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Negligible surface uplift following foundering of thickened Central Tibetan lower crust

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FIGURES

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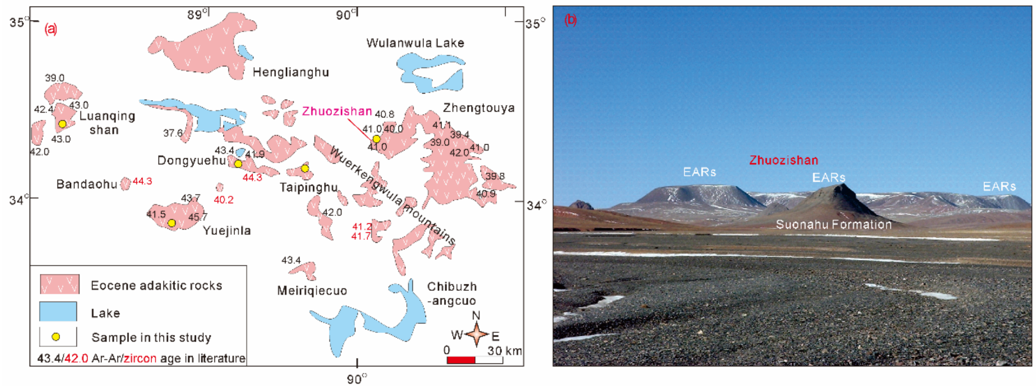
FIGURES

Figure S1-(a) simplified geological map showing the sample location; (b) Filed photo showing EARs overlying on early Tertiary fluviolacustrine strata (Suonahu Formation) that occurs as flat beds and experienced little or no N-S shortening in the Zhuozishan region at modern elevation of ~5200m. The depositional age of Suonahu Formation is a long time of debate, but has been recently well constrained by SIMS (secondary ion mass spectroscopy) zircon U–P b dating (46.57 ± 0.30 Ma) of bentonite layers drilled at 220.8~220.95m depth in the Bandonghu region (Wang et al., 2019). This demonstrates that shortening ceased, and that low-relief topographic conditions were achieved in this region by ~46 Ma.



Reference

Wang, J., Zeng, S.Q., Fu, X.G., Chen, W.B., Dai, J., Ren, J., 2019, New evidence for deposition age of the Suonahu Formation in the Qiangtang Basin. Geological Bulletin of China, 2019, 38(7),1256–1 258.

Figure S2-Microphotograph for the EARs in this study (Fig. i is under backscattered electron images). Cpx = clinopyroxene, Pl = plagioclase, Bi = biotite, Q = quartz, Am = amphibole, Sa = sanidine. The red line in Fig. i shows the compositional profile measured by EPMA. The results are listed in Table S5, which show similar variational trend with YJL-24 (not shown).

