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Supporting Online Material for

Magmatic and Crustal Differentiation History of Granitic Rocks from Hf-O Isotopes in Zircon

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Materials and methods

Zircons were separated from 1-5 kg of pulverised rock by conventional hydrodynamic, magnetic separation and heavy liquid techniques. Around 100-250 grains from each sample were mounted in epoxy resin and ground and polished to expose their interior. Zircons of assorted morphologies were selected, and all were carefully characterised by cathodoluminescence (CL) and back-scattered electron imaging before analysis (see ref. S1). The (U-Th)-Pb isotope characteristics of the zircons, as determined by ion microprobe, are listed in Table S1 (from ref. S1).

Oxygen isotopes

The oxygen isotope data (Table S2) were acquired at the University of Edinburgh with a Cameca ims 1270, using a 6 nA primary $^{133}Cs^{+}$ beam and charge compensation by normal-incidence electron gun. The method closely followed that outlined by ref. S2. Secondary ions were extracted at 10 kV, and $^{18}O^{-}$ and $^{16}O^{-}$ were monitored simultaneously on dual Faraday cups. Each analysis involved a pre-sputtering time of 45 seconds, followed by data collection in two blocks of five cycles, amounting to a total count time of 40 seconds. Data were collected over two separate analytical periods using slightly different analytical protocols. In the first period (November 2004), a fixed primary beam was focussed directly onto the sample, sputtering material from an oval area measuring ~25 μm in the longest dimension. The secondary yield of ^{18}O under these conditions was typically between 2.5 x10^{6} and 3.0 x 10^{6} counts. Kohler illumination was employed in the second period (April 2005), which produced a slightly smaller and more regular, flat-bottomed pit and improved sensitivity for ^{18}O (average 4.0 x10^{6} counts). To correct for instrumental mass fractionation (IMF), all data were normalised to an internal standard, Geostandards zircon 91500 ($\delta^{18}O$ 10.07 ± 0.03‰ VSMOW, 0.66 wt% HfO_2, ref. S3), which was assumed to be homogeneous under the analytical conditions employed. Chips of this zircon were embedded into grain mounts and analysed (in blocks of five to ten) to bracket every 10-15 measurements on the sample zircons. For the November 2004 analytical period, the internal precision on each standard analysis based on counting statistics was typically between ±0.3‰ and ±0.7‰ (2 s.e.) and spot-to-spot reproducibility ~0.25-0.40 ‰ (1 s.d.). The internal precision was marginally improved in the April 2005 period (average 0.4 ‰, mostly < 0.5 ‰ at 2 s.e.), but the external precision based on replicate analysis of the same standard chip remained ~ 0.3 ‰ (1 s.d.). Analyses of the KIM-5 zircon standard (1.23 % HfO_2, $\delta^{18}O$ = 5.09 ± 0.06 ‰, ref. S3) were interposed as a monitor on data quality. Analyses during November 2004 and April 2005 yielded mean values of 5.14 ± 0.28 ‰ (1 s.d., n = 68) and 5.15 ± 0.28 ‰ (1 s.d., n = 34) respectively, both indistinguishable from the laser fluorination value ($\delta^{18}O$ = 5.09 ± 0.06 ‰) given by ref. S3. One grain mount analysed in April 2005 also contained the zircon standard Temora 2 (1 % HfO_2). The average $\delta^{18}O$ of 23 analyses from these zircons was 8.27 ± 0.20 ‰ (1 s.d.), indistinguishable from the laser fluorination value quoted by ref. S3 (8.20 ± 0.01 ‰).

Oxygen isotope data for unknowns and bracketing standards are listed in Table S2. The session divisions variously reflect primary beam restarts, specimen exchanges, or major adjustments to magnet calibration, electrostatic lens settings or the primary beam steering or intensity. Only analyses relevant to this paper are tabulated. Fractionation-corrected oxygen isotope data are quoted at 2 standard errors and include the propagated standard deviation of the 91500 standard analyses to account for any instrumental drift. The analytical errors for the sample zircons also incorporate the uncertainty in the oxygen isotope ratio of 91500 (± 0.03‰, *S3*). For unknowns, the fractionation factors used to correct raw $^{18}O/^{16}O$ data were calculated from bracketing analyses of the 91500 standard. When the instrument was stable, assessed by comparison between standard datasets acquired over the course of the session, the fractionation factor was derived from pooled standards. In cases where standard analyses showed significant drift, unknowns were corrected to the average fractionation factor derived from the immediate bracketing standard set. For each block of 91500 standard analyses, the table also lists the per mil deviation of the average measured $^{18}O/^{16}O$ from the accepted ratio reported by ref. S3. This gives a measure of the magnitude of the IMF and its variation during and between sessions. During this study we observed contrasts in $\delta^{18}O$ approaching 6 ‰ between inherited zircon cores and their immediately adjacent magmatic overgrowths, consistent with sluggish oxygen diffusion under magmatic conditions (*S4*).

Hafnium isotopes

Lu-Hf isotope analysis (Table S3) was conducted by excimer laser ablation multi-collector ICP-MS, using either a Nu instruments Nu Plasma (School of Earth Sciences, University of Melbourne) or a ThermoFinnigan Neptune (Department of Earth Sciences, University of Bristol). The beam delivery system at Melbourne included a custom-built ablation cell and signal-smoothing device, whereas a small volume (8 cm^3) glass mixing chamber was employed for the latter purpose at Bristol. Analytical and interference correction procedures for the instrumentation at Melbourne are described by ref. S5. Similar protocols were adopted at Bristol (*S6, S7*) except that a small (~0.005 l/min) N_2 flow was introduced into the Ar carrier gas upstream of the mixing chamber to enhance sensitivity. Ablation was carried out in a He atmosphere in both laboratories.

Hafnium isotope data were acquired using either a 40 μm or 50 μm (predominantly) beam size and 4-5 Hz laser pulse repetition rate, producing total Hf beams of ~8-28 V. The power density at the sample was maintained at around 6 J/cm^2 (ca. 5 J/cm^2 at Melbourne), which translated into an estimated drilling rate of ca. 0.5-1 μm/sec. Ablation periods were 60 seconds at Bristol and 60-120 seconds at Melbourne. Results from three zircon standards (91500, Temora 2 and Mud Tank) show excellent agreement for the two laboratories (*S8*). Wherever possible, clear, crack- and inclusion-free zircons were targeted for Hf isotope analysis, although intersecting tiny inclusions (mostly apatite needles) had negligible impact upon Hf isotope ratios (*S8*). Ablation was ideally conducted as close as practical to the pits resulting from U-Pb and O isotope analysis, and within the same CL-defined growth phase. Where growth zones of different age and $^{176}Hf/^{177}Hf$ where intersected during depth profiling, as for the case of drilling through an inherited core into a magmatic rim, the Hf isotope ratios of the two components were isolated from the resulting mixed signal using time-resolved software (*S5, S8*). In any case, only the flattest, most stable portions of the time-resolved signal were selected for integration. To correct for instrumental mass fractionation, Hf isotope ratios were normalised to $^{179}Hf/^{177}Hf = 0.7325$ (the exponential law was applied). To monitor data quality, analyses of standards (especially Temora 2, which has the highest Yb/Hf ratio) were regularly interspersed with unknowns during the course of the analytical session. These standard data are shown in Table S4. Reproducibility at 1 standard deviation is 0.4 epsilon units for 91500 (n= 15) and Temora 2 (n= 69), 0.3 epsilon units for Mud Tank (n = 32) and 0.1 epsilon units for CZ3 (n= 4), similar to the long-term values quoted by ref. S5 and ref. S8. Epsilon Hf values were calculated using a ^{176}Lu decay constant of 1.865×10^{-11} yr^{-1} (*S9, S10*) and using the chondritic values of ref. S11. All $^{176}Hf/^{177}Hf$ ratios are adjusted for radiogenic ingrowth, the magnitude of this correction being small relative to analytical uncertainty.

Trace elements

Trace element analyses were performed by a 266 nm solid-state laser and PlasmaQuad II ICP-MS at the University of Bristol using a static 25 µm beam and 5 Hz repetition rate. Data collection involved a 60 second acquisition time followed by 2.5 minute wash-out, to ensure that count-rates dropped to background levels before commencing the next analysis. Isotopes of Ba, Ca and P were monitored to screen for the effects of inclusions and contamination by secondary material in cracks and from the epoxy resin; analyses showing unacceptably high count rates of these elements were either truncated to omit the contaminated portion of the signal or rejected. Apatite inclusions posed the most problem. Data were calibrated according to the measured count-rates for each element yielded by NIST610 under the same analytical conditions (bracketing 10-12 unknown analyses). Sample zircons were bracketed by analyses of NIST612 and standard zircon 91500 as a secondary check on data quality. Trace element concentrations were determined as close as possible to the pits generated by Hf isotope analysis.

The Th, U concentrations and Th/U ratios are listed in Table S3 paired with the Hf isotope analysis from the same part of each grain. In instances where the Hf isotope data were obtained by directly ablating the pit generated during the foregoing ion microprobe U-Pb isotope analysis, then Th/U ratios determined by the latter were used (from *S1*).

Supporting text

Calculation of assimilation-fractional crystallisation (AFC) curves

The shape of the AFC curves plotted for each granitic suite in Figure 3 are dictated by the following- (1) the elemental concentration of Hf in the envisaged end-member components (the nature of the end-members being constrained by the Hf-O isotope arrays), (2) D_{Hf} during crystallisation, and (3) electron microprobe data, which show that for zircons of each suite the Hf concentration increases systematically with decreasing ε Hf (mirroring general intra-crystal core-rim trends towards increasing Hf content and lower ε Hf), before decreasing for zircons that have the least radiogenic $^{176}Hf/^{177}Hf$. This most likely reflects zircon crystallisation at a late stage in the assimilation history, since the solubility of zircon decreases as temperature falls and the melt becomes more aluminous due to increased supracrustal input. The implication is that D_{Hf} changes during the AFC process as a consequence of the saturation and diminishing solubility of zircon, and this behaviour is also required to produce the best fits to the measured zircon data (see below).

On the other hand, the inferred degree of supracrustal assimilation experienced by each magma batch upon zircon crystallisation (approximated by the ticks on the curves) is most sensitive to the rate of assimilation to crystallisation (r). If the hot zone scenario is valid, this predicts that r should increase with time, as the temperature in the hot zone and the fraction of crustal melt increases. One independent constraint on r is given by the Sr and Nd isotope compositions of the bulk rocks, since these record the average amount of supracrustal material incorporated during the crystallisation process. Using the end-member components inferred from the Hf-O isotope arrays, these proportions were estimated by simple mixing calculations (Table S5), thus guiding the choice of r values used in the AFC equations. Although a first approximation, this is an important constraint given that D_{Hf} is also a variable in these equations.

Balancing the constraints on D_{Hf} and r, the AFC curves on Figure 3 were thus calculated on an iterative basis so as to provide the optimum fit to the observed zircon Hf-O isotope arrays. The greatest proportion of zircon crystallisation and thus highest D_{Hf} is required for the Why Worry Suite, since accelerated assimilation of high Hf metasedimentary material leads to unrealistic Hf enrichment in the residual melts (>100 ppm), which is not evident in either the zircon trace element data or in bulk rock geochemical trends. Note that due to zircon/melt $\delta^{18}O$ fractionation, the trajectory of an evolving silicic melt in equilibrium with zircon will be displaced 1-2 ‰ above the zircon arrays. The AFC curves were calculated on this basis, allowing for a linear increase in zircon/melt $\delta^{18}O$ fractionation from 1 ‰ to 1.5 ‰ during crystallisation (the curves are relatively insensitive to the choice of these values), and then fractionation-adjusted for rationalisation with the measured zircon data.

The parameters used in calculation of the assimilation-fractional crystallisation curves are as follows. Hf contents of 2.3 ppm, 1.5 ppm and 2.3 ppm were used for the low $\delta^{18}O$ parental magmas of Cobargo, Why Worry and Jindabyne, respectively, based on average analyses of associated mafic rocks. For high $\delta^{18}O$ components, a value of 1.4 ppm Hf was adopted for partial melts of metasedimentary rocks (Cobargo) and S-type granites (Jindabyne) from migmatite leucosome geochemistry and extrapolation of S-type granite trends to high silica. Values of ε Hf -11.6 and $\delta^{18}O$ 8.9 ‰ were used for the S-type melt based on data from S-type granites (*S15*). The metasedimentary component used for Why Worry had 9 ppm Hf, the average value of nearby metagreywackes and metasedimentary enclaves. The Hf isotope composition of the Ordovician metasedimentary rocks was estimated from the average ε Nd value (-10.1 ± 0.5 at 400 Ma) using the expression ε Hf = 1.35ε Nd- 2.82 (*S16*). Initial D_{Hf} values of 0.24 (Cobargo), 0.21 (Why Worry) and 0.19 (Jindabyne) were computed from mafic rock modes and partition coefficients on the 'Earthref' database (www.earthref.org). Zircon saturation was simulated by exponentially increasing D_{Hf} after 20% AFC, to values corresponding to 0.041% zircon at 50% AFC (Cobargo), 0.055% at 70% AFC (Why Worry) and 0.043% at 75% AFC (Jindabyne). Zircon crystallisation occurred down to the solidus. The rate of assimilation to crystallisation was assumed to increase linearly with AFC and hot zone maturation (*S17, S18*). The r values for each suite (Cobargo, 0.50-0.70; Why Worry 0.28-0.48; Jindabyne 0.5-0.66) were chosen so that the average mixing proportions inferred from the zircon Hf-O isotope arrays match those calculated from the bulk rock Sr-Nd isotope data. It is notable that simple mixing calculations based on Hf and O isotopes establish a similar proportion of supracrustal material in each suite to that estimated by AFC.

