008	0.2409	0.004	2.991	0.055	0.0728	0.004	2	1427	17	1391	20
0814D.3-1	533	30988	58	0.31	0.0906	0.0007	0.2407	0.005	3.009	0.063	0.0721	0.005	3	1439	15	1390	24
f_{206} >1%																	
0814F.1-5	608	35341	58	1.61	0.0925	0.0021	0.2414	0.003	3.078	0.079	0.0753	0.003	6	1477	42	1394	16

TABLE DR3 SHRIMP U-PB DATA FOR MONAZITE IN MUSCOVITE SCHIST SAMPLE K89

Analysis No.	U (ppm)	Th (ppm)	Th/U	f_{206} (%)	$^{207}Pb^*/^{206}Pb^*$	± 1σ	$^{206}Pb^*/^{238}U$	± 1σ	$^{207}Pb^*/^{235}U$	± 1σ	$^{208}Pb^*/^{232}Th$	± 1σ	Disc. (%)	$^{207}Pb^*/^{206}Pb^*$ Age (Ma)	± 1σ	$^{206}Pb^*/^{238}U$ Age (Ma)	± 1σ
Main group																	
0908G.1-5	197	1580	8	0.87	0.0840	0.0024	0.218	0.004	2.52	0.08	0.059	0.004	2	1292	55	1270	19
0908H.1-8	131	5172	39	0.52	0.0850	0.0023	0.216	0.004	2.53	0.08	0.068	0.004	4	1315	52	1258	20
0908H.1-4	209	14490	69	0.25	0.0873	0.0015	0.238	0.004	2.87	0.07	0.074	0.004	-1	1367	32	1378	20
0908H.1-5	173	5367	31	0.05	0.0884	0.0013	0.230	0.007	2.80	0.09	0.068	0.007	4	1392	28	1333	35
0908C.1-4	235	4242	18	0.82	0.0892	0.0023	0.237	0.005	2.91	0.10	0.065	0.005	3	1408	48	1371	28
Possible additions (slightly higher apparent discordance or higher common Pb)																	
0908G.1-7	62	881	14	-0.44	0.0935	0.0033	0.243	0.006	3.14	0.13	0.067	0.006	6	1498	66	1404	31
0908H.1-7	258	8193	32	0.23	0.0875	0.0013	0.222	0.003	2.68	0.06	0.067	0.003	6	1373	29	1295	17
0908H.1-2	68	6633	97	1.38	0.0866	0.0070	0.245	0.006	2.93	0.25	0.073	0.006	-5	1352	155	1414	28
0908G.1-2	171	4501	26	1.39	0.0900	0.0026	0.236	0.005	2.93	0.11	0.073	0.005	4	1426	56	1364	27
Disc. >5% and/or f_{206} >1%																	
0908G.1-4	165	4271	26	1.27	0.0716	0.004	0.1527	0.003	1.51	0.08	0.046	0.003	6	974	107	916.1	15
0908G.1-8	176	2857	16	0.53	0.0804	0.002	0.1855	0.003	2.06	0.07	0.057	0.003	9	1207	56	1097	17
0908G.1-3	100	1577	16	1.03	0.0728	0.004	0.2041	0.004	2.05	0.11	0.050	0.004	-19	1008	97	1197	21
0908C.1-3	215	7304	34	2.14	0.0793	0.004	0.1943	0.008	2.12	0.15	0.054	0.008	3	1178	105	1145	45
0908H.1-6	147	11283	77	3.12	0.0855	0.006	0.2258	0.004	2.66	0.21	0.068	0.004	1	1327	145	1312	22
0908H.1-1	50	7897	158	3.48	0.0695	0.008	0.2394	0.007	2.30	0.28	0.077	0.007	-51	914	244	1384	34
0908C.1-2	258	9401	36	4.56	0.0959	0.008	0.1865	0.004	2.47	0.21	0.053	0.004	29	1546	158	1102	19
0908G.1-1	137	2694	20	4.97	0.0875	0.008	0.1827	0.008	2.20	0.23	0.053	0.008	21	1371	180	1082	42
0908C.1-1	188	3482	19	7.36	0.1135	0.015	0.1991	0.006	3.11	0.41	0.053	0.006	37	1856	233	1170	31
0908H.1-3	68	5647	83	8.84	0.0811	0.028	0.2066	0.008	2.31	0.80	0.067	0.008	1	1224	673	1211	42