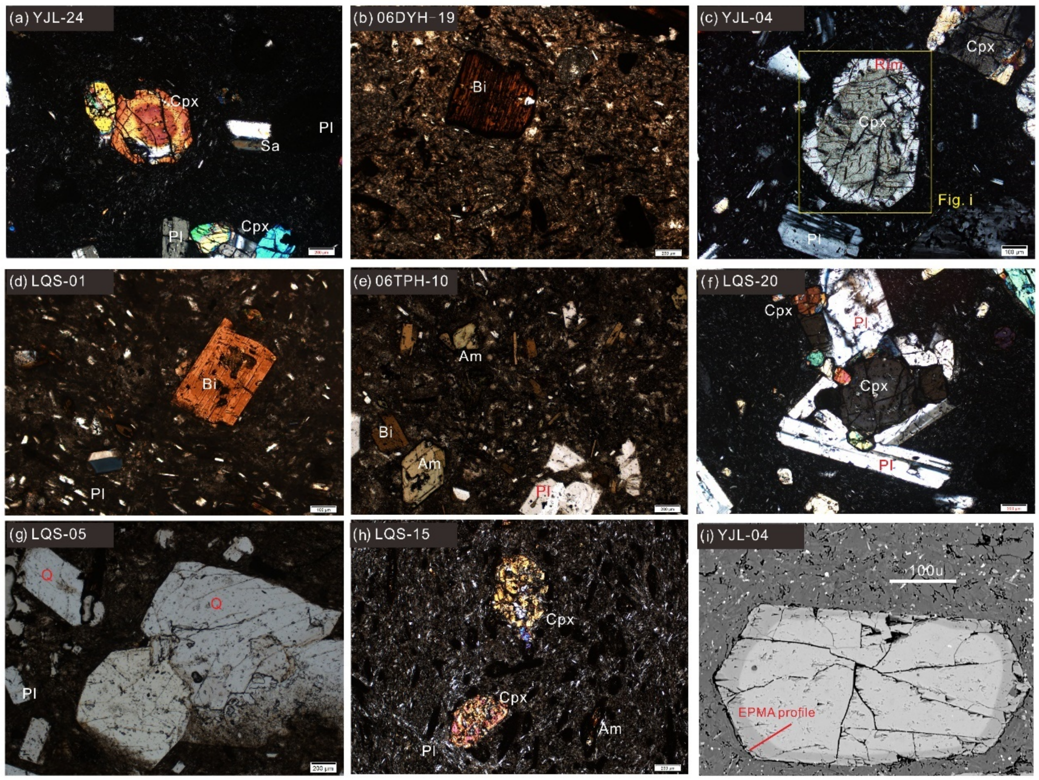


Figure S3-Zircon concordant U–Pb age and representative cathodoluminescence images for the EARs. The yellow, red and blue circles in Fig. e show the positions for U–Pb, Lu–Hf and O isotope analysis, respectively.