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										Apparent Ages		(Ma)			
Sample/ spot	**[U] ppm**	**[Th] ppm**	**[Pb] ppm**	**Th/U**	**f_{206}% †**	**$^{206}Pb/^{238}U$**	**±**	**$^{207}Pb/^{206}Pb$**	**±**	**$^{207}Pb/^{206}Pb$**	**±**	**$^{206}Pb/^{238}U$**	**±**	**^{207}Pb corr.**	**±**
TKB5															
479-5-1a	48	21	4	0.438	0.08	0.0678	0.0016	0.0538	0.0018	363.1	74.5	422.7	9.7	423.4	9.9
479-5-1b	166	121	13	0.731	0.43	0.0629	0.0015	0.0545	0.0009	390.6	38.0	393.1	8.9	393.2	9.0
479-5-2a	319	345	29	1.084	0.71	0.0645	0.0015	0.0545	0.0008	393.3	34.3	403.2	9.1	403.3	9.3
479-5-2b	127	62	11	0.489	0.22	0.0685	0.0016	0.0563	0.0011	462.7	43.7	427.3	9.7	426.8	9.8
479-5-2c	163	126	14	0.777	0.13	0.0661	0.0016	0.0553	0.0010	424.4	39.4	412.9	9.7	412.8	9.8
479-5-3	89	66	7	0.741	0.29	0.0629	0.0015	0.0563	0.0017	463.1	65.7	393.4	9.0	392.5	9.1
479-5-4a	124	100	10	0.809	0.03	0.0637	0.0015	0.0523	0.0011	299.0	46.9	398.1	9.1	399.2	9.2
479-5-4b	110	63	9	0.571	0.09	0.0684	0.0016	0.0636	0.0016	728.2	51.6	426.7	9.7	422.3	9.8
479-5-5a	179	162	15	0.904	0.18	0.0617	0.0014	0.0551	0.0009	417.8	37.8	385.8	8.8	385.4	8.9
479-5-5b	111	50	8	0.455	0.00	0.0570	0.0013	0.0542	0.0014	379.8	57.9	357.4	8.2	357.2	8.3
479-5-6a	101	68	8	0.672	0.21	0.0632	0.0015	0.0527	0.0011	314.0	48.0	395.2	9.1	396.2	9.3
479-5-6b	133	98	11	0.734	1.92	0.0624	0.0015	0.0548	0.0010	405.2	41.8	389.9	9.4	389.7	9.5
479-5-7a	132	77	10	0.585	0.00	0.0599	0.0014	0.0533	0.0012	339.9	50.4	374.9	8.5	375.3	8.6
479-5-7b	206	124	15	0.603	0.00	0.0600	0.0014	0.0537	0.0009	360.3	37.5	375.7	8.6	375.9	8.7
479-5-9a	184	165	15	0.902	0.20	0.0626	0.0015	0.0562	0.0009	462.2	36.3	391.3	8.9	390.4	9.0
479-5-9b	124	63	9	0.509	0.12	0.0612	0.0014	0.0558	0.0011	444.8	43.3	382.9	8.7	382.1	8.8
479-5-10a	199	174	16	0.876	0.41	0.0618	0.0014	0.0556	0.0009	435.2	34.4	386.5	8.8	385.9	8.9
479-5-10b	104	60	8	0.580	0.15	0.0624	0.0015	0.0573	0.0012	503.9	46.7	389.9	8.9	388.5	9.0
479-5-15	267	277	23	1.041	0.06	0.0616	0.0014	0.0552	0.0010	422.2	41.7	385.6	8.7	385.2	8.8
482-5-1	58	28	4	0.482	1.16	0.0612	0.0011	0.0631	0.0022	711.5	71.3	382.9	3.4	378.6	6.9
482-5-2	52	32	4	0.611	0.36	0.0624	0.0012	0.0557	0.0024	441.5	93.7	390.3	3.6	389.6	7.4
482-5-3	131	105	10	0.806	0.49	0.0607	0.0013	0.0578	0.0015	522.7	55.0	379.9	3.9	378.2	7.9
482-5-4	99	59	8	0.595	0.47	0.0641	0.0013	0.0506	0.0017	221.3	74.8	400.5	3.9	402.6	8.0
TKB1															
479-1-1a	113	87	9	0.771	0.00	0.0623	0.0014	0.0552	0.0012	419.6	46.1	389.3	8.8	389.0	8.9
479-1-3a	94	61	7	0.647	0.44	0.0615	0.0014	0.0564	0.0013	466.6	49.8	384.8	8.8	383.8	8.9
479-1-3b	188	100	14	0.532	0.33	0.0613	0.0015	0.0552	0.0012	420.9	46.1	383.7	9.1	383.3	9.2
479-1-4a	124	89	9	0.723	0.00	0.0558	0.0013	0.0570	0.0012	490.4	47.6	350.2	8.0	348.7	8.1
479-1-4b	184	100	14	0.541	0.15	0.0627	0.0015	0.0539	0.0009	368.5	38.0	392.2	8.9	392.5	9.0
479-1-6	511	574	45	1.124	0.05	0.0623	0.0014	0.0560	0.0006	452.6	22.4	389.5	8.8	388.7	8.9
479-1-8a	171	135	14	0.788	0.15	0.0625	0.0015	0.0550	0.0012	412.2	48.2	390.7	8.9	390.4	9.0
479-1-8b	147	90	10	0.616	0.00	0.0567	0.0013	0.0530	0.0011	329.1	45.8	355.4	8.2	355.7	8.3
479-1-9a	105	66	8	0.630	0.17	0.0573	0.0014	0.0563	0.0016	463.6	61.9	359.1	8.3	357.9	8.4
479-1-9b	185	103	14	0.557	0.11	0.0628	0.0015	0.0565	0.0009	472.6	36.6	392.6	8.9	391.6	9.0
479-1-11	156	124	14	0.793	0.16	0.0666	0.0016	0.0577	0.0011	518.3	43.0	415.7	9.4	414.3	9.5
479-1-12	195	163	16	0.839	0.13	0.0615	0.0014	0.0569	0.0009	489.2	34.1	384.7	8.7	383.4	8.8
479-1-13a	158	129	14	0.820	0.20	0.0654	0.0016	0.0562	0.0010	460.9	37.2	408.1	9.4	407.4	9.5
479-1-14a	92	50	7	0.542	0.48	0.0610	0.0015	0.0551	0.0013	414.4	50.9	381.6	9.1	381.2	9.2
479-1-14b	154	95	12	0.618	0.20	0.0606	0.0014	0.0550	0.0010	412.7	40.3	379.3	8.6	378.9	8.7
479-1-15a	262	262	24	0.997	0.12	0.0649	0.0015	0.0563	0.0008	462.8	32.9	405.5	9.2	404.7	9.3
479-1-15b	189	101	15	0.535	0.18	0.0658	0.0015	0.0548	0.0010	405.1	40.1	410.9	9.3	411.0	9.4
479-1-17	285	156	22	0.545	0.25	0.0621	0.0015	0.0561	0.0008	456.1	42.7	388.2	9.1	387.3	9.2
479-1-18	165	138	13	0.835	0.00	0.0609	0.0014	0.0551	0.0010	417.9	40.3	381.1	8.7	380.7	8.8
479-1-19a	189	146	15	0.771	0.31	0.0615	0.0015	0.0585	0.0010	549.5	35.3	384.9	9.0	382.9	9.0
479-1-19b	154	77	11	0.497	0.29	0.0616	0.0014	0.0538	0.0011	363.9	44.3	385.3	8.8	385.6	8.9
482-1-1	156	120	13	0.769	0.08	0.0622	0.0014	0.0551	0.0009	416.7	35.6	389.0	8.5	388.7	8.6
482-1-1c	120	78	9	0.647	0.53	0.0620	0.0010	0.0538	0.0016	363.2	66.5	387.7	6.0	388.0	6.1
482-1-2	182	98	14	0.537	0.16	0.0626	0.0014	0.0564	0.0010	467.5	40.5	391.4	8.4	390.4	8.5
482-1-2a	229	199	19	0.867	0.17	0.0618	0.0014	0.0558	0.0008	443.8	32.2	386.8	8.3	386.1	8.4
482-1-3	228	210	19	0.923	0.16	0.0613	0.0014	0.0548	0.0008	404.3	34.0	383.4	8.3	383.1	8.4
482-1-4	178	125	13	0.701	0.33	0.0590	0.0013	0.0561	0.0011	456.0	41.8	369.3	8.2	368.3	8.3
482-1-5	188	95	50	0.507	0.02	0.2141	0.0020	0.0854	0.0007	1325.3	16.1	1250.9	10.5	1245.7	11.2
482-1-6	318	248	26	0.780	0.11	0.0630	0.0006	0.0560	0.0008	453.2	31.7	393.6	3.5	392.8	3.6
482-1-7	209	166	17	0.792	0.41	0.0621	0.0006	0.0540	0.0010	372.0	59.7	388.7	3.5	388.9	3.6

482-1-7b	121	59	9	0.485	0.48	0.0629	0.0006	0.0556	0.0014	436.2	53.5	393.1	3.6	392.6	3.7
482-1-8	186	80	15	0.429	0.47	0.0675	0.0006	0.0557	0.0011	439.6	63.5	421.3	3.8	421.1	4.0
482-1-9a	137	101	11	0.739	0.43	0.0616	0.0006	0.0533	0.0013	339.6	54.0	385.4	3.6	385.9	3.7
482-1-10	137	97	11	0.708	0.42	0.0622	0.0006	0.0546	0.0015	394.7	59.4	389.0	3.8	388.9	3.9
482-1-14	126	51	9	0.405	0.78	0.0616	0.0018	0.0533	0.0018	341.8	75.0	385.2	11.0	385.9	11.1

<u>TKB11</u>

479-11-1a	256	134	19	0.525	0.15	0.0614	0.0014	0.0551	0.0008	415.2	31.2	384.4	8.7	384.0	8.8
479-11-1b	248	131	18	0.528	0.27	0.0594	0.0014	0.0561	0.0009	455.7	36.0	372.2	8.5	371.2	8.6
479-11-3a	466	282	35	0.606	0.26	0.0610	0.0014	0.0572	0.0006	500.5	30.3	381.9	8.6	380.5	8.7
479-11-3b	176	87	13	0.496	0.09	0.0611	0.0014	0.0541	0.0009	373.8	38.3	382.4	8.7	382.5	8.8
479-11-4	680	441	47	0.649	4.03	0.0575	0.0013	0.0850	0.0018	1316.0	108.8	360.7	7.9	346.4	8.0
479-11-5a	621	410	47	0.660	2.38	0.0613	0.0014	0.0734	0.0015	1026.4	81.1	383.3	8.6	374.0	8.7
479-11-5b	221	134	17	0.605	0.10	0.0610	0.0015	0.0534	0.0009	347.6	36.5	381.5	8.8	381.9	8.9
479-11-6a	289	189	22	0.653	0.02	0.0619	0.0015	0.0540	0.0008	371.6	32.7	387.3	9.0	387.5	9.1
479-11-6b	326	166	26	0.510	0.13	0.0664	0.0015	0.0549	0.0007	409.4	26.8	414.4	9.3	414.5	9.5
479-11-7a	683	474	54	0.694	0.05	0.0614	0.0014	0.0550	0.0005	410.4	19.1	384.1	8.7	383.8	8.8
479-11-7b	279	125	20	0.449	0.09	0.0585	0.0014	0.0542	0.0007	380.1	30.1	366.3	8.3	366.2	8.4
479-11-8a	570	338	39	0.593	0.18	0.0550	0.0013	0.0569	0.0007	486.7	32.5	345.3	7.8	343.8	7.9
479-11-8b	261	114	19	0.438	0.08	0.0607	0.0014	0.0546	0.0007	396.8	30.5	379.9	8.6	379.7	8.7
479-11-9a	482	329	37	0.683	0.04	0.0601	0.0014	0.0544	0.0006	386.3	25.7	376.4	8.8	376.2	8.9
479-11-9b	393	173	27	0.441	1.62	0.0581	0.0014	0.0649	0.0007	772.4	60.8	364.3	8.1	359.2	8.2
479-11-10a	190	108	14	0.569	8.76	0.0636	0.0016	0.1179	0.0021	1924.0	211.6	397.5	8.8	365.6	8.9
479-11-13a	352	222	27	0.631	0.06	0.0602	0.0014	0.0540	0.0007	373.1	29.3	376.9	8.6	376.9	8.7
482-11-4	283	173	23	0.612	0.25	0.0642	0.0012	0.0568	0.0006	483.7	23.6	401.4	7.0	400.3	7.1
482-11-5	293	147	22	0.504	0.18	0.0628	0.0011	0.0554	0.0006	429.6	24.5	392.3	6.9	391.9	6.9
482-11-6	329	181	25	0.551	0.90	0.0614	0.0013	0.0616	0.0007	658.6	25.1	384.4	7.6	380.9	7.7
482-11-7	372	205	28	0.551	1.58	0.0597	0.0011	0.0661	0.0011	808.7	33.0	374.0	6.9	368.3	6.9
482-11-2a	375	211	29	0.562	0.16	0.0621	0.0006	0.0542	0.0008	380.6	34.5	388.2	3.5	388.2	3.5
482-11-3a	418	151	31	0.361	0.19	0.0623	0.0006	0.0552	0.0009	421.7	34.5	389.3	3.5	388.9	3.5
482-11-4a	189	137	15	0.726	0.18	0.0619	0.0006	0.0589	0.0013	561.9	47.8	386.9	3.5	384.7	3.6
482-11-5a	205	122	15	0.595	0.46	0.0598	0.0011	0.0555	0.0013	432.9	50.9	374.4	3.4	373.8	6.8
482-11-6a	275	143	21	0.519	0.33	0.0625	0.0006	0.0573	0.0010	502.5	38.1	391.1	3.5	389.7	3.6
482-11-7a	217	129	17	0.594	0.52	0.0626	0.0006	0.0580	0.0010	530.3	37.2	391.2	3.6	389.4	3.6
482-11-10	359	240	31	0.668	0.07	0.0671	0.0012	0.0557	0.0005	438.6	20.2	418.4	7.3	418.2	7.4