TABLE DR4 SHRIMP U-PB DATA FOR MONAZITE IN MUSCOVITE SCHIST SAMPLE K96

Analysis No.	U (ppm)	Th (ppm)	Th/U	f_{206} (%)	$^{207}Pb^*/^{206}Pb^*$	± 1σ	$^{206}Pb^*/^{238}U$	± 1σ	$^{207}Pb^*/^{235}U$	± 1σ	$^{208}Pb^*/^{232}Th$	± 1σ	Disc. (%)	$^{207}Pb^*/^{206}Pb^*$ Age (Ma)	± 1σ	$^{206}Pb^*/^{238}U$ Age (Ma)	± 1σ
Main group																	
0819G.1-3	528	7568	14	0.72	0.0857	0.0015	0.233	0.004	2.75	0.07	0.071	0.004	-1	1331	33	1349	23
0819I.1-4	466	1969	4	0.87	0.0861	0.0016	0.238	0.004	2.83	0.07	0.068	0.004	-3	1341	37	1376	21
0819I.1-1	404	3722	9	0.98	0.0866	0.0019	0.236	0.005	2.82	0.08	0.068	0.005	-1	1351	41	1365	24
0819G.1-5	492	9033	18	0.51	0.0867	0.0013	0.231	0.004	2.76	0.06	0.068	0.004	1	1354	29	1340	21
0819I.1-3	680	5485	8	0.35	0.087	0.0010	0.241	0.003	2.90	0.05	0.069	0.003	-2	1360	22	1393	17
0819G.1-4	504	7389	15	0.48	0.0873	0.0012	0.237	0.004	2.85	0.06	0.070	0.004	0	1367	27	1368	21
0819J.1-1	565	10484	19	0.59	0.0874	0.0014	0.225	0.003	2.71	0.06	0.065	0.003	4	1369	31	1308	17
0814L.1-2	417	6507	16	0.08	0.0875	0.0006	0.230	0.005	2.77	0.06	0.068	0.005	3	1372	13	1334	26
0819G.1-2	433	7071	16	0.58	0.0877	0.0014	0.244	0.004	2.95	0.06	0.071	0.004	-2	1377	30	1406	18
0819I.1-5	1268	8232	6	0.31	0.0879	0.0008	0.229	0.004	2.78	0.05	0.067	0.004	4	1380	17	1331	20
0814L.1-4	279	4271	15	0.31	0.0879	0.0008	0.248	0.005	3.01	0.06	0.071	0.005	-3	1381	18	1429	24
0819J.1-2	304	8042	26	0.91	0.089	0.0020	0.241	0.004	2.95	0.08	0.068	0.004	1	1405	42	1390	19
0819E.1-5	202	4881	24	0.98	0.0897	0.0023	0.245	0.004	3.02	0.09	0.072	0.004	1	1419	48	1411	21
0819J.1-3	277	3234	12	0.36	0.0905	0.0015	0.240	0.004	2.99	0.07	0.068	0.004	3	1436	31	1387	19
Disc. >5% or f_{206} >1%																	
0819J.1-4	303	6580	22	1.12	0.0861	0.0022	0.234	0.004	2.78	0.08	0.070	0.004	-1	1341	50	1358	19
0819E.1-3	417	5895	14	1.12	0.0886	0.0025	0.229	0.003	2.80	0.09	0.067	0.003	5	1395	55	1328	18
0819G.1-1	212	1201	6	1.19	0.0887	0.0024	0.237	0.004	2.89	0.09	0.068	0.004	2	1397	52	1368	20
0819E.1-1	312	3952	13	1.26	0.0881	0.0024	0.238	0.004	2.89	0.09	0.070	0.004	1	1385	53	1376	20
0819E.1-2	362	5379	15	1.34	0.0901	0.0023	0.241	0.004	2.99	0.09	0.071	0.004	3	1428	48	1389	19
0814L.1-1	256	5331	21	0.59	0.0888	0.0025	0.221	0.004	2.71	0.09	0.066	0.004	8	1399	55	1288	23
Unstable analyses, imprecise data																	