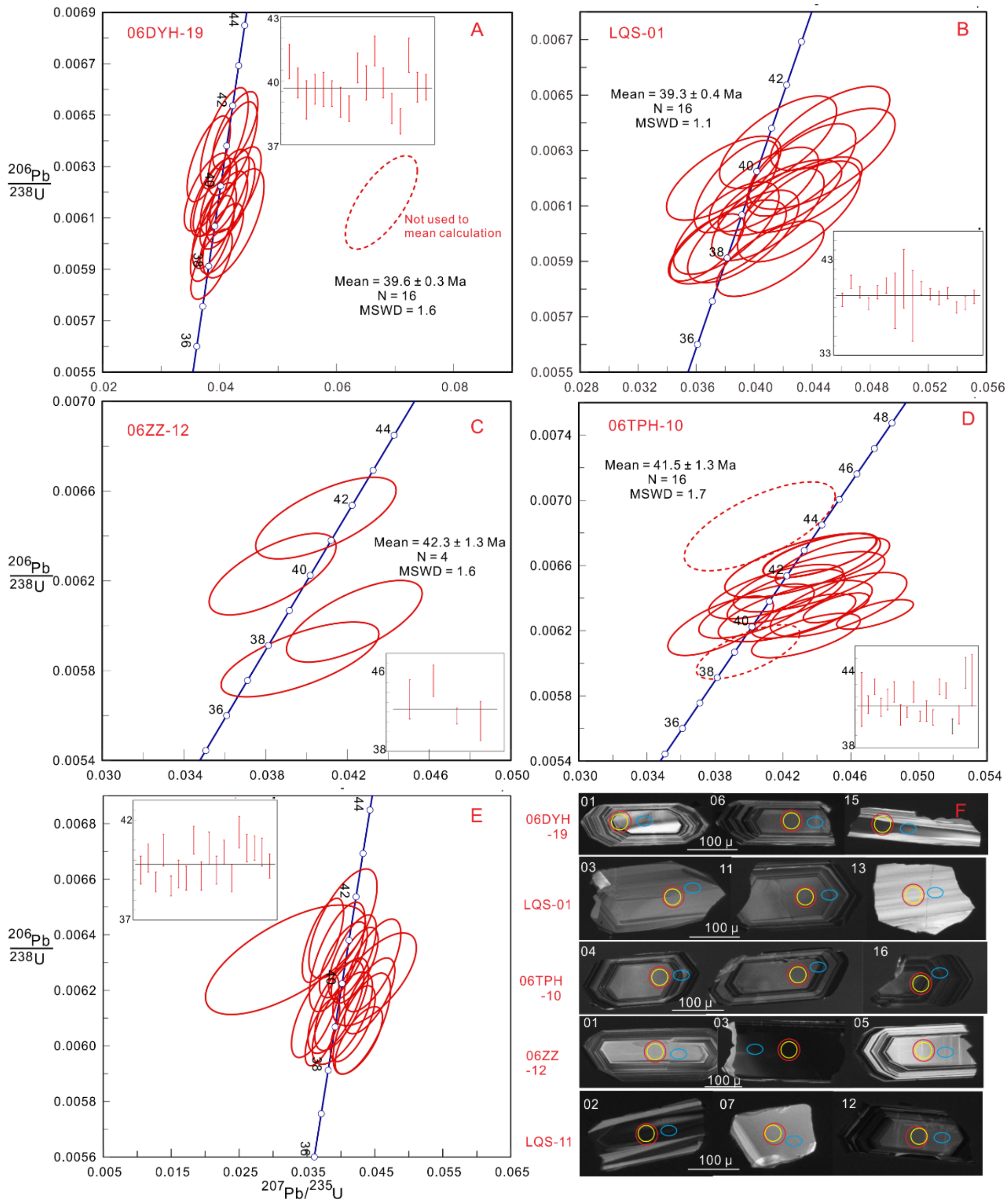
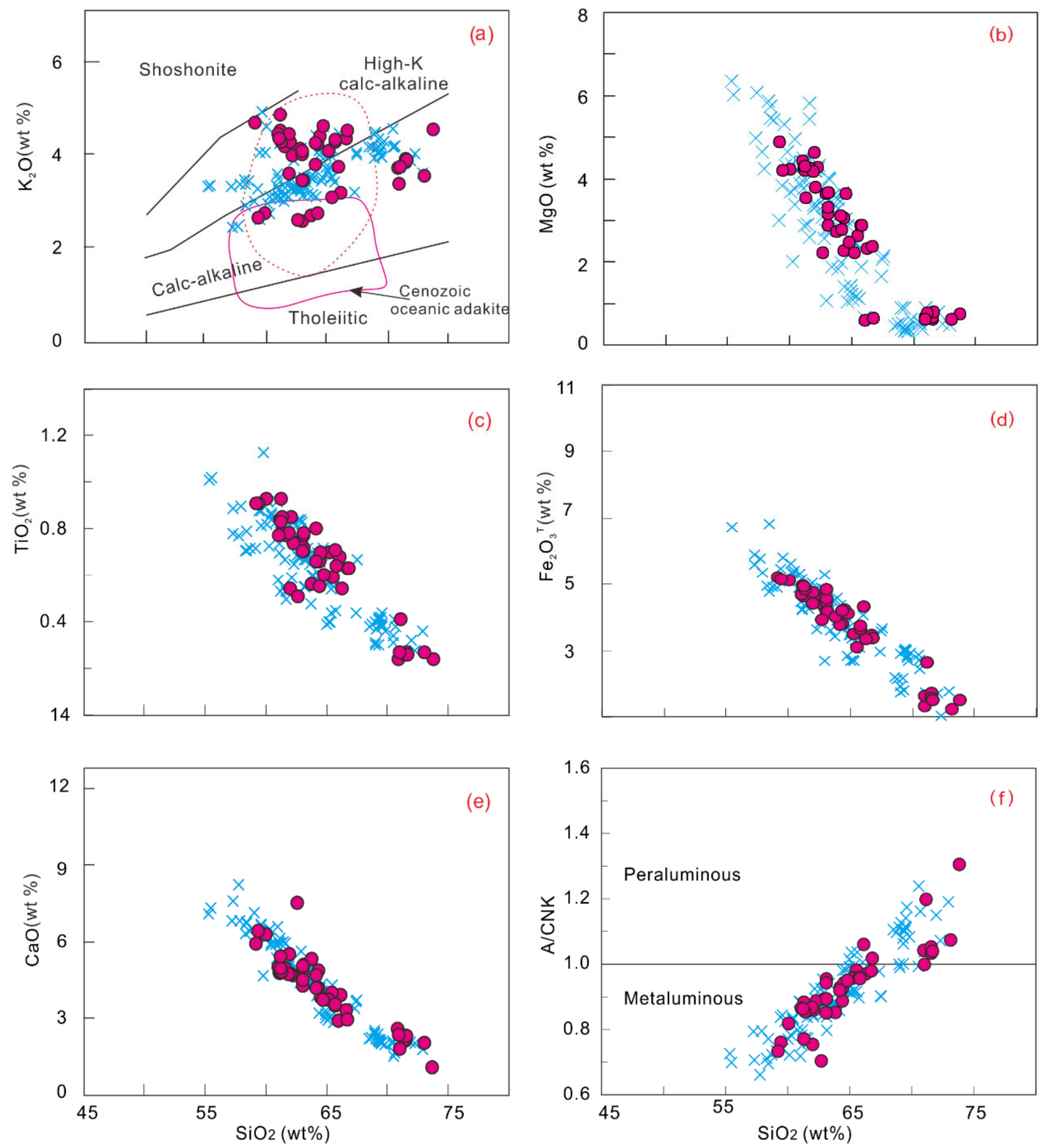