<u>TKB15</u>

1	147	79	11	0.540	0.23	0.0617	0.0008	0.0550	0.0007	412.4	29.0	386.2	4.7	385.9	4.8
2	110	82	9	0.747	0.14	0.0643	0.0008	0.0553	0.0009	424.1	34.6	401.8	5.1	401.5	5.2
3	126	72	10	0.572	0.16	0.0636	0.0008	0.0559	0.0008	448.8	30.5	397.3	4.9	396.6	5.0
4	169	121	14	0.715	0.06	0.0647	0.0008	0.0550	0.0007	413.5	26.5	404.1	5.0	404.0	5.1
6	231	139	18	0.603	0.07	0.0639	0.0008	0.0549	0.0008	406.3	33.2	399.4	5.2	399.3	5.2
7	249	221	21	0.887	0.05	0.0635	0.0008	0.0546	0.0005	395.1	22.1	397.2	5.1	397.2	5.1
8	120	68	10	0.564	0.27	0.0641	0.0008	0.0558	0.0009	445.3	33.8	400.6	5.0	400.1	5.1

<u>TKB100</u>

478-100-1	195	100	15	0.513	0.11	0.0630	0.0014	0.0558	0.0009	442.9	34.4	394.0	8.6	393.4	8.7
478-100-2b	255	133	19	0.522	0.14	0.0616	0.0014	0.0557	0.0008	441.2	31.7	385.4	8.4	384.8	8.5
478-100-3b	156	79	12	0.508	0.19	0.0608	0.0014	0.0573	0.0013	502.2	48.0	380.3	8.3	378.8	8.4
478-100-4b	196	103	15	0.526	0.09	0.0645	0.0015	0.0561	0.0009	457.1	35.2	403.1	8.8	402.4	8.9
478-100-5a	424	439	38	1.037	0.14	0.0649	0.0015	0.0567	0.0006	478.2	21.4	405.1	8.8	404.1	8.9
478-100-5b	320	197	26	0.616	0.08	0.0648	0.0015	0.0558	0.0006	445.7	23.7	404.7	8.8	404.2	8.9
478-100-7b	132	72	10	0.549	0.30	0.0640	0.0014	0.0546	0.0009	396.1	38.0	399.9	8.7	399.9	8.8
478-100-9a	37	24	3	0.642	0.54	0.0617	0.0014	0.0594	0.0019	580.6	66.4	386.1	8.4	383.6	8.5
478-100-10a	384	281	31	0.732	0.04	0.0641	0.0016	0.0552	0.0006	422.0	23.3	400.4	9.6	400.1	9.7
478-100-10b	208	106	16	0.508	0.15	0.0634	0.0014	0.0570	0.0008	489.8	29.6	396.6	8.6	395.4	8.7
478-100-11	130	74	10	0.571	0.11	0.0611	0.0014	0.0558	0.0010	445.2	39.8	382.0	8.3	381.3	8.4
478-100-11b	147	82	11	0.555	0.30	0.0621	0.0010	0.0566	0.0009	474.2	35.6	388.2	5.8	387.1	5.9
478-100-12a	152	126	12	0.827	0.16	0.0621	0.0014	0.0538	0.0009	361.3	38.5	388.5	8.5	388.8	8.6

478-100-13a	155	82	11	0.527	0.90	0.0612	0.0014	0.0596	0.0010	587.5	74.7	382.8	8.3	380.2	8.4
478-100-13b	147	69	11	0.471	0.13	0.0618	0.0014	0.0563	0.0011	463.1	43.2	386.8	8.4	385.9	8.5
478-100-14a	68	52	6	0.769	0.12	0.0646	0.0015	0.0571	0.0013	493.8	50.4	403.8	8.8	402.7	8.9
478-100-15a	133	118	11	0.884	0.68	0.0635	0.0015	0.0586	0.0010	553.1	66.1	396.8	8.8	394.8	8.9
478-100-16a	109	67	8	0.612	0.43	0.0612	0.0010	0.0572	0.0011	498.3	42.3	383.0	5.8	381.6	5.9
478-100-17a	64	69	5	1.066	0.33	0.0602	0.0014	0.0585	0.0019	549.3	68.7	376.7	8.6	374.6	8.7
478-100-17b	203	110	15	0.541	0.15	0.0600	0.0013	0.0550	0.0008	410.3	33.4	375.7	8.2	375.2	8.3
478-100-17c	65	69	6	1.058	0.54	0.0657	0.0010	0.0572	0.0013	499.8	50.4	410.3	6.2	409.1	6.2
478-100-18a	174	113	13	0.648	0.14	0.0600	0.0014	0.0569	0.0010	487.8	37.7	375.4	8.3	374.1	8.4
478-100-19	171	147	16	0.862	0.65	0.0723	0.0016	0.0598	0.0013	595.2	71.8	450.1	9.7	447.9	9.9
478-100-20a	190	64	16	0.334	0.23	0.0706	0.0016	0.0579	0.0009	525.6	33.8	439.8	9.6	438.6	9.7
478-100-22	134	74	10	0.557	0.28	0.0612	0.0010	0.0554	0.0009	428.7	36.6	383.0	5.8	382.5	5.9
478-100-23	73	52	5	0.707	0.38	0.0583	0.0009	0.0570	0.0013	491.2	51.2	365.1	5.7	363.7	5.7
478-100-24	177	98	14	0.551	0.20	0.0639	0.0010	0.0551	0.0008	416.4	30.8	399.4	6.0	399.2	6.1
483-100-1	196	108	15	0.550	0.13	0.0625	0.0008	0.0553	0.0007	424.2	27.7	391.1	4.8	390.7	4.8
483-100-2	196	95	15	0.484	0.13	0.0630	0.0008	0.0559	0.0006	449.8	24.7	393.8	5.0	393.1	5.0
483-100-3	65	64	6	0.985	0.54	0.0641	0.0009	0.0572	0.0011	499.2	41.5	400.4	5.5	399.2	5.6
483-100-5	179	84	14	0.468	0.08	0.0633	0.0008	0.0553	0.0007	424.4	29.3	395.8	4.9	395.4	5.0
483-100-7	129	67	10	0.522	0.12	0.0630	0.0008	0.0546	0.0009	397.0	34.8	393.9	4.8	393.9	4.9
483-100-8	234	149	19	0.639	0.10	0.0653	0.0011	0.0547	0.0006	401.2	25.0	407.5	5.0	407.6	5.1
483-100-9	193	159	16	0.821	0.14	0.0615	0.0008	0.0559	0.0006	446.9	24.7	384.9	4.8	384.2	4.8
483-100-10	111	77	9	0.698	0.17	0.0620	0.0008	0.0547	0.0008	401.4	32.8	388.0	4.9	387.9	5.0
483-100-11	135	70	10	0.514	0.11	0.0619	0.0008	0.0552	0.0008	418.6	32.4	387.4	4.8	387.1	4.8
483-100-12	114	55	9	0.482	0.29	0.0631	0.0008	0.0558	0.0009	445.3	34.4	394.3	5.0	393.7	5.0
TKB17															
1b	273	182	21	0.666	0.22	0.0622	0.0014	0.0567	0.0008	478.9	29.1	388.8	8.5	387.7	8.5
2b	262	155	20	0.592	0.08	0.0621	0.0014	0.0554	0.0008	428.4	31.5	388.6	8.5	388.1	8.6
2c	166	89	13	0.537	0.09	0.0634	0.0014	0.0559	0.0011	447.9	43.6	396.6	8.8	395.9	8.9
3	219	129	17	0.588	0.17	0.0642	0.0014	0.0568	0.0010	482.6	37.6	401.3	8.7	400.3	8.8
6a	47	33	4	0.692	0.42	0.0663	0.0015	0.0589	0.0016	563.3	57.3	413.5	9.1	411.5	9.2
6b	165	81	13	0.493	0.21	0.0637	0.0014	0.0555	0.0010	434.4	40.5	398.0	8.7	397.5	8.8
7	138	70	10	0.505	0.62	0.0633	0.0014	0.0573	0.0009	503.0	61.8	395.5	8.6	394.1	8.7
9b	190	91	15	0.480	0.35	0.0650	0.0015	0.0568	0.0008	485.4	29.4	406.1	8.9	405.1	9.0
10	306	181	25	0.590	0.03	0.0646	0.0015	0.0551	0.0006	418.0	24.1	403.8	8.8	403.6	8.9
11b	177	99	14	0.558	0.09	0.0647	0.0015	0.0555	0.0008	431.3	31.8	404.1	8.8	403.7	8.9
12b	252	141	21	0.560	0.13	0.0668	0.0015	0.0560	0.0007	453.6	26.6	416.7	9.1	416.2	9.2
13b	152	73	13	0.482	0.27	0.0676	0.0015	0.0573	0.0010	501.8	38.9	421.8	9.2	420.8	9.3
14	61	63	6	1.030	0.83	0.0762	0.0017	0.0588	0.0016	559.8	106.6	473.3	10.2	471.9	10.5
15	141	83	11	0.585	0.08	0.0635	0.0014	0.0553	0.0009	424.3	37.9	397.0	8.7	396.7	8.8
KK4															
1	81	45	6	0.560	0.62	0.0595	0.0018	0.0555	0.0013	433.2	51.9	372.6	10.8	371.9	11.0
3	95	53	8	0.550	0.23	0.0663	0.0020	0.0569	0.0011	487.8	43.4	413.8	12.0	412.8	12.1
4	113	94	10	0.839	0.24	0.0656	0.0020	0.0571	0.0011	494.9	40.6	409.4	11.9	408.3	12.1
6	100	54	8	0.542	0.42	0.0666	0.0020	0.0562	0.0011	461.1	42.5	415.9	12.4	415.3	12.5
8	68	39	5	0.572	0.19	0.0649	0.0019	0.0565	0.0013	471.6	51.1	405.6	11.7	404.7	11.9
9b	191	67	15	0.350	0.11	0.0670	0.0020	0.0548	0.0008	406.0	31.7	418.1	12.1	418.2	12.2
10	167	117	14	0.698	0.11	0.0670	0.0020	0.0559	0.0011	448.9	41.6	418.0	12.1	417.6	12.3
11a	633	89	49	0.141	0.11	0.0701	0.0021	0.0564	0.0006	468.1	22.4	436.7	12.6	436.3	12.8
11b	120	60	10	0.500	0.28	0.0664	0.0020	0.0573	0.0013	501.5	47.7	414.3	12.0	413.2	12.1
12a	129	94	11	0.728	0.23	0.0684	0.0020	0.0572	0.0012	497.7	46.9	426.8	12.4	425.8	12.5
13	531	146	33	0.257	0.22	0.0714	0.0021	0.0598	0.0005	598.4	19.4	444.9	12.8	442.6	12.9
15b	122	63	10	0.515	0.24	0.0676	0.0020	0.0567	0.0010	480.1	40.1	421.9	12.2	421.1	12.4
14b	139	70	11	0.505	0.29	0.0662	0.0020	0.0549	0.0013	409.8	51.4	413.5	12.0	413.6	12.2
16	95	49	8	0.513	0.28	0.0660	0.0011	0.0568	0.0011	484.2	40.5	412.2	6.8	411.2	6.9
KK2															
2b	295	118	24	0.399	0.09	0.0676	0.0010	0.0558	0.0005	443.2	21.6	421.6	6.3	421.3	6.4

5	496	285	40	0.574	0.07	0.0658	0.0010	0.0555	0.0004	433.7	16.8	411.1	6.2	410.8	6.3
6b	578	253	31	0.438	0.14	0.0447	0.0008	0.0566	0.0006	475.9	21.6	281.9	4.9	280.2	4.9
8b	411	106	29	0.258	0.10	0.0637	0.0010	0.0554	0.0005	428.7	18.9	398.0	5.9	397.6	6.0
9	891	94	66	0.105	0.08	0.0680	0.0010	0.0552	0.0003	422.1	13.8	424.2	6.3	424.2	6.4
11	728	343	58	0.472	0.11	0.0659	0.0010	0.0557	0.0004	441.5	17.0	411.4	6.1	411.1	6.2
12b	148	132	13	0.893	0.18	0.0669	0.0011	0.0597	0.0009	593.2	31.9	417.5	6.5	415.0	6.6
14a	122	87	11	0.710	0.26	0.0687	0.0011	0.0550	0.0009	410.3	36.0	428.3	6.4	428.5	6.5
14b	1492	215	116	0.144	0.03	0.0709	0.0011	0.0558	0.0003	444.4	10.3	441.8	6.6	441.8	6.7
15	1610	1234	136	0.766	0.07	0.0650	0.0010	0.0556	0.0003	437.3	11.6	406.0	6.0	405.6	6.1

Table S1. (U-Th)-Pb isotope compositions of zircon grains determined by ion microprobe. Isotope ratios are not corrected for common Pb.

'^{207}Pb corr.' is the ^{206}Pb/^{238}U age corrected for common lead using the ^{207}Pb method. All errors are given at 1σ.

†Denotes the percentage of ^{206}Pb contributed by non-radiogenic Pb, calculated from the measured ^{206}Pb/^{204}Pb and assuming a 0 Ma age for the contaminant (ref. S1).