0819I.1-2	303	3835	13	0.94	0.0906	0.005	0.2414	0.004	3.015	0.182	0.0678	0.004	3	1438	110	1394	21
0814L.1-3	174	2641	15	1.08	0.095	0.02	0.2596	0.009	3.4	0.71	0.0708	0.009	3	1527	390	1488	44
0819J.1-5	303	2353	8	3.02	0.1124	0.022	0.2405	0.004	3.727	0.725	0.0698	0.004	24	1838	350	1389	19
0819E.1-4	187	2518	13	7.94	0.104	0.036	0.2344	0.01	3.363	1.163	0.0672	0.01	20	1697	630	1358	54

TABLE DR5 SHRIMP U-PB DATA FOR MONAZITE IN MUSCOVITE SCHIST SAMPLE K99

Analysis No.	U (ppm)	Th (ppm)	Th /U	f_{206} (%)	$^{207}Pb^{*}$ / $^{206}Pb^{*}$	± 1σ	$^{206}Pb^{*}$ / ^{238}U	± 1σ	$^{207}Pb^{*}$ / ^{235}U	± 1σ	$^{208}Pb^{*}$ / ^{232}Th	± 1σ	Disc. (%)	$^{207}Pb^{*}$ / $^{206}Pb^{*}$ Age (Ma)	± 1σ	$^{206}Pb^{*}$ / ^{238}U Age (Ma)	± 1σ
M-I monazite																	
0911F.1-1	3561	212608	60	0.02	0.0890	0.0004	0.221	0.005	2.71	0.06	0.071	0.002	8	1405	9	1287	27
0911I.1-1	3374	173208	51	-0.06	0.0889	0.0005	0.209	0.005	2.56	0.06	0.066	0.002	13	1402	11	1224	26
0911D.1-1	2230	144556	65	0.08	0.0887	0.0005	0.230	0.005	2.82	0.06	0.075	0.002	5	1398	10	1335	26
0911G.2-1	1625	90325	56	0.20	0.0887	0.0007	0.189	0.005	2.32	0.06	0.067	0.002	20	1397	15	1118	25
M-II monazite																	
0911K.1-1	10520	93205	9	0.03	0.0878	0.0002	0.210	0.005	2.54	0.06	0.066	0.002	11	1378	5	1227	24
outlier																	
0911G.1-1	2282	152796	67	-0.11	0.0908	0.0005	0.220	0.005	2.75	0.06	0.073	0.002	11	1443	12	1282	24

TABLE DR6 SHRIMP U-PB DATA FOR MONAZITE IN MUSCOVITE SCHIST SAMPLE K100

Analysis No.	U (ppm)	Th (ppm)	Th /U	f_{206} (%)	$^{207}Pb^*/^{206}Pb^*$	± 1σ	$^{206}Pb^*/^{238}U$	± 1σ	$^{207}Pb^*/^{235}U$	± 1σ	$^{208}Pb^*/^{232}Th$	± 1σ	Disc. (%)	$^{207}Pb^*/^{206}Pb^*$ Age (Ma)	± 1σ	$^{206}Pb^*/^{238}U$ Age (Ma)	± 1σ
M-I (small grains)																	
0911H.1-1	1918	171883	90	0.10	0.0899	0.0010	0.212	0.005	2.63	0.07	0.069	0.002	13	1423	21	1241	28
0911C.1-2	1708	153371	90	0.28	0.0895	0.0008	0.199	0.005	2.46	0.07	0.065	0.002	17	1414	18	1170	28
0911J.2-2	2383	175369	74	-0.12	0.0888	0.0007	0.177	0.005	2.16	0.06	0.052	0.002	25	1399	16	1049	26
0911A.1-2	2580	184100	71	0.14	0.0885	0.0005	0.214	0.004	2.61	0.05	0.068	0.002	10	1394	12	1251	22
Overgrowth (rim) on M-I core																	
0911A.1-1	4895	223214	46	-0.04	0.0878	0.0004	0.205	0.004	2.49	0.05	0.063	0.002	13	1379	8	1204	23
Distinctly lower $^{207}Pb/^{206}Pb$																	
0911J.1-1	1955	60364	31	0.05	0.0695	0.0006	0.137	0.003	1.32	0.03	0.042	0.001	9	914	19	830	16
0911J.2-1	1199	109947	92	0.25	0.0829	0.0012	0.164	0.005	1.88	0.06	0.053	0.002	23	1267	28	981	25
0911C.1-1	1575	123586	78	0.20	0.0864	0.0007	0.203	0.005	2.42	0.06	0.069	0.002	12	1347	16	1191	25
M-II (aggregate grain)																	
0911M.1-4	634	9555	15	0.20	0.0829	0.0015	0.2289	0.005	2.617	0.069	0.0671	0.002	-5	1267	35	1329	24
0911M.1-2	292	4146	14	0.60	0.0844	0.0017	0.2375	0.005	2.765	0.08	0.0702	0.002	-5	1302	39	1374	25
0911M.1-6	390	6769	17	0.80	0.0865	0.0017	0.2247	0.005	2.68	0.076	0.073	0.002	3	1350	38	1307	24
0911M.1-5	328	8034	25	0.59	0.0877	0.0017	0.2397	0.006	2.899	0.09	0.0748	0.002	-1	1376	36	1385	31
f_{206} >1%																	
0911M.1-3	316	4236	13	1.65	0.0834	0.0048	0.2188	0.005	2.516	0.154	0.065	0.002	0	1279	112	1276	24
0911M.1-1	284	4867	17	1.77	0.0808	0.0032	0.245	0.005	2.73	0.123	0.0697	0.002	-16	1216	77	1413	27
0819J.1-5	303	2353	8	3.02	0.1124	0.022	0.2405	0.004	3.727	0.725	0.0698	0.004	24	1838	350	1389	19
0819E.1-4	187	2518	13	7.94	0.104	0.036	0.2344	0.01	3.363	1.163	0.0672	0.01	20	1697	630	1358	54