Figure S4- Selective elemental hacker diagram for the EARs. The data for the published EARs are given in the Table S7. The data for the oceanic adakites are from Castillo (2012). Although not shown here, the trace elements, like Y, Zr, Th and Ba of the EARs are also in good correlation with SiO_2. The A/CNK in Fig. f refers to peraluminous index (A/CNK = molar proportions $Al_2O_3/(Na_2O + K_2O + CaO)$). The positive correlation between A/CNK and SiO2 indicate sediment assimilation with possible impact of fractional crystallization (e.g., removal of amphibole; Clemens et al., 2011).



References:

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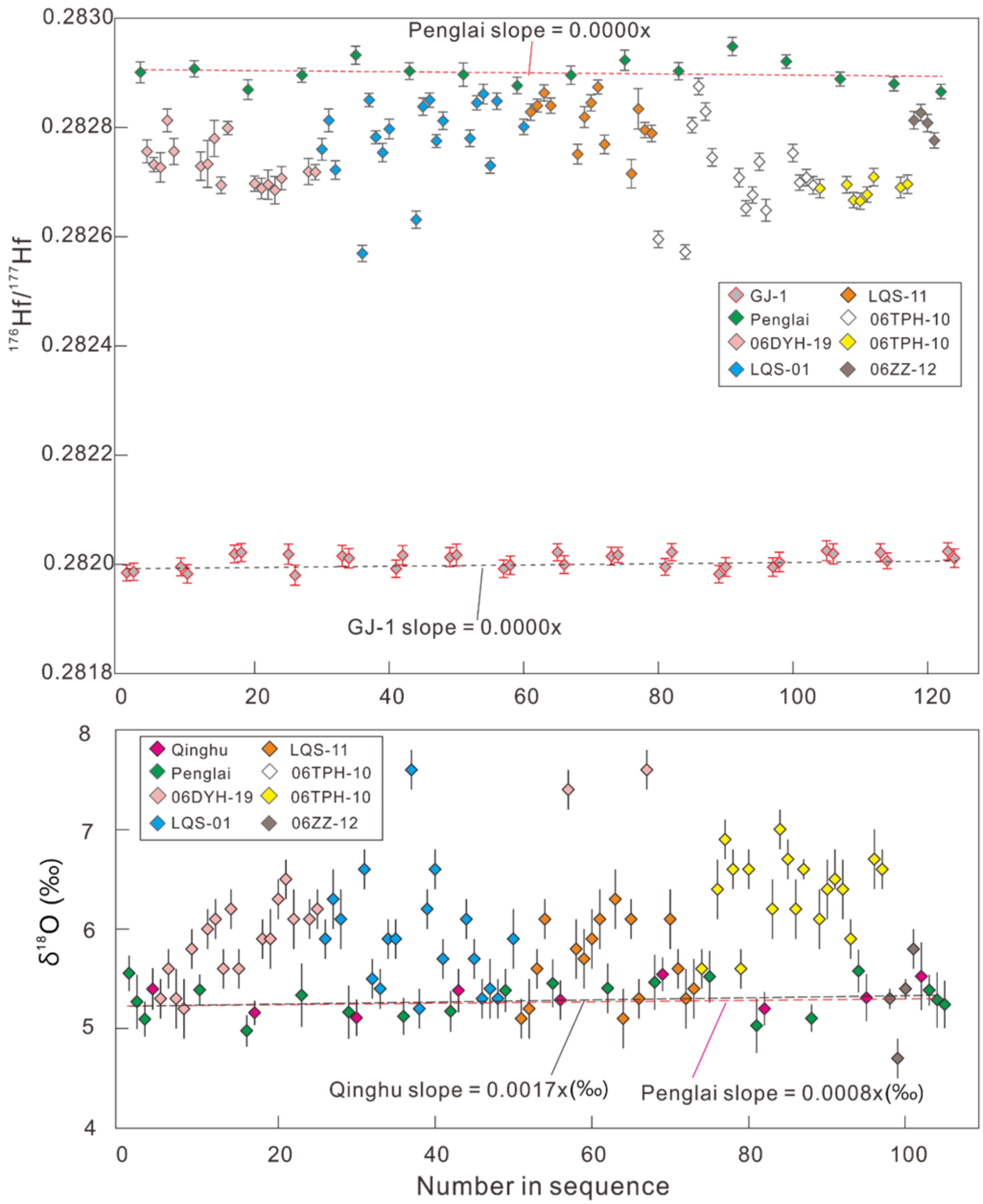
Clemens, J.D., Stevens, G., Farina, F., The enigmatic sources of I-type granites: The peritectic connexion, 2011: Lithos, v. 126, p. 174–181, https://doi:10.1016/j.lithos.2011.07.004.