Session	grain/spot	$^{18}O/^{16}O$ (measured)	±2 s.e.	fractionation factor	± 2 s.e.	$^{18}O/^{16}O$ (corrected)	±2 s.e.	$\delta^{18}O$ VSMOW	±2 s.e.
	91500 (n = 31)	0.0020116	0.0000007	(1 s.d.)		deviation from accepted value (‰)		-6.83	± 0.35
	5-2a	0.0020048	0.0000019	0.99322	0.00013	0.0020185	0.0000019	6.63	0.94
	5-17	0.0020049	0.0000008			0.0020186	0.0000008	6.67	0.41
	5-4a	0.0020056	0.0000014			0.0020193	0.0000014	7.01	0.70
	5-28	0.0020053	0.0000008			0.0020190	0.0000009	6.89	0.42
	5-25	0.0020036	0.0000013			0.0020173	0.0000013	6.04	0.66
	5-6	0.0020044	0.0000019			0.0020181	0.0000019	6.44	0.96
	5-26	0.0020041	0.0000011			0.0020178	0.0000011	6.28	0.57
	5-9b	0.0020057	0.0000010			0.0020194	0.0000011	7.06	0.53
	5-27a	0.0020039	0.0000015			0.0020176	0.0000016	6.17	0.77
	91500 (n = 10)	0.0020116	0.0000008	(1 s.d.)		deviation from accepted value (‰)		-6.79	± 0.37
	5-27b	0.0020047	0.0000016	0.99322	0.00013	0.0020183	0.0000016	6.56	0.82
	5-11	0.0020050	0.0000011			0.0020187	0.0000012	6.75	0.58
	5-13	0.0020029	0.0000011			0.0020165	0.0000011	5.66	0.55
	5-13B	0.0020047	0.0000015			0.0020184	0.0000015	6.56	0.75
	5-19a	0.0020056	0.0000012			0.0020193	0.0000012	7.03	0.62
	5-16	0.0020057	0.0000024			0.0020194	0.0000024	7.09	1.22
	1-N1	0.0020040	0.0000012			0.0020177	0.0000012	6.22	0.60
	1-1b	0.0020056	0.0000011			0.0020192	0.0000011	7.01	0.56
	1-3a	0.0020045	0.0000009			0.0020182	0.0000009	6.47	0.46
	1-6a	0.0020053	0.0000011			0.0020190	0.0000012	6.89	0.59
	1-9a	0.0020040	0.0000009			0.0020177	0.0000009	6.24	0.47
	1-8	0.0020036	0.0000009			0.0020172	0.0000009	6.00	0.46
	1-22a	0.0020032	0.0000010			0.0020169	0.0000011	5.84	0.53
	1-26	0.0020054	0.0000016			0.0020191	0.0000016	6.93	0.82
	91500 (n = 9)	0.0020120	0.0000008	(1 s.d.)		deviation from accepted value (‰)		-6.60	± 0.39
New session									
	91500 (n = 10)	0.0020113	0.0000006	(1 s.d.)		deviation from accepted value (‰)		-6.98	± 0.28
	1-7B	0.0020045	0.0000009	0.99320	0.00018	0.0020182	0.0000010	6.50	0.49
	1-20	0.0020046	0.0000010			0.0020183	0.0000010	6.55	0.51
	1-15	0.0020042	0.0000006			0.0020179	0.0000007	6.35	0.33
	1-27	0.0020034	0.0000010			0.0020171	0.0000010	5.94	0.52
	1-23	0.0020039	0.0000010			0.0020176	0.0000011	6.20	0.54
	1-28	0.0020040	0.0000007			0.0020177	0.0000008	6.24	0.40
	1-25a	0.0020039	0.0000011			0.0020176	0.0000012	6.19	0.58
	91500 (n = 10)	0.0020120	0.0000008	(1 s.d.)		deviation from accepted value (‰)		-6.63	± 0.38
	11-19a	0.0020038	0.0000007			0.0020175	0.0000008	6.14	0.40
	11-19b	0.0020046	0.0000006			0.0020184	0.0000007	6.56	0.34
	11-14b	0.0020041	0.0000015			0.0020178	0.0000016	6.30	0.80
	11-20a	0.0020026	0.0000012			0.0020163	0.0000013	5.53	0.63
	11-20b	0.0020049	0.0000017			0.0020186	0.0000017	6.68	0.85
	11-21	0.0020044	0.0000011			0.0020181	0.0000012	6.44	0.59
after retune									
	91500 (n = 9)	0.0020136	0.0000006	(1 s.d.)		deviation from accepted value (‰)		-5.81	± 0.29
	11-5b	0.0020062	0.0000007	0.99410	0.00018	0.0020181	0.0000008	6.45	0.39
	11-18	0.0020061	0.0000014			0.0020180	0.0000015	6.37	0.73
	11-6	0.0020070	0.0000007			0.0020189	0.0000007	6.83	0.37
	11-22a	0.0020049	0.0000003			0.0020168	0.0000005	5.79	0.25
	11-22b	0.0020073	0.0000012			0.0020192	0.0000013	6.97	0.65
	11-11b	0.0020063	0.0000007			0.0020182	0.0000008	6.47	0.41
	11-23	0.0020049	0.0000011			0.0020168	0.0000011	5.77	0.57
	91500 (n = 5)	0.0020131	0.0000006	(1 s.d.)		deviation from accepted value (‰)		-6.06	± 0.29
	11-22c	0.0020057	0.0000009			0.0020176	0.0000010	6.17	0.49
	11-8	0.0020062	0.0000007			0.0020181	0.0000007	6.43	0.37
	11-11c	0.0020064	0.0000015			0.0020183	0.0000016	6.56	0.79
New session									
	91500 (n = 20)	0.0020114	0.0000006	(1 s.d.)		deviation from accepted value (‰)		-6.91	± 0.29
	KK2-16a	0.0020062	0.0000005	0.99324	0.00013	0.0020198	0.0000006	7.29	0.30
	KK2-4b	0.0020043	0.0000011			0.0020180	0.0000011	6.38	0.56

	KK2-6b	0.0020072	0.0000010			0.0020209	0.0000011	7.82	0.52
	KK2-7b	0.0020043	0.0000006			0.0020180	0.0000007	6.38	0.35
	91500 (n = 6)	0.0020115	0.0000010	(1 s.d.)		deviation from accepted value (‰)		-6.85	± 0.49
	KK2-12b	0.0020104	0.0000007			0.0020241	0.0000008	9.42	0.39
	KK2-14c	0.0020094	0.0000011			0.0020231	0.0000012	8.94	0.58
	KK2-16b	0.0020056	0.0000011			0.0020192	0.0000011	7.00	0.55
	KK4-2b	0.0020052	0.0000005			0.0020189	0.0000005	6.83	0.26
	KK4-3a	0.0020074	0.0000012			0.0020211	0.0000013	7.93	0.63
	KK4-4a	0.0020056	0.0000009			0.0020193	0.0000009	7.02	0.47
	91500 (n = 5)	0.0020124	0.0000007	(1 s.d.)		deviation from accepted value (‰)		-6.43	± 0.34
	KK4-8	0.0020042	0.0000008			0.0020178	0.0000009	6.29	0.44
	KK4-16b	0.0020047	0.0000009			0.0020184	0.0000009	6.58	0.46
	KK4-12a	0.0020097	0.0000010			0.0020234	0.0000011	9.08	0.53
	KK4-15b	0.0020056	0.0000010			0.0020192	0.0000011	6.99	0.54
	KK2-E3	0.0020059	0.0000009			0.0020196	0.0000010	7.18	0.48
	17-3	0.0020081	0.0000007			0.0020217	0.0000008	8.25	0.38
	17-5	0.0020083	0.0000012			0.0020220	0.0000013	8.37	0.63
	17-5Ab	0.0020073	0.0000010			0.0020210	0.0000010	7.87	0.52
	91500 (n = 5)	0.0020117	0.0000006	(1 s.d.)		deviation from accepted value (‰)		-6.77	± 0.32
	17-6c	0.0020098	0.0000007			0.0020235	0.0000008	9.12	0.40
	17-15	0.0020089	0.0000007			0.0020225	0.0000008	8.65	0.39
	17-17a	0.0020070	0.0000011			0.0020207	0.0000011	7.72	0.55
	17-17b	0.0020078	0.0000010			0.0020214	0.0000011	8.10	0.54
	17-7b	0.0020094	0.0000011			0.0020231	0.0000011	8.92	0.56
	17-9b	0.0020064	0.0000012			0.0020200	0.0000013	7.39	0.63
	17-11b	0.0217785	0.0000009			0.0020193	0.0000009	7.01	0.46
	17-11B	0.0020062	0.0000015			0.0020199	0.0000015	7.33	0.75
	91500 (n = 5)	0.0020118	0.0000004	(1 s.d.)		deviation from accepted value (‰)		-6.72	± 0.20
	17-13c	0.0020090	0.0000010			0.0020226	0.0000010	8.69	0.50
	17-13b	0.0020075	0.0000011			0.0020212	0.0000012	7.96	0.58
	100-2B	0.0020082	0.0000010			0.0020219	0.0000010	8.32	0.51
	100-1a	0.0020104	0.0000009			0.0020241	0.0000010	9.41	0.48
	100-10a	0.0020084	0.0000017			0.0020221	0.0000017	8.41	0.86
	100-14	0.0020095	0.0000015			0.0020231	0.0000015	8.95	0.74
	100-15b	0.0020076	0.0000005			0.0020213	0.0000006	8.02	0.31
	100-16a	0.0020103	0.0000005			0.0020240	0.0000006	9.36	0.28
	91500 (n = 5)	0.0020123	0.0000009	(1 s.d.)		deviation from accepted value (‰)		-6.46	± 0.44
mount exchange									
	91500 (n = 5)	0.0020114	0.0000006	(1 s.d.)		deviation from accepted value (‰)		-6.92	± 0.31
	482-1-5b	0.0020057	0.0000009	0.99318	0.00025	0.0020195	0.0000010	7.13	0.50
	482-1-7a	0.0020043	0.0000006			0.0020181	0.0000006	6.41	0.32
	482-1-7c	0.0020043	0.0000004			0.0020181	0.0000005	6.42	0.24
	482-5-4	0.0020073	0.0000014			0.0020211	0.0000015	7.91	0.73
	482-11-10a	0.0020050	0.0000010			0.0020187	0.0000011	6.74	0.53
	482-11-10N	0.0020067	0.0000010			0.0020204	0.0000010	7.60	0.50
	482-11-4N	0.0020103	0.0000007			0.0020240	0.0000008	9.40	0.39
	91500 (n = 5)	0.0020118	0.0000009	(1 s.d.)		deviation from accepted value (‰)		-6.71	± 0.43
New session									
	91500 (n = 19)	0.0020140	0.0000005	(1 s.d.)		deviation from accepted value (‰)		-5.63	± 0.23
	temora-1	0.0020106	0.0000004	0.99442	0.00010	0.0020219	0.0000005	8.32	0.23
	temora-2	0.0020095	0.0000003			0.0020207	0.0000004	7.74	0.20
	temora-3	0.0020108	0.0000009			0.0020221	0.0000009	8.44	0.44
	temora-4	0.0020105	0.0000006			0.0020218	0.0000006	8.27	0.31
	temora-5	0.0020106	0.0000008			0.0020219	0.0000008	8.32	0.40
	temora-6	0.0020102	0.0000007			0.0020215	0.0000007	8.11	0.35
	temora-7	0.0020113	0.0000006			0.0020226	0.0000007	8.67	0.34
	temora-8	0.0020103	0.0000008			0.0020215	0.0000009	8.14	0.43
	temora-9	0.0020106	0.0000007			0.0020219	0.0000007	8.32	0.34
	temora-10	0.0020101	0.0000010			0.0020214	0.0000011	8.06	0.53
	temora-11	0.0020103	0.0000013			0.0020216	0.0000013	8.16	0.65
	temora-12	0.0020103	0.0000005			0.0020216	0.0000005	8.17	0.25