TABLE DR7 SHRIMP U-PB DATA FOR MONAZITE IN BANDED PELITE SAMPLE K101

Analysis No.	U (ppm)	Th (ppm)	Th/U	f_{206} (%)	$^{207}Pb^{*}/^{206}Pb^{*}$	± 1σ	$^{206}Pb^{*}/^{238}U$	± 1σ	$^{207}Pb^{*}/^{235}U$	± 1σ	$^{208}Pb^{*}/^{232}Th$	± 1σ	Disc. (%)	$^{207}Pb^{*}/^{206}Pb^{*}$ Age (Ma)	± 1σ	$^{206}Pb^{*}/^{238}U$ Age (Ma)	± 1σ
Main Group																	
0819B.3-2	1069	10561	10	0.46	0.0709	0.0009	0.164	0.002	1.61	0.03	0.049	0.002	-3	954	27	981	12
0819B.2-2	1053	7909	8	0.62	0.0709	0.0011	0.167	0.003	1.63	0.04	0.050	0.003	-4	955	31	996	17
0819C.1-2	1053	20184	19	0.61	0.0713	0.0011	0.165	0.002	1.62	0.03	0.050	0.002	-2	967	30	985	12
0819C.1-1	1328	19262	15	0.50	0.0716	0.0009	0.169	0.003	1.67	0.03	0.052	0.003	-3	976	25	1008	14
0819B.2-3	1215	13911	12	0.36	0.0719	0.0008	0.166	0.002	1.64	0.03	0.050	0.002	-1	983	23	988	13
0819B.4-1	997	13808	14	0.74	0.0725	0.0012	0.161	0.003	1.61	0.04	0.049	0.003	4	1000	34	962	14
0819B.2-1	1460	8629	6	0.21	0.0727	0.0006	0.169	0.003	1.70	0.03	0.052	0.003	0	1006	18	1008	15
0819B.1-3	1220	8751	7	0.67	0.0729	0.0011	0.165	0.002	1.66	0.03	0.049	0.002	3	1010	30	984	13
0819B.3-1	1265	10878	9	0.39	0.0731	0.0008	0.169	0.002	1.70	0.03	0.051	0.002	1	1015	23	1006	13
0819C.1-3	1084	13594	13	0.40	0.0735	0.0013	0.170	0.003	1.72	0.04	0.052	0.003	2	1026	35	1009	15
Disc. >5%																	
0819B.1-2	1345	10535	8	0.51	0.0729	0.0010	0.159	0.002	1.60	0.03	0.048	0.002	6	1012	27	950	13
0819C.1-4	1292	21421	17	0.32	0.0735	0.0008	0.161	0.003	1.63	0.03	0.048	0.003	6	1027	22	961	14
0819C.1-5	2515	18074	7	0.22	0.0724	0.0005	0.153	0.002	1.53	0.02	0.047	0.002	8	997	15	918	12
0819C.1-6	847	12751	15	0.41	0.0769	0.0010	0.166	0.003	1.77	0.04	0.050	0.003	11	1119	27	992	16