Figure S5-Sample-standard bracketing of measured Hf and O isotopic results during analyses.



APPENDIX. EXPERIMENTAL METHODS

In-Situ Zircon U–Pb, Lu–Hf And O Isotope Analysis

Zircon grains were separated by standard density and magnetic separation techniques, and individually selected by hand-picking under a binocular microscope. Zircon grains were then inlaid in epoxy blocks, and polished to smooth surface. Cathodoluminescence (CL) images are used to select the appropriate grains for analysis. Zircon U–Pb isotope analyses were performed by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) at the Guangxi Key Laboratory of Hidden Metallic Ore Deposits Exploration, Guilin University of Technology (GUT), Guilin, China. Laser sampling was performed using a Coherent GeoLas 193 ArF excimer. An Agilent 7500a ICP-MS instrument was used to acquire ion-signal intensities. Detailed metadata related to the laboratory and sample preparation methods, following the guidelines in http://www.plasmage.org/recommendations and recommended in Horstwood et al. (2016) and thte metadata of LA-MC-ICPMS U-Pb and Lu-Hf data used are listed in Table S8. Helium was used as a carrier gas. Argon was used as the make-up gas and mixed with the carrier gas via a T-connector before entering the ICP. Following about 20 s period of background analysis, samples were spot ablated for 60 s at a 6 Hz repetition rate with a spot size of 32 μm beam and laser energy of 10 J/cm^{-2} at the sample surface. Plesovice zircon standard ($^{206}Pb/^{238}U$ age = 337 Ma; Slám et al., 2008) and NIST 610 were used as isotope and trace elements external standards, respectively. GJ-1 standard zircon ($^{206}Pb/^{238}U$ age = 608.5 ± 0.4; Jackson et al., 2004) was used as isotope internal standards and unknow samples. Off-line inspection and integration of background and analyte signals, and time-drift correction and quantitative calibration for trace element analyses and U-Pb dating were performed using ICPMSDataCal software (Liu et al., 2008; Liu et al., 2010), and the results were reported with 2σ errors. Reported uncertainties (2σ) of the $^{206}Pb/^{238}U$ ratio were propagated by quadratic addition of the external reproducibility (2 SD%) of standard zircon Plesovice during the analytical session and the within-run precision of each analysis (2 SE%; standard error) (Liu et al. 2008; Liu et al., 2010). The common Pb was corrected using the method proposed by Andersen (2002). Final assessment of uncertainty, concordia diagrams and weighted mean calculation were done by using Isoplot ExcelTM (Ludwig, 2012) and following the recommendation of Horstwood et al. (2016) and Spencer et al. (2016). Errors are quoted at the 2σ level. During the course of this study, the analyzed GJ-1 standard zircon grains yielded a weighted $^{206}Pb/^{238}U$ age of 605 ± 3 Ma (2 σ, MSWD = 0.4, n = 24; Table S1), which is in agreement with the recommended U–Pb age in allowed precision. One spot of 06DYH-19 is discordant, and two spots of sample 06TPH-10 have $^{206}Pb/^{238}U$ age that are overdispersion as defined by Spencer et al. (2016), which are therefore are not used to calculate the weighted averages.