	temora-13	0.0020105	0.0000004			0.0020218	0.0000005	8.25	0.23
	temora-14	0.0020103	0.0000006			0.0020215	0.0000007	8.15	0.33
	temora-15	0.0020101	0.0000006			0.0020214	0.0000006	8.08	0.32
	temora-16	0.0020112	0.0000007			0.0020224	0.0000008	8.60	0.38
	temora-17	0.0020108	0.0000011			0.0020221	0.0000011	8.42	0.56
	temora-18	0.0020110	0.0000005			0.0020223	0.0000005	8.52	0.25
	temora-19	0.0020108	0.0000006			0.0020220	0.0000006	8.39	0.30
	temora-20	0.0020104	0.0000002			0.0020217	0.0000002	8.22	0.13
	temora-21	0.0020105	0.0000007			0.0020218	0.0000007	8.28	0.35
	temora-22	0.0020103	0.0000004			0.0020215	0.0000004	8.14	0.22
	temora-23	0.0020107	0.0000006			0.0020219	0.0000006	8.35	0.29
	b4-28-1	0.0020076	0.0000006			0.0020188	0.0000006	6.79	0.30
	91500 (n = 28)	0.0020142	0.0000005	(1 s.d.)		deviation from accepted value (‰)		-5.53	± 0.24
	5-18	0.0020080	0.0000006			0.0020193	0.0000006	7.02	0.30
	5-8C-2	0.0020078	0.0000007			0.0020190	0.0000007	6.89	0.37
	5-12a	0.0020078	0.0000004			0.0020191	0.0000004	6.92	0.22
	11-15a	0.0020062	0.0000006			0.0020175	0.0000006	6.11	0.31
	11-11a	0.0020074	0.0000007			0.0020187	0.0000007	6.71	0.35
	91500-48	0.0020134	0.0000010					-5.92	0.50
	91500-49	0.0020142	0.0000005					-5.53	0.25
	91500-50	0.0020138	0.0000010					-5.74	0.49
	91500-51	0.0020133	0.0000009					-5.95	0.47
	91500-52	0.0020144	0.0000008					-5.44	0.41
	91500-53	0.0020141	0.0000008					-5.56	0.41
	91500-54	0.0020140	0.0000009					-5.62	0.44
	91500-55	0.0020131	0.0000006					-6.05	0.29
	91500-56	0.0020153	0.0000011					-5.00	0.53
	91500-57	0.0020143	0.0000010					-5.46	0.48
	91500 (n = 10)	0.0020140	0.0000006	(1 s.d.)		deviation from accepted value (‰)		-5.63	± 0.31
mount exchange									
	91500 (n = 9)	0.0020143	0.0000003	(1 s.d.)		deviation from accepted value (‰)		-5.49	± 0.17
	100-5b	0.0020093	0.0000007	0.99448	0.00012	0.0020204	0.0000008	7.60	0.39
	100-11a	0.0020095	0.0000008			0.0020206	0.0000008	7.70	0.41
	100-12c	0.0020102	0.0000009			0.0020213	0.0000009	8.05	0.45
	100-12a	0.0020094	0.0000011			0.0020206	0.0000011	7.66	0.55
	100-15a	0.0020083	0.0000006			0.0020194	0.0000006	7.10	0.31
	100-19a	0.0020077	0.0000009			0.0020188	0.0000010	6.80	0.48
	100-19b	0.0020105	0.0000010			0.0020217	0.0000011	8.21	0.53
	100-20c	0.0020103	0.0000011			0.0020214	0.0000011	8.09	0.56
	17-6a	0.0020109	0.0000007			0.0020221	0.0000007	8.41	0.37
	17-7	0.0020092	0.0000008			0.0020205	0.0000009	7.57	0.44
	17-10b	0.0020113	0.0000007			0.0020225	0.0000007	8.60	0.37
	91500 (n = 8)	0.0020142	0.0000005	(1 s.d.)		deviation from accepted value (‰)		-5.54	± 0.26
	17-9c	0.0020116	0.0000004	0.99465	0.00016	0.0020224	0.0000005	8.57	0.26
	17-12	0.0020110	0.0000003			0.0020218	0.0000005	8.27	0.23
	kk4-13b	0.0020097	0.0000007			0.0020205	0.0000007	7.64	0.36
	kk4-14b	0.0020087	0.0000006			0.0020195	0.0000007	7.12	0.35
	kk4-15-#2	0.0020041	0.0000006			0.0020148	0.0000007	4.81	0.36
	kk4-20a	0.0020063	0.0000007			0.0020171	0.0000008	5.92	0.40
	kk4-20b	0.0020076	0.0000010			0.0020184	0.0000011	6.57	0.53
	kk4-22	0.0020072	0.0000005			0.0020180	0.0000006	6.39	0.29
	kk4-16a	0.0020086	0.0000010			0.0020194	0.0000010	7.07	0.51
	91500 (n = 10)	0.0020149	0.0000004	(1 s.d.)		deviation from accepted value (‰)		-5.19	± 0.22
	kk2-9a	0.0020133	0.0000007	0.99481	0.00013	0.0020238	0.0000008	9.27	0.40
	kk2-18	0.0020092	0.0000011			0.0020197	0.0000011	7.21	0.56
	kk2-14b	0.0020113	0.0000005			0.0020218	0.0000006	8.29	0.29
Mount exchange									
	91500 (n = 7)	0.0020139	0.0000003	(1 s.d.)		deviation from accepted value (‰)		-5.68	± 0.16
wrong scan pmms	15-2	0.0020107	0.0000006	0.99434	0.00010	0.0020221	0.0000007	8.44	0.33
	15-7	0.0020070	0.0000007			0.0020185	0.0000007	6.61	0.35
	15-6b	0.0020085	0.0000006			0.0020199	0.0000006	7.34	0.31
	15-8	0.0020055	0.0000003			0.0020169	0.0000004	5.82	0.20
	15-4	0.0020085	0.0000006			0.0020200	0.0000006	7.36	0.32
	15-3	0.0020082	0.0000009			0.0020196	0.0000009	7.20	0.46

	15-2	0.0020081	0.0000007			0.0020195	0.0000007	7.15	0.35
	483-100-10a	0.0020096	0.0000007			0.0020210	0.0000007	7.89	0.36
	91500 (n = 13)	0.0020140	0.0000003	(1 s.d.)		deviation from accepted value (‰)		-5.65	± 0.14
Mount exchange									
	91500 (n = 10)	0.0020167	0.0000003	(1 s.d.)		deviation from accepted value (‰)		-4.27	± 0.17
	B4-28-2	0.0020099	0.0000009	0.99584	0.00011	0.0020183	0.0000010	6.51	0.48
	B4-28-3	0.0020104	0.0000006			0.0020188	0.0000007	6.78	0.33
	B4-28-4b	0.0020112	0.0000006			0.0020196	0.0000006	7.17	0.32
	B4-28-4	0.0020100	0.0000007			0.0020184	0.0000008	6.59	0.39
	B4-28-1	0.0020109	0.0000009			0.0020193	0.0000010	7.03	0.48
	B4-28-5	0.0020096	0.0000009			0.0020180	0.0000009	6.38	0.46
	B4-28-6	0.0020110	0.0000007			0.0020193	0.0000007	7.04	0.37
	B4-28-7	0.0020095	0.0000007			0.0020179	0.0000007	6.33	0.36
	B4-28-8	0.0020114	0.0000007			0.0020197	0.0000007	7.25	0.36
	B4-28-9	0.0020079	0.0000004			0.0020162	0.0000005	5.51	0.23
	B4-28-10	0.0020107	0.0000006			0.0020191	0.0000006	6.94	0.32
	B4-28-11	0.0020103	0.0000006			0.0020187	0.0000006	6.71	0.32
	15-1	0.0020094	0.0109118			0.0020177	0.0000005	6.26	0.25
	91500 (n = 27)	0.0020171	0.0000006	(1 s.d.)		deviation from accepted value (‰)		-4.10	± 0.29
New session									
	91500 (n = 19)	0.0020161	0.0000005	(1 s.d.)		deviation from accepted value (‰)		-4.58	± 0.27
	482-11-1	0.0020092	0.0000005	0.99569	0.00019	0.0020179	0.0000006	6.34	0.32
	482-11-8	0.0020078	0.0000004			0.0020165	0.0000006	5.64	0.29
	482-11-10b	0.0020091	0.0000007			0.0020178	0.0000008	6.27	0.39
	482-1-1b	0.0020087	0.0000005			0.0020174	0.0000007	6.06	0.33
	482-1-1a	0.0020106	0.0000002			0.0020193	0.0000004	7.01	0.21
	482-1-5c	0.0020137	0.0000008			0.0020224	0.0000009	8.60	0.44
	482-1-14b	0.0020088	0.0000006			0.0020175	0.0000007	6.12	0.36
	482-5-9	0.0020094	0.0000008			0.0020181	0.0000009	6.45	0.45
	91500 (n = 10)	0.0020177	0.0000007	(1 s.d.)		deviation from accepted value (‰)		-3.79	± 0.34

Table S2. Oxygen isotope data for zircons from I-type granites of southeastern Australia, as determined by ion microprobe. The $\delta^{18}O$ values for unknowns are reported relative to VSMOW. For each block of analyses of the standard zircon 91500, the per mil deviation of the measured $^{18}O/^{16}O$ ratio from the value of ref. S3 is also shown (at 1 s.d.).

Grain	Beam size (μm)	$^{176}Hf/^{177}Hf$	± 2 se	$^{176}Lu/^{177}Hf$	± 2se	Age (Ma)	$(^{176}Hf/^{177}Hf)t$	ε Hf (t)	± 2 se	Th (ppm)	U (ppm)	Th/U	Method
TKB5 Cobargo diorite													
1 rim	50	0.282694	0.000045	0.000279	0.000003	390	0.282692	5.75	1.59	121	166	0.729	IMP
2a core	50	0.282725	0.000040	0.001448	0.000175	390	0.282714	6.55	1.42	78.22	93.83	0.834	LA
2b rim	50	0.282745	0.000032	0.001008	0.000048	390	0.282738	7.37	1.13	126	163	0.773	IMP
3	50	0.282715	0.000026	0.000492	0.000020	390	0.282711	6.44	0.92	66	89	0.742	IMP
4a core	50	0.282696	0.000026	0.000796	0.000014	390	0.282690	5.69	0.92	92.57	145.8	0.635	LA
4b rim	50	0.282709	0.000030	0.000690	0.000025	390	0.282704	6.18	1.06	63	110	0.573	IMP
5	50	0.282686	0.000024	0.000398	0.000008	390	0.282683	5.44	0.85	50	111	0.450	IMP
6	50	0.282716	0.000019	0.000520	0.000039	390	0.282712	6.47	0.66	68	101	0.673	IMP
7a core	50	0.282718	0.000026	0.000694	0.000029	390	0.282713	6.50	0.92	77	132	0.583	IMP
7b rim	50	0.282689	0.000024	0.000479	0.000004	390	0.282685	5.53	0.85	86.33	158.7	0.544	LA
8A core	50	0.282778	0.000036	0.001158	0.000076	390	0.282770	8.50	1.27	122.6	134.7	0.910	LA
8C core	50	0.282769	0.000026	0.000649	0.000069	390	0.282764	8.31	0.92	101.8	117.7	0.865	LA
8C-2 rim	50	0.282703	0.000018	0.000561	0.000061	390	0.282699	6.00	0.61	24.72	45.66	0.541	LA
9b	50	0.282672	0.000026	0.000658	0.000011	390	0.282667	4.88	0.92	63	124	0.508	IMP
10a core	50	0.282758	0.000030	0.001734	0.000190	390	0.282745	7.64	1.06	174	199	0.874	IMP
10b rim	50	0.282738	0.000022	0.000678	0.000026	390	0.282733	7.21	0.78	37.02	58.56	0.632	LA
11	50	0.282751	0.000014	0.000796	0.000011	390	0.282745	7.62	0.52				
12a-core	50	0.282675	0.000034	0.000768	0.000044	390	0.282669	4.96	1.20	71.48	157	0.455	LA
12b-rim	50	0.282627	0.000028	0.000608	0.000041	390	0.282623	3.30	0.99	71.72	137.5	0.522	LA
13 core	50	0.282760	0.000016	0.001305	0.000058	390	0.282751	7.84	0.57				
13b rim	50	0.282755	0.000018	0.001341	0.000032	390	0.282745	7.63	0.65				
14	50	0.282756	0.000028	0.001710	0.000107	390	0.282744	7.58	0.99				
15	50	0.282754	0.000032	0.000887	0.000054	390	0.282748	7.72	1.13	277	267	1.037	IMP
16	50	0.282726	0.000018	0.000650	0.000035	390	0.282721	6.79	0.62				
17	50	0.282776	0.000030	0.001212	0.000143	390	0.282767	8.42	1.06	98.57	110.9	0.889	LA
18	50	0.282696	0.000035	0.000865	0.000009	390	0.282690	5.67	1.24	126.9	252.9	0.502	LA
19a	50	0.282732	0.000022	0.000858	0.000005	390	0.282726	6.95	0.78	110.8	130.2	0.851	LA
19b	50	0.282739	0.000017	0.001299	0.000090	390	0.282729	7.07	0.61				
25	50	0.282748	0.000018	0.001170	0.000067	390	0.282740	7.45	0.67				
26	50	0.282739	0.000020	0.000784	0.000054	390	0.282734	7.23	0.72				
27a core	50	0.282729	0.000017	0.001043	0.000079	390	0.282722	6.81	0.61				
27b rim	50	0.282720	0.000018	0.000959	0.000021	390	0.282713	6.49	0.64				
28	50	0.282730	0.000018	0.001292	0.000041	390	0.282721	6.77	0.62				
482-4	50	0.282646	0.000020	0.001058	0.000046	390	0.282638	3.85	0.71	59	99	0.596	IMP
482-8	50	0.282739	0.000012	0.000967	0.000036	390	0.282732	7.17	0.45				
482-9	50	0.282768	0.000018	0.001459	0.000036	390	0.282757	8.06	0.65				
A-1a core	50	0.282753	0.000018	0.002247	0.000162	390	0.282737	7.34	0.63	95.18	114.9	0.828	LA
A-1b rim	50	0.282747	0.000018	0.001561	0.000188	390	0.282736	7.31	0.62				
A-2	50	0.282733	0.000024	0.001806	0.000142	390	0.282720	6.74	0.84				
A-3	50	0.282745	0.000018	0.001156	0.000015	390	0.282736	7.33	0.66				
A-4	50	0.282742	0.000022	0.000876	0.000022	390	0.282736	7.30	0.81				
A-5a core	50	0.282738	0.000019	0.000762	0.000035	390	0.282733	7.19	0.67				
A-5b rim	50	0.282720	0.000024	0.000653	0.000015	390	0.282716	6.59	0.85				
A-7	50	0.282669	0.000020	0.001103	0.000017	390	0.282661	4.67	0.70				
A-8	50	0.282716	0.000014	0.000852	0.000015	390	0.282710	6.38	0.50				
TKB1 Cobargo Tonalite													
1a core	40	0.282676	0.000030	0.000457	0.000039	390	0.282673	5.07	1.06	87	113	0.770	IMP
1b core	50	0.282655	0.000028	0.000842	0.000036	390	0.282649	4.24	0.51				
1c rim	40	0.282666	0.000030	0.000452	0.000009	390	0.282663	4.72	1.06	67.68	119.5	0.566	LA
2a core	40	0.282639	0.000038	0.000685	0.000050	390	0.282634	3.70	1.34	173.9	203.5	0.855	LA
2b rim	40	0.282627	0.000056	0.000948	0.000136	390	0.282620	3.21	1.98				
3a core	40	0.282628	0.000038	0.000689	0.000029	390	0.282623	3.31	1.34	61	94	0.649	IMP
3b rim	40	0.282698	0.000040	0.000813	0.000051	390	0.282692	5.76	1.42	169.6	305.3	0.556	LA
4a core	40	0.282649	0.000042	0.000843	0.000058	390	0.282643	4.02	1.49	89	124	0.718	IMP
4b rim	40	0.282644	0.000030	0.000594	0.000006	390	0.282640	3.90	1.06	100	185	0.541	IMP
6a	40	0.282653	0.000030	0.000526	0.000012	390	0.282649	4.24	1.06	154	180.7	0.852	LA
7a core	40	0.282698	0.000025	0.000510	0.000008	390	0.282694	5.84	0.88	143.2	173.9	0.823	LA
7b rim	40	0.282635	0.000034	0.000745	0.000123	390	0.282630	3.55	1.20	98.16	186.7	0.526	LA
8a core	50	0.282669	0.000054	0.000611	0.000031	390	0.282665	4.78	1.91	151.6	193.8	0.782	LA
9a core	40	0.282649	0.000038	0.000761	0.000031	390	0.282643	4.04	1.34	66	105	0.629	IMP
9b rim	50	0.282640	0.000020	0.000750	0.000031	390	0.282635	3.72	0.71	103	186	0.554	IMP
11	50	0.282637	0.000034	0.000681	0.000033	390	0.282632	3.63	1.20	124	156	0.795	IMP
12A core	50	0.282664	0.000026	0.000910	0.000038	390	0.282657	4.53	0.92	107	147.2	0.727	LA
12b rim	50	0.282659	0.000024	0.000704	0.000053	390	0.282654	4.41	0.85	164	195	0.841	IMP
13	50	0.282674	0.000028	0.000736	0.000013	390	0.282669	4.93	0.99	129	158	0.816	IMP
14a core	50	0.282643	0.000032	0.001007	0.000231	390	0.282636	3.76	1.13	90.5	133.4	0.678	LA
14b rim	50	0.282670	0.000022	0.000539	0.000018	390	0.282666	4.84	0.78	95	154	0.617	IMP
14c rim	50	0.282639	0.000014	0.000581	0.000001	390	0.282635	3.73	0.52	92.42	168.5	0.548	LA
15	50	0.282641	0.000016	0.000547	0.000018	390	0.282637	3.81	0.55	101	190	0.532	IMP
17	50	0.282690	0.000024	0.001059	0.000056	390	0.282682	5.41	0.85				
20 core	50	0.282680	0.000028	0.000705	0.000126	390	0.282675	5.15	0.99	135.9	173.3	0.784	LA
21 core	40	0.282631	0.000040	0.000789	0.000064	390	0.282625	3.39	1.42	117.7	166.9	0.705	LA
22b rim	50	0.282646	0.000026	0.000964	0.000019	390	0.282639	3.88	0.92	192.9	251.7	0.766	LA
23	50	0.282690	0.000024	0.000609	0.000076	390	0.282686	5.53	0.85				
24a core	50	0.282650	0.000024	0.000754	0.000041	390	0.282644	4.07	0.85	199.1	277.8	0.717	LA
24b rim	50	0.282654	0.000022	0.000914	0.000044	390	0.282647	4.18	0.75				

25a	50	0.282682	0.000028	0.001192	0.000101	390	0.282673	5.09	0.99				
25b	50	0.282631	0.000016	0.001119	0.000083	390	0.282623	3.31	0.55				
26	40	0.282643	0.000020	0.000633	0.000003	390	0.282638	3.84	0.72				
27	40	0.282669	0.000036	0.001050	0.000118	390	0.282661	4.67	1.27				
28	50	0.282642	0.000018	0.000939	0.000025	390	0.282635	3.74	0.63				
N1	40	0.282654	0.000015	0.000954	0.000042	390	0.282647	4.00	0.53	141.5	175.8	0.805	LA
482-1a	50	0.282644	0.000012	0.000960	0.000033	390	0.282637	3.81	0.42	120	156	0.769	IMP
482-1b	40	0.282659	0.000010	0.000474	0.000011	390	0.282656	4.47	0.35	78	120	0.650	IMP
482-22a core	50	0.282704	0.000024	0.000541	0.000026	390	0.282700	6.04	0.85				
482-22c rim	50	0.282652	0.000016	0.000877	0.000039	390	0.282646	4.11	0.54				
482-22b rim	50	0.282625	0.000022	0.000571	0.000028	390	0.282621	3.24	0.78	66.54	118.9	0.560	LA
482-5b rim	40	0.282609	0.000022	0.000792	0.000059	390	0.282603	2.61	0.78				
482-7a	40	0.282647	0.000026	0.001178	0.000048	390	0.282638	3.86	0.92	166	209	0.794	IMP
482-7b	40	0.282626	0.000020	0.000596	0.000017	390	0.282622	3.27	0.68	59	121	0.488	IMP
482-7c	40	0.282672	0.000020	0.000456	0.000028	390	0.282669	4.95	0.73				
482-50	40	0.282711	0.000046	0.000923	0.000060	390	0.282704	6.19	1.63				
482-14a	40	0.282593	0.000026	0.000781	0.000080	390	0.282587	2.04	0.94	51	126	0.405	IMP
482-14b	40	0.282663	0.000023	0.000764	0.000029	390	0.282657	4.53	0.82				
482-52	40	0.282663	0.000030	0.001282	0.000093	390	0.282654	4.41	1.05				
A-1a core	50	0.282651	0.000016	0.001128	0.000048	390	0.282643	4.01	0.57				
A-1b rim	50	0.282643	0.000014	0.001353	0.000076	390	0.282633	3.68	0.52				
A-2a core	50	0.282665	0.000002	0.000774	0.000050	390	0.282659	4.60	0.54				
A-2b rim	50	0.282660	0.000012	0.000692	0.000007	390	0.282655	4.43	0.46				
A-2c rim	40	0.282655	0.000032	0.000885	0.000051	390	0.282648	4.21	1.10				
A-3	50	0.282664	0.000016	0.001080	0.000026	390	0.282657	4.50	0.55				
A-4	50	0.282651	0.000002	0.000868	0.000044	390	0.282644	4.07	0.58				
A-5b	40	0.282640	0.000026	0.001532	0.000082	390	0.282629	3.50	0.91				
A-6a core	50	0.282569	0.000016	0.001253	0.000040	390	0.282559	1.06	0.54	110.5	243.2	0.454	LA
A-6b rim	40	0.282627	0.000023	0.000508	0.000005	390	0.282624	3.34	0.81				
A-7	50	0.282661	0.000018	0.001327	0.000027	390	0.282652	4.32	0.64				
A-8a core	50	0.282662	0.000016	0.001234	0.000112	390	0.282653	4.36	0.55				
A-8b rim	50	0.282659	0.000016	0.000664	0.000026	390	0.282654	4.41	0.54				
A-9a core	40	0.282682	0.000024	0.001513	0.000066	390	0.282671	5.01	0.88	165.4	189.5	0.873	LA
A-9b rim	40	0.282652	0.000024	0.000973	0.000052	390	0.282645	4.08	0.87				
TKB11 Cobargo Granite													
1a core	40	0.282659	0.000028	0.000970	0.000112	390	0.282652	4.34	0.99	135	257	0.525	IMP
1b rim	40	0.282607	0.000028	0.000521	0.000020	390	0.282603	2.61	0.99	131	248	0.528	IMP
2a core	40	0.282626	0.000034	0.001022	0.000089	390	0.282619	3.16	1.20				
2b rim	40	0.282651	0.000028	0.000550	0.000021	390	0.282647	4.16	0.99				
2c core	40	0.282659	0.000026	0.001373	0.000043	390	0.282649	4.23	0.95				
3	40	0.282621	0.000032	0.000822	0.000126	390	0.282615	3.03	1.13	282	466	0.605	IMP
4A core	40	0.282675	0.000034	0.000930	0.000013	390	0.282668	4.91	1.20	441	682	0.647	IMP
4A rim	40	0.282647	0.000030	0.000669	0.000021	390	0.282642	3.99	1.06				
5a	50	0.282653	0.000016	0.001486	0.000096	390	0.282642	3.98	1.15	410	621	0.660	IMP
5b	50	0.282658	0.000012	0.000774	0.000045	390	0.282653	4.36	0.85	134	221	0.606	IMP
6	50	0.282641	0.000022	0.000911	0.000058	390	0.282634	3.72	0.78	189	289	0.654	IMP
7a core	40	0.282649	0.000024	0.001080	0.000027	390	0.282641	3.96	0.84	474	683	0.694	IMP
7b rim	40	0.282651	0.000020	0.000685	0.000025	390	0.282646	4.13	0.70				
8a core	50	0.282639	0.000022	0.001254	0.000048	390	0.282630	3.56	0.78	338	572	0.591	IMP
8b rim	50	0.282647	0.000018	0.000471	0.000011	390	0.282644	4.04	0.64				
9	50	0.282695	0.000019	0.000888	0.000036	390	0.282689	5.63	0.67	330	484	0.682	IMP
10	50	0.282587	0.000016	0.001097	0.000025	390	0.282579	1.76	0.58	100.8	216.5	0.466	LA
11a core	50	0.282669	0.000025	0.000865	0.000017	390	0.282663	4.72	0.87	107.2	140.6	0.762	LA
11b rim	50	0.282704	0.000020	0.000664	0.000012	390	0.282699	6.01	0.69				
11c core	40	0.282690	0.000022	0.001380	0.000066	390	0.282680	5.33	0.78				
13	50	0.282664	0.000022	0.000814	0.000021	390	0.282658	4.55	0.78	235	303.1	0.775	LA
14a core	40	0.282631	0.000032	0.000921	0.000099	390	0.282624	3.36	1.13				
14b rim	50	0.282649	0.000018	0.000880	0.000050	390	0.282643	4.01	0.64				
15a core	40	0.282688	0.000038	0.001068	0.000121	390	0.282680	5.34	1.34	772.2	844.9	0.914	LA
15b rim	40	0.282681	0.000030	0.000844	0.000053	390	0.282675	5.15	1.06				
18a core	50	0.282659	0.000022	0.000791	0.000030	390	0.282653	4.38	0.78				
18b rim	50	0.282643	0.000017	0.000477	0.000012	390	0.282640	3.90	0.62				
19a	40	0.282633	0.000027	0.000975	0.000080	390	0.282626	3.41	0.96				
19b	40	0.282639	0.000028	0.001075	0.000052	390	0.282631	3.61	0.97				
20 core	40	0.282689	0.000020	0.001105	0.000046	390	0.282681	5.36	0.72				
20b rim	40	0.282641	0.000018	0.000582	0.000010	390	0.282637	3.80	0.64				
21	40	0.282682	0.000024	0.001112	0.000020	390	0.282674	5.11	0.87				
22a core	50	0.282668	0.000018	0.001091	0.000049	390	0.282660	4.63	0.63				
22b rim	50	0.282656	0.000016	0.001001	0.000055	390	0.282649	4.22	0.57				
23	40	0.282665	0.000022	0.000838	0.000042	390	0.282659	4.58	0.78				
N1	40	0.282663	0.000042	0.000866	0.000063	390	0.282657	4.51	1.49				
N3	50	0.282623	0.000024	0.000675	0.000016	390	0.282618	3.14	0.85	139.8	209.7	0.667	LA
482-1	50	0.282667	0.000022	0.000606	0.000005	390	0.282663	4.71	0.78	248.7	334.4	0.744	LA
482-2	50	0.282609	0.000032	0.000786	0.000098	390	0.282603	2.61	1.13	211	375	0.563	IMP
482-3	50	0.282647	0.000022	0.000556	0.000011	390	0.282643	4.02	0.78	137	198.8	0.689	LA
482-4N	50	0.282498	0.000032	0.000881	0.000023	390	0.282492	-1.34	1.13				
482-10N	40	0.282588	0.000014	0.000988	0.000060	390	0.282581	1.82	0.99				
482-10a core	50	0.282633	0.000015	0.000979	0.000036	390	0.282626	3.42	0.55	240	359	0.669	IMP
482-10b rim	40	0.282664	0.000020	0.000561	0.000008	390	0.282660	4.63	0.68				

TKB15 Syn-plutonic basalt

1	40	0.282668	0.000026	0.000842	0.000026	400	0.282662	4.90	0.92				
2	40	0.282615	0.000030	0.000835	0.000067	400	0.282609	3.03	1.06				
3	40	0.282670	0.000030	0.000793	0.000038	400	0.282664	4.99	1.06				
4	40	0.282632	0.000038	0.001410	0.000067	400	0.282621	3.48	1.35				
6a rim	40	0.282322	0.000028	0.000830	0.000012	400	0.282316	-7.34	0.99				
6b core	40	0.282450	0.000042	0.000855	0.000064	400	0.282444	-2.82	1.49				
7	40	0.282664	0.000036	0.001569	0.000129	400	0.282652	4.57	1.27				
8	40	0.282689	0.000042	0.001346	0.000078	400	0.282679	5.51	1.49				
tk6-1	40	0.282323	0.000017	0.002179	0.000122	400	0.282307	-7.65	1.23				
tk6-2	40	0.282365	0.000015	0.001311	0.000036	400	0.282355	-5.94	1.07				