Zircon Lu-Hf isotopes are performed by using a Neptune Plus MC–ICP-MS equipped with a laser ablation system at GST. The Lu–Hf isotopic measurements were made on the spots which were previously analyzed for U–Pb ages as much as possible. The analyses were conducted with a beam diameter of 44 μm. Normally, a signal intensity of >5 V at ^{180}Hf mass can be obtained using the laser repetition rate of 6 Hz with energy of 10 Jcm^{-2}. The ablated material was transported in a helium carrier gas with addition of a small flow of nitrogen. Data acquisition for each analysis consists of 20 s period of background analysis and about 47 s period of laser ablation. The measured isotopic ratios of $^{176}Hf/^{177}Hf$ were normalized to $^{179}Hf/^{177}Hf$ = 0.7325, using exponential correction for mass bias. In order to obtain accurate $^{176}Hf/^{177}Hf$ ratios, the isobaric interferences of ^{176}Lu and ^{176}Yb on ^{176}Hf must be corrected. The ratios of $^{176}Lu/^{175}Lu$ = 0.02655, $^{172}Yb/^{176}Yb$＝0.5886, βYb = 0.8725×βHf obtained during Hf analysis on the same spot were used in the isobaric interference correction. Two GJ-1 and one Penglai zircon standard were analyzed after every five specimens as isotope external standards and unknown samples, respectively. The $^{176}Hf/^{177}Hf$ value for GJ-1 zircon grains during the analytical session ranges from 0.281984 ± 19 to 0.282025 ± 18 with a weighted average value of 0.282005 ± 0.000005 (2σ; MSWD = 0.75; n = 32), consistent with the reference value of 0.282015 ± 0.000019 (2σ) within the analytical error (Elhlou et al., 2006). The $^{176}Hf/^{177}Hf$ value of analyzed Penglai zircon grains ranges from 0.282869 ± 16 to 0.282921 ± 17 with a weighted average value of 0.282897 ± 9 (2σ, n = 16, MSWD = 0.52), which is consist with the reference value within analytical errors (0.282906 ± 0.000010; Li et al., 2010). The stable $^{178}Hf/^{177}Hf$ and $^{180}Hf/^{177}Hf$ ratios of GJ-1 grains yielded values of 1.46716 ± 0.00008 and 1.88683 ± 0.00009 (2σ, n = 32), the stable $^{178}Hf/^{177}Hf$ and $^{180}Hf/^{177}Hf$ ratios of PengLai grains yielded values of 1.46745 ± 11 and

1.88618 ± 11 (2σ, n = 16), respectively, and are within 200 ppm of known values based upon atomic masses and abundances as recommended by Spencer et al. (2020). Thus, these data demonstrate the instrument was working properly.

Zircon oxygen isotopes were measured using Cameca IMS 1280 large–radius SIMS (Secondary Ion Mass Spectroscopy) at Guangzhou Institute of Geochemistry, Chinese Academy of Sciences (GIGCAS). The detailed analytical procedures were similar with those described by Li et al. (2010). The normal–incidence electron flood gun was used to compensate for sample charging during analysis with homogeneous electron density over a 100 μm oval area. Negative secondary ions were extracted with a –10 kV potential. The field aperture was set to 5000 μm, and the transfer–optics magnification was adjusted to give a field of view of 125 μm (FA=8000). Energy slit width was 30 eV, the mechanical position of the energy slit was controlled before starting the analysis (5 eV gap, –500 digits with respect to the maximum). The entrance slit width is ~120 μm and exit slit width for multicollector Farady cups (FCs) for 16O and ^{18}O is 500 μm (MRP = 2500). The intensity of ^{16}O was typically 1×109 cps. Oxygen isotopes were measured in multi–collector mode using two off–axis Faraday cups. The NMR (Nuclear Magnetic Resonance) probe was used for magnetic field control with stability better than 2.5 ppm over 16 h on mass 17. One analysis takes ~4 minutes, consisting of pre–sputtering (~120 s), automatic beam centering (~60 s) and integration of oxygen isotopes (10 cycles×4 s, total 40 s). Uncertainties on individual analyses are reported at a 2σ level. With low noise on the two FC amplifiers, the internal precision of a single analysis is generally better than 0.3‰ (2σ) for $^{18}O/^{16}O$ ratio. Values of $\delta^{18}O$ are standardized to Vienna Standard Mean Ocean Water compositions (VSMOW) and reported in standard per mil notation. The measured oxygen isotopic data were corrected for instrumental mass fractionation using the Penglai zircon standard ($\delta^{18}O_{VSMOW}$ = 5.31 ± 0.10 ‰) (Li et al., 2010). The PengLai zircon standard during the course of this study yield a weighted mean of $\delta^{18}O$ = 5.27 ± 0.09 ‰ (2 σ, MSWD = 0.84, n = 20; Table S1), which is identical within errors to the recommended value (Li et al., 2010). Measured $^{18}O/^{16}O$ is normalized using VSMOW, then corrected for the instrumental mass fractionation factor (IMF) as follows: $(\delta^{18}O)M = ((^{18}O/^{16}O)_M/0.0020052 - 1) \times 1000$ (‰); IMF = $(\delta^{18}O)_{M(standard)} - (\delta^{18}O)_{VSMOW}$; $\delta^{18}O_{sample} = (\delta^{18}O)_M$ + IMF. Besides, Qinghu zircon grains analyzed as unknown samples yielded a weighted mean of $\delta^{18}O$ = 5.28 ± 0.12 ‰ (2 σ, MSWD = 0.70, n = 9; Table S3), which is consistent with the recommended value of 5.4 ± 0.2 ‰ within analytical errors (Li et al., 2013). Results of Hf and O isotope data of standard and samples are graphically plotted in Fig. S5.