TKB100 Why Worry Tonalite

1a core	50	0.282329	0.000016	0.000616	0.000018	400	0.282324	-7.03	0.57	100	195	0.513	IMP
1b rim	50	0.282363	0.000020	0.000601	0.000003	400	0.282358	-5.83	0.71	125.4	227.6	0.551	LA
2a-1	50	0.282409	0.000034	0.000650	0.000086	400	0.282404	-4.21	1.20				
2a-3	50	0.282368	0.000036	0.000592	0.000109	400	0.282364	-5.65	1.27	103.5	176.5	0.586	LA
2b rim	50	0.282352	0.000014	0.000664	0.000009	400	0.282347	-6.23	0.49	133	255	0.522	IMP
2B	50	0.282337	0.000014	0.000640	0.000014	400	0.282332	-6.77	0.50	99.42	161.6	0.615	LA
3b	50	0.282325	0.000015	0.000487	0.000025	400	0.282321	-7.14	0.54	79	156	0.506	IMP
4b	50	0.282378	0.000024	0.000589	0.000013	400	0.282374	-5.29	0.85	105	188.6	0.557	LA
5a core	50	0.282354	0.000022	0.000647	0.000033	400	0.282349	-6.16	0.78	113.1	204.3	0.554	LA
5b rim	50	0.282369	0.000017	0.000586	0.000020	400	0.282365	-5.61	0.62	197	320	0.616	IMP
7b	50	0.282321	0.000018	0.000675	0.000013	400	0.282316	-7.33	0.64	44.94	97.88	0.459	LA
9B core	50	0.282327	0.000022	0.000706	0.000031	400	0.282322	-7.13	0.78	17.82	29.5	0.604	LA
9B rim	50	0.282352	0.000017	0.000558	0.000012	400	0.282348	-6.21	0.62				
10a core	50	0.282362	0.000022	0.000900	0.000007	400	0.282355	-5.94	0.78	281	384	0.732	IMP
10b rim	50	0.282353	0.000016	0.000662	0.000012	400	0.282348	-6.20	0.56	89.2	152	0.587	LA
11a core	50	0.282367	0.000026	0.001282	0.000079	400	0.282357	-5.87	0.92	141.2	193.5	0.730	LA
11b rim	50	0.282328	0.000014	0.000489	0.000013	400	0.282324	-7.04	0.50	75.66	131.7	0.574	LA
12a core	50	0.282396	0.000022	0.001170	0.000015	400	0.282387	-4.81	0.78	126	152	0.829	IMP
12b rim	50	0.282319	0.000039	0.000896	0.000025	400	0.282312	-7.46	1.38	73.55	130.8	0.562	LA
14	50	0.282304	0.000017	0.000693	0.000029	400	0.282299	-7.94	0.62	37.83	64.64	0.585	LA
15a core	50	0.282432	0.000028	0.001261	0.000098	400	0.282423	-3.56	0.99	118	133	0.887	IMP
15b rim	50	0.282375	0.000020	0.000936	0.000021	400	0.282368	-5.49	0.71	153.1	239.6	0.639	LA
16a core	50	0.282315	0.000022	0.000759	0.000054	400	0.282309	-7.57	0.78	67	109	0.615	IMP
16b rim	50	0.28234	0.000017	0.000418	0.000006	400	0.282337	-6.59	0.59	96.88	185.1	0.523	LA
19a core	50	0.282482	0.000020	0.000631	0.000014	400	0.282477	-1.62	0.71	147	171	0.860	IMP
19b rim	50	0.282364	0.000014	0.000686	0.000004	400	0.282359	-5.81	0.49	101.8	200.9	0.507	LA
20a core	50	0.282263	0.000024	0.000783	0.000018	400	0.282257	-9.42	0.85	64	190	0.337	IMP
20b rim	50	0.282285	0.000030	0.000370	0.000024	400	0.282282	-8.53	1.06	79.13	208.1	0.380	LA
22B rim	50	0.282365	0.000015	0.000664	0.000013	400	0.282360	-5.77	0.53	74	134	0.552	IMP
23a	50	0.282350	0.000019	0.000718	0.000012	400	0.282345	-6.32	0.69	79.34	135.3	0.586	LA
23b	50	0.282356	0.000024	0.000829	0.000021	400	0.282350	-6.14	0.85	103.8	190.3	0.545	LA
24	50	0.282291	0.000026	0.000664	0.000004	400	0.282286	-8.39	0.92	71.78	144.8	0.496	LA
N1	50	0.282354	0.000030	0.000924	0.000014	400	0.282347	-6.23	1.06				
483-10a core	50	0.282396	0.000028	0.000769	0.000035	400	0.282390	-4.70	0.99	77	111	0.694	IMP
483-10b rim	50	0.282346	0.000024	0.000806	0.000040	400	0.282340	-6.48	0.85				

TKB17 Pretty Point Tonalite

1 rim	50	0.282366	0.000016	0.000710	0.000003	400	0.282361	-5.75	0.57	135.5	230.7	0.587	LA
1A core	50	0.282413	0.000025	0.001385	0.000501	400	0.282403	-4.27	0.88	300.9	311.8	0.965	LA
1A rim	50	0.282342	0.000015	0.000726	0.000011	400	0.282337	-6.60	0.55	166.7	279.3	0.597	LA
2b	50	0.282358	0.000022	0.000606	0.000033	400	0.282353	-6.01	0.78	275.8	397.9	0.693	LA
2C	50	0.282356	0.000013	0.000649	0.000014	400	0.282351	-6.10	0.49	89	166	0.536	IMP
3	50	0.282360	0.000016	0.000586	0.000010	400	0.282356	-5.93	0.57	129	219	0.589	IMP
4b-1	40	0.282416	0.000040	0.000449	0.000021	400	0.282413	-3.91	1.42				
4b-2	50	0.282368	0.000024	0.000549	0.000009	400	0.282364	-5.64	0.85				
4a-N	50	0.282394	0.000019	0.001022	0.000126	400	0.282386	-4.84	0.69	152.8	180.6	0.846	LA
5	40	0.282343	0.000018	0.000684	0.000012	400	0.282338	-6.55	0.66	192.7	332.7	0.579	LA
5A core	50	0.282331	0.000020	0.001032	0.000030	400	0.282323	-7.06	0.72				
6a core	40	0.282364	0.000022	0.000640	0.000012	400	0.282359	-5.80	0.78	33.58	45.21	0.743	LA
6b rim	50	0.282374	0.000017	0.000517	0.000016	400	0.282370	-5.42	0.60	65.34	121.5	0.538	LA
6c rim	50	0.282322	0.000016	0.000515	0.000026	400	0.282318	-7.27	0.59	81	165	0.491	IMP
7	50	0.282512	0.000036	0.002492	0.000397	400	0.282493	-1.06	1.27	48.23	120.4	0.401	LA
7A core	50	0.282345	0.000018	0.000903	0.000003	400	0.282338	-6.54	0.63	115.6	205.2	0.563	LA
7A rim	50	0.282358	0.000016	0.000574	0.000002	400	0.282354	-6.00	0.56	115.6	205.2	0.563	LA
9b	50	0.282428	0.000014	0.000234	0.000012	400	0.282426	-3.43	0.49	69.81	76.31	0.915	LA
10	50	0.282395	0.000022	0.000850	0.000013	400	0.282389	-4.76	0.78	181	306	0.592	IMP
11a rim	50	0.282353	0.000024	0.000543	0.000035	400	0.282349	-6.17	0.85	99	177	0.559	IMP
11b rim	40	0.282387	0.000018	0.000576	0.000004	400	0.282383	-4.97	0.66				
11B rim	50	0.282391	0.000029	0.000655	0.000010	400	0.282386	-4.85	1.02	164	257	0.638	IMP
12	40	0.282358	0.000020	0.000645	0.000020	400	0.282353	-6.03	0.68	122.3	215.1	0.569	LA
13a	50	0.282382	0.000022	0.000638	0.000012	400	0.282377	-5.16	0.78				
13b core	50	0.282361	0.000014	0.000778	0.000018	400	0.282355	-5.95	0.52				
13c rim	50	0.282355	0.000016	0.000976	0.000038	400	0.282348	-6.21	0.58	73	152	0.480	IMP
15	40	0.282350	0.000018	0.000959	0.000012	400	0.282343	-6.37	0.64	83	141	0.589	IMP
16	50	0.282367	0.000017	0.000671	0.000012	400	0.282362	-5.70	0.60				
17a	40	0.282349	0.000020	0.000662	0.000010	400	0.282344	-6.34	0.71	95.3	146.2	0.652	LA
17b	50	0.282348	0.000016	0.000749	0.000008	400	0.282342	-6.41	0.58	84.45	161.5	0.523	LA

KK4 Round Flat Tonalite													
2b	50	0.282424	0.000020	0.000718	0.000028	415	0.282418	-3.39	0.71				
3a	50	0.282408	0.000022	0.000585	0.000006	415	0.282403	-3.90	0.78	139.1	336.9	0.413	LA
4a core	50	0.282434	0.000019	0.000838	0.000021	415	0.282427	-3.05	0.69	140	151.8	0.922	LA
4b rim	50	0.282392	0.000015	0.000693	0.000018	415	0.282387	-4.50	0.52				
6	50	0.282499	0.000020	0.001015	0.000022	415	0.282491	-0.80	0.70	54	100	0.540	IMP
8	50	0.282418	0.000028	0.000828	0.000035	415	0.282412	-3.62	0.99	39	68	0.574	IMP
9	50	0.282433	0.000024	0.000790	0.000010	415	0.282427	-3.08	0.85	67	191	0.351	IMP
10	40	0.282420	0.000022	0.000860	0.000030	415	0.282413	-3.56	0.78	117	167	0.701	IMP
11-1b	40	0.282444	0.000036	0.000692	0.000075	415	0.282439	-2.66	1.27	60	120	0.500	IMP
12a core	50	0.282330	0.000018	0.000841	0.000043	415	0.282324	-6.72	0.63				
12b rim	40	0.282442	0.000030	0.000806	0.000055	415	0.282436	-2.76	1.06	94	129	0.729	IMP
13a core	50	0.282435	0.000016	0.000659	0.000020	415	0.282430	-2.96	0.57	48.89	102.9	0.475	LA
13b rim	50	0.282406	0.000017	0.000627	0.000014	415	0.282401	-3.99	0.60	136	531	0.256	IMP
13B	50	0.282447	0.000028	0.000914	0.000022	415	0.282440	-2.61	0.99				
14b	40	0.282456	0.000024	0.000582	0.000022	415	0.282451	-2.20	0.85	70	139	0.504	IMP
15a2	50	0.282425	0.000038	0.000914	0.000025	415	0.282418	-3.39	1.35				
15b	50	0.282390	0.000026	0.000662	0.000048	415	0.282385	-4.56	0.92	63	122	0.516	IMP
15-#2	50	0.282484	0.000026	0.000503	0.000062	415	0.282480	-1.19	0.92				
16a core	50	0.282419	0.000030	0.000826	0.000075	415	0.282413	-3.58	1.06	49	95	0.516	IMP
16b rim	40	0.282463	0.000018	0.000649	0.000016	415	0.282458	-1.97	0.61				
17 rim	50	0.282427	0.000026	0.000929	0.000157	415	0.282420	-3.33	0.92				
18 core	50	0.282440	0.000018	0.000819	0.000030	415	0.282434	-2.84	0.62				
18 rim	50	0.282412	0.000020	0.000807	0.000012	415	0.282406	-3.82	0.71				
19	50	0.282405	0.000028	0.000579	0.000028	415	0.282400	-4.01	0.99				
20a core	50	0.282443	0.000046	0.001342	0.000183	415	0.282433	-2.87	1.63				
20b rim	50	0.282424	0.000024	0.000994	0.000018	415	0.282416	-3.45	0.85				
22	50	0.282405	0.000017	0.000566	0.000022	415	0.282401	-4.01	1.22				
KK2 Round Flat Tonalite													
2b	50	0.282415	0.000026	0.000800	0.000085	415	0.282409	-3.72	0.92	118	295	0.400	IMP
4b	40	0.282417	0.000013	0.000585	0.000116	415	0.282412	-3.59	0.92				
6b	50	0.282410	0.000028	0.001555	0.000052	415	0.282398	-4.10	0.99	253	578	0.438	IMP
7b	50	0.282456	0.000026	0.001982	0.000159	415	0.282441	-2.57	0.94				
8 rim	50	0.282424	0.000024	0.001492	0.000217	415	0.282412	-3.59	0.85	106	411	0.258	IMP
9 rim	50	0.282451	0.000029	0.001801	0.000066	415	0.282437	-2.72	1.03				
9B	50	0.282411	0.000024	0.001952	0.000043	415	0.282396	-4.17	0.85	94	891	0.105	IMP
11	50	0.282416	0.000036	0.002061	0.000052	415	0.282400	-4.03	1.27	343	728	0.471	IMP
12b	50	0.282284	0.000026	0.001145	0.000096	415	0.282275	-8.44	0.89				
14b	50	0.282398	0.000010	0.001921	0.000093	415	0.282383	-4.63	0.68	215	1492	0.144	IMP
16a	50	0.282400	0.000034	0.001894	0.000052	415	0.282385	-4.55	1.20				
16b	40	0.282420	0.000030	0.002184	0.000120	415	0.282403	-3.92	1.07				
17	50	0.282377	0.000056	0.001520	0.000183	415	0.282365	-5.26	1.98				
18	50	0.282446	0.000034	0.001918	0.000067	415	0.282431	-2.93	1.20				
51	50	0.282424	0.000018	0.001657	0.000088	415	0.282411	-3.62	0.65				
E3	40	0.282410	0.000044	0.000661	0.000020	415	0.282405	-3.86	1.56				
B4-28 Blind Gabbo													
1	50	0.282437	0.000014	0.000972	0.000030	415	0.282429	-2.69	0.51				
1b	50	0.282434	0.000021	0.001801	0.000039	415	0.282419	-3.03	0.73				
2	50	0.282425	0.000016	0.001690	0.000025	415	0.282412	-3.30	0.55				
2b	50	0.282434	0.000013	0.001174	0.000021	415	0.282425	-2.85	0.90				
3	50	0.282435	0.000011	0.003140	0.000087	415	0.282410	-3.37	0.79				
4	50	0.282451	0.000010	0.004033	0.000100	415	0.282419	-3.06	0.70				
4b	50	0.282417	0.000017	0.003773	0.000082	415	0.282386	-4.20	1.19				
5	50	0.282430	0.000013	0.004020	0.000485	415	0.282397	-3.81	0.93				
6	50	0.282453	0.000008	0.001849	0.000052	415	0.282438	-2.38	0.57				
6b	50	0.282457	0.000010	0.001694	0.000052	415	0.282444	-2.17	0.69				
7	50	0.282449	0.000010	0.003495	0.000042	415	0.282421	-2.96	0.72				
8	50	0.282424	0.000011	0.001703	0.000120	415	0.282410	-3.35	0.74				
9	50	0.282448	0.000011	0.001208	0.000059	415	0.282438	-2.36	0.78				
9b	50	0.282419	0.000010	0.000946	0.000026	415	0.282411	-3.31	0.69				
10	50	0.282451	0.000009	0.001688	0.000104	415	0.282438	-2.38	0.64				
11	40	0.282440	0.000017	0.002383	0.000239	415	0.282421	-2.98	1.20				
12	50	0.282446	0.000012	0.003096	0.000103	415	0.282421	-2.98	0.83				
13	50	0.282441	0.000007	0.001367	0.000037	415	0.282430	-2.67	0.49				
14	50	0.282432	0.000007	0.000923	0.000014	415	0.282424	-2.86	0.46				
15	50	0.282447	0.000011	0.001808	0.000051	415	0.282432	-2.58	0.80				
17	40	0.282460	0.000011	0.001460	0.000099	415	0.282448	-2.01	0.78				
18	50	0.282441	0.000008	0.001661	0.000020	415	0.282428	-2.74	0.57				
19	40	0.282433	0.000010	0.002814	0.000161	415	0.282411	-3.34	0.69				

Table S3. Laser ablation Lu-Hf isotope data for zircons of the Lachlan Fold Belt I-type granites, together with Th and U concentrations as determined by ion microprobe (IMP, from ref. S1) and laser ablation (LA). 'Core' and 'rim' refers to the relative position of the analysis site within the crystal.

standard	$^{176}Hf/^{177}Hf$	± 1 se	$^{176}Lu/^{177}Hf$	± 1 se	Yb/Hf	Hf signal (v)
91500	0.282283	0.000010	0.000360	0.0000007	0.014	11.4
	0.282301	0.000009	0.000274	0.0000006	0.010	11.4
	0.282318	0.000012	0.000275	0.0000010	0.010	11.3
	0.282302	0.000010	0.000277	0.0000007	0.010	11.7
	0.282302	0.000010	0.000270	0.0000002	0.010	12.5
	0.282291	0.000010	0.000341	0.0000008	0.012	12.7
	0.282288	0.000010	0.000335	0.0000005	0.012	11.0
	0.282308	0.000007	0.000335	0.0000004	0.012	11.3
	0.282300	0.000009	0.000335	0.0000004	0.012	11.6
	0.282318	0.000011	0.000308	0.0000006	0.015	12.6
	0.282285	0.000009	0.000273	0.0000001	0.012	13.9
	0.282316	0.000010	0.000312	0.0000003	0.012	12.5
	0.282291	0.000010	0.000307	0.0000004	0.012	12.7
	0.282300	0.000010	0.000314	0.0000001	0.012	14.7
	0.282311	0.000007	0.000309	0.0000002	0.012	15.4
average ± 2 s.d.	**0.282301**	**0.000023**	0.000308	0.000058		
Solution ± 2 s.d.	**0.282306**	**0.000008**	0.000311		(*S12, S13*)	
Temora-2	0.282697	0.000009	0.001111	0.000002	0.043	16.1
	0.282683	0.000008	0.001022	0.000020	0.039	17.1
	0.282677	0.000007	0.001544	0.000009	0.070	18.9
	0.282696	0.000007	0.001525	0.000009	0.070	18.9
	0.282705	0.000008	0.001086	0.000009	0.052	17.0
	0.282695	0.000012	0.001172	0.000017	0.057	17.1
	0.282698	0.000009	0.001160	0.000041	0.046	18.3
	0.282677	0.000008	0.000825	0.000014	0.033	16.7
	0.282681	0.000013	0.001999	0.000086	0.085	10.7
	0.282684	0.000006	0.000894	0.000005	0.034	19.9
	0.282672	0.000010	0.000836	0.000006	0.030	17.4
	0.282695	0.000010	0.001821	0.000039	0.075	15.4
	0.282694	0.000016	0.000764	0.000008	0.029	14.1
	0.282691	0.000008	0.001313	0.000018	0.051	18.0
	0.282689	0.000010	0.000780	0.000009	0.030	16.3
	0.282705	0.000009	0.000758	0.000017	0.028	16.3
	0.282696	0.000009	0.000652	0.000009	0.024	15.8
	0.282692	0.000017	0.000762	0.000008	0.029	14.1
	0.282689	0.000009	0.000966	0.000022	0.035	16.8
	0.282674	0.000010	0.001166	0.000003	0.045	16.0
	0.282668	0.000009	0.001227	0.000027	0.044	16.8
	0.282672	0.000009	0.001410	0.000009	0.050	16.5
	0.282682	0.000010	0.000975	0.000002	0.036	14.1
	0.282684	0.000014	0.000988	0.000011	0.034	15.4
	0.282669	0.000010	0.001503	0.000006	0.052	16.3
	0.282677	0.000013	0.001293	0.000014	0.049	11.7
	0.282671	0.000011	0.001211	0.000004	0.046	13.1
	0.282671	0.000008	0.000745	0.000011	0.028	18.8
	0.282673	0.000011	0.002183	0.000003	0.070	11.5
	0.282679	0.000011	0.001568	0.000026	0.061	16.8
	0.282667	0.000010	0.000780	0.000004	0.027	15.1
	0.282656	0.000008	0.000737	0.000007	0.026	15.5
	0.282673	0.000008	0.000890	0.000019	0.037	15.7
	0.282676	0.000010	0.000907	0.000007	0.035	16.9
	0.282667	0.000009	0.001048	0.000017	0.043	16.4
	0.282700	0.000008	0.000920	0.000007	0.032	16.8
	0.282706	0.000009	0.001006	0.000016	0.034	16.6
	0.282698	0.000009	0.001087	0.000033	0.038	16.7
	0.282662	0.000011	0.001005	0.000028	0.035	15.4
	0.282653	0.000007	0.001265	0.000011	0.045	18.2

	0.282679	0.000008	0.001211	0.000005	0.044	19.3
	0.282701	0.000009	0.000829	0.000010	0.030	17.5
	0.282678	0.000009	0.001373	0.000005	0.050	19.2
	0.282701	0.000008	0.000636	0.000005	0.023	20.6
	0.282683	0.000008	0.001525	0.000004	0.060	19.1
	0.282683	0.000007	0.001216	0.000010	0.045	21.0
	0.282684	0.000011	0.001187	0.000009	0.044	17.5
	0.282681	0.000008	0.001139	0.000006	0.041	16.6
	0.282683	0.000012	0.001247	0.000026	0.042	18.7
	0.282683	0.000009	0.000705	0.000015	0.025	16.7
	0.282678	0.000010	0.001214	0.000004	0.045	15.1
	0.282690	0.000009	0.001092	0.000009	0.039	17.5
	0.282668	0.000010	0.001135	0.000007	0.042	16.6
	0.282702	0.000009	0.001320	0.000022	0.049	16.2
	0.282679	0.000010	0.001957	0.000012	0.079	15.0
	0.282692	0.000011	0.001483	0.000019	0.056	16.9
	0.282693	0.000010	0.000848	0.000004	0.032	15.9
	0.282697	0.000011	0.000837	0.000011	0.035	17.0
	0.282680	0.000009	0.000783	0.000003	0.034	17.8
	0.282688	0.000009	0.001186	0.000002	0.055	19.6
	0.282691	0.000015	0.001340	0.000009	0.052	18.7
	0.282696	0.000019	0.000963	0.000020	0.036	18.6
	0.282673	0.000009	0.000822	0.000019	0.031	18.1
	0.282671	0.000009	0.001266	0.000016	0.050	18.6
	0.282685	0.000010	0.000817	0.000021	0.032	20.2
	0.282669	0.000009	0.001265	0.000014	0.051	20.0
	0.282679	0.000008	0.000786	0.000013	0.029	20.7
	0.282673	0.000010	0.001320	0.000031	0.052	20.1
	0.282665	0.000007	0.001281	0.000001	0.052	23.1
average ± 2 s.d.	**0.282683**	**0.000025**	0.001126	**0.00065**		
Solution ± 2 s.d.	**0.282686**	**0.000008**	**0.001090**		(*S12*)	
<u>Mud Tank</u>	0.282501	0.000007	0.000007	0.00000004	0.0003	20.2
	0.282492	0.000007	0.000006	0.00000006	0.0003	25.7
	0.282504	0.000006	0.000006	0.00000005	0.0004	23.8
	0.282492	0.000007	0.000024	0.00000008	0.0011	20.8
	0.282501	0.000006	0.000026	0.00000014	0.0011	24.8
	0.282509	0.000007	0.000006	0.00000005	0.0003	18.0
	0.282506	0.000006	0.000016	0.00000058	0.0007	19.3
	0.282496	0.000011	0.000023	0.00000006	0.0009	14.5
	0.282501	0.000010	0.000006	0.00000006	0.0003	15.5
	0.282510	0.000008	0.000005	0.00000012	0.0002	18.8
	0.282483	0.000007	0.000026	0.00000009	0.0011	18.1
	0.282494	0.000007	0.000026	0.00000010	0.0011	21.1
	0.282491	0.000008	0.000025	0.00000010	0.0011	19.2
	0.282492	0.000007	0.000026	0.00000010	0.0011	20.3
	0.282487	0.000006	0.000026	0.00000010	0.0011	20.6
	0.282490	0.000006	0.000027	0.00000010	0.0011	22.7
	0.282484	0.000007	0.000027	0.00000008	0.0011	21.5
	0.282478	0.000007	0.000027	0.00000006	0.0012	17.0
	0.282495	0.000007	0.000014	0.00000021	0.0009	19.8
	0.282499	0.000007	0.000021	0.00000096	0.0020	21.4
	0.282508	0.000007	0.000025	0.00000006	0.0011	23.0
	0.282503	0.000006	0.000025	0.00000009	0.0011	23.7
	0.282494	0.000007	0.000016	0.00000004	0.0006	22.8
	0.282493	0.000008	0.000024	0.00000006	0.0010	17.8
	0.282506	0.000008	0.000024	0.00000008	0.0010	18.1
	0.282486	0.000009	0.000024	0.00000007	0.0010	17.4
	0.282486	0.000004	0.000013	0.00000077	0.0005	18.2
	0.282486	0.000007	0.000024	0.00000007	0.0010	20.2
	0.282490	0.000007	0.000023	0.00000007	0.0011	24.7

	0.282509	0.000011	0.000014	0.00000016	0.0007	19.8
	0.282496	0.000007	0.000016	0.00000005	0.0008	21.4
	0.282484	0.000007	0.000016	0.00000004	0.0007	23.5
average ± 2 s.d.	**0.282495**	**0.000017**	0.000019	**0.000015**		
Solution ± 2 s.d.	**0.282507**	**0.000006**	0.000042		(*S12*)	
<u>CZ3</u>	0.281712	0.000005	0.000034	0.00000005	0.0014	23.8
	0.281706	0.000005	0.000034	0.00000004	0.0014	24.6
	0.281712	0.000005	0.000034	0.00000013	0.0014	23.0
	0.281708	0.000006	0.000034	0.00000008	0.0014	23.6
average ± 2 s.d.	**0.281710**	**0.000006**	0.000034	**0.0000002**		
Solution ± 2 s.d.	**0.281732**	**0.000007**	0.000034*		(*S14*)	

Table S4. Laser ablation Lu-Hf isotope data for standard zircons acquired during this study. The data are reported relative to JMC475 $^{176}Hf/^{177}Hf$ = 0.282160 to facilitate comparison with the solution values quoted in the literature (* laser ablation value of ref. S14).

Suite	**Sr ppm**	**initial $^{87}Sr/^{86}Sr$**	**Nd ppm**	**initial $^{143}Nd/^{144}Nd$**
1. Cobargo				
Gabbro	442	0.70464	19.0	0.512185
Sediment melt	81	0.71704	22.0	0.511610
Gabbro + 15% sed. melt	388	0.70502	19.5	0.512087
Observed average tonalite	**396**	**0.70511**	**19.4**	**0.512087**
2. Why Worry				
Gabbro	353	0.70591	21.1	0.512134
Sediment	79	0.71652	41.9	0.511603
Gabbro + 49% sediment	220	0.70776	31.2	0.511788
Observed average tonalite	**243**	**0.70784**	**30.4**	**0.511788**
3. Jindabyne				
Gabbro	356	0.70567	12.3	0.511975
S-type melt	81	0.71287	22	0.511664
Gabbro + 31% S-type melt	271	0.70634	15.3	0.511837
Observed tonalite	**234**	**0.70601**	**15.6**	**0.511837**

Table S5. Isotope mixture modelling for the three granite suites using end-members defined by the zircon Hf-O isotope arrays. The average proportion of supracrustal material was determined iteratively by matching the Nd isotope ratios of the mixture with that observed in each granite suite. The satisfactory fits obtained for Nd and Sr concentrations, and for initial $^{87}Sr/^{86}Sr$ ratios, provide confidence in this approach. Sr and Nd isotope ratios and concentration data are from A.I.S. Kemp and C.M. Gray (unpublished data).