Bulk-Rock Element and Sr-Nd Isotope Analysis

Bulk-rock geochemical data were performed at GIGCAS. Firstly, fresh sample were crushed into small grains (~0.5 cm), and soaked in water with <3% HNO_3 until no bubbles were observed. Then, these small grains were further crushed into 200 meshes in an agate mortar. About 1.2 g rock powder were baked in the muffle furnace for more than 3 hours at 915 °C to determine the loss-on-ignition (LOI) value. Then about 0.5 g baked samples were fluxed with $Li_2B_4O_7$ (1:8) at ~1200°C to make homogeneous glass disks for major elements determination with a Rigaku ZSX100e X-ray fluorescence spectrometer (XRF). During analysis, USGS rock reference materials (GSR-1, GSR-2 and GSR-3) were used to monitor the data quality. The analytical uncertainties are estimated at 1-5%.

For trace elements analysis, 35–45 mg sample powders were dissolved in Teflon bakers using a hybrid acid for 2–3 days (HF, HNO_3 and $HClO_4$ proportions are 2:2:1) at 120 °C. Then the solutions were dried and the residues were dissolved using the same hybrid acid again and moved in the high-pressure bombs at 190 °C for 48 hours. After that, the sample solutions were dried again and dissolved with 50% HNO_3 in the bombs at 170 °C for 4 hours. Subsequently, the sample solutions were diluted by 3% HNO_3 to 2000 times. Then, about 2.5g diluted solution was mixed with the internal standard solution (pure single element Rh solution) at 1:1 ratio. Finally, the hybrid solutions were used to trace-element data measures by inductively coupled plasma-mass spectrometry (ICP-MS). During the procedure, USGS international materials (BHVO-2, AGV-1, GSR-1, GSR-2, GSR-3, W-2, SY-4) and two blank samples were taken as the external calibration standards. The analytical precision was generally better than 10%.

Powdered samples (~100 mg) for Sr and Nd isotopic analyses were dissolved using an acidic mixture of HF and HNO_3 (1:3) for 7 days at 120 °C in PFA beakers. The Sr-REE and Nd-REE separation were performed using cationic ion-exchange columns and HDEHP columns, respectively. The powders for Hf isotopic analysis were dissolved by alkali fusion method which a mixture of about 0.5 g rock powders and 1.0 g $Li_2B_4O_7$ was made into glass disk similar with that of the major element analysis. Then the powders of alkali glass were dissolved in 2 M HCl at ~60 °C for about 2 hours. Hf fraction was separated by using a modified single-column Ln extraction chromatography method. The Sr–Nd isotopic data were obtained on multi-collector inductively-coupled plasma mass spectrometer (MC-ICP-MS) at GIGCAS, and normalized values are $^{86}Sr/^{88}Sr = 0.1194$ and $^{146}Nd/^{144}Nd = 0.7219$, respectively, while the $^{87}Rb/^{86}Sr$ and $^{147}Sm/^{144}Nd$ ratios were calculated from abundances of these trace elements measured by ICP-MS. The analytical procedure method is the same as in Chen et al. (2010).

In-situ cpx composition Analysis

Major elements were measured on individual minerals using a JEOL JXA-8100 electron microscope (EPMA) with an accelerating potential of 15 kV and sample current of 10 nA at the Institute of Geology and Geophysics, Chinese Academy of Sciences (IGGCAS). The detailed method has been described in Liu et al. (2010).

The major and trace elements of cpx were also measured using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) with a spot size of 35 μm at the State Key Laboratory of Geological Process and Mineral Resource, China University of Geology (Wuhan). Detailed operating conditions for the laser ablation system and the ICP-MS instrument were described previously (Liu et al., 2008) and are the same with later studies like Zou et al. (2014). Off-line selection and integration of the background and the analyzed signals, along with time-drift correction and quantitative calibration, were performed by ICPMSDataCal (Liu et al., 2008, 2010).

Notably, within the analytical errors, the major elements obtained by EPMA and LA-ICP-MS in the same position are comparable, therefore both of them are used to discussion directly.

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TABLES

Table S1-Zircon U-Pb isotope data for the EARs

No	Pb	Th	U	Th/U	^{207}Pb/^{235}U (Ratio)	± 2σ	^{206}Pb/^{238}U (Ratio)	± 2σ	^{207}Pb/^{235}U (Ma)	± 2σ	^{206}Pb/^{238}U (Ma)	± 2σ
06DYH-19: Mean = 39.4 ± 0.6 Ma, N = 16,（spot 05 is not used）MSWD = 1.6												
01	15	491	1072	0.46	0.04223	0.00278	0.00637	0.00012	42.0	2.7	40.9	0.8
02	16	434	1267	0.34	0.04089	0.00275	0.00620	0.00011	40.7	2.7	39.9	0.7
03	7	201	586	0.34	0.04620	0.00346	0.00609	0.00014	45.9	3.4	39.1	0.9
04	9	217	782	0.28	0.04189	0.00273	0.00617	0.00011	41.7	2.7	39.6	0.7
05	17	382	1098	0.35	0.06765	0.00407	0.00616	0.00012	66.5	3.9	39.6	0.8
06	35	1577	1966	0.80	0.04072	0.00268	0.00613	0.00010	40.5	2.6	39.4	0.6
07	21	717	1584	0.45	0.03908	0.00248	0.00607	0.00011	38.9	2.4	39.0	0.7
08	25	976	1692	0.58	0.04033	0.00246	0.00602	0.00009	40.2	2.4	38.7	0.6
09	17	535	1339	0.40	0.03813	0.00244	0.00633	0.00011	38.0	2.4	40.6	0.7
10	46	1862	2770	0.67	0.0379	0.0026	0.0062	0.0001	37.8	2.5	39.9	0.8
11	21	740	1387	0.53	0.04269	0.00255	0.00644	0.00010	42.4	2.5	41.4	0.7
12	18	565	1297	0.44	0.04270	0.00290	0.00621	0.00011	42.5	2.8	39.9	0.7
13	22	705	1611	0.44	0.03875	0.00247	0.00602	0.00011	38.6	2.4	38.7	0.7
14	28	969	2044	0.47	0.03863	0.00233	0.00592	0.00009	38.5	2.3	38.1	0.6
15	12	331	857	0.39	0.04081	0.00270	0.00641	0.00013	40.6	2.6	41.2	0.8
16	14	322	1291	0.25	0.03900	0.00261	0.00618	0.00010	38.8	2.6	39.7	0.7
17	20	650	1556	0.42	0.03919	0.00243	0.00618	0.00010	39.0	2.4	39.7	0.6
LQS-01: Mean = 39.3 ± 0.4Ma, n = 16, MSWD = 1.1												
01	10.2	488	270	1.81	0.0379	0.0026	0.0062	0.0001	41.2	2.7	38.8	0.7
02	15	73	179	0.41	0.27379	0.01692	0.03669	0.00077	246	13.5	232.3	4.8
03	15	390	1211	0.32	0.04165	0.00266	0.00633	0.00011	41.4	2.6	40.7	0.7
04	90	674	941	0.72	0.20650	0.00811	0.03314	0.00053	191	6.8	210	3.3
05	22	880	1422	0.62	0.04067	0.00248	0.00616	0.00010	40.5	2.4	39.6	0.6
06	10	242	945	0.26	0.03820	0.00265	0.00597	0.00010	38.1	2.6	38.4	0.6
07	21	431	2118	0.20	0.03879	0.00192	0.00617	0.00011	38.6	1.9	39.6	0.7
08	8	93	890	0.10	0.04466	0.00333	0.00627	0.00012	44.4	3.2	40.3	0.8
09	15	332	1524	0.22	0.03808	0.00240	0.00602	0.00011	37.9	2.3	38.7	2.9
10	18	523	1507	0.35	0.04524	0.00271	0.00638	0.00010	44.9	2.6	41.0	3.1
11	47	1960	2807	0.70	0.03670	0.00172	0.00595	0.00008	36.6	1.7	38.2	3.7
12	18	539	1346	0.40	0.04325	0.00248	0.00623	0.00011	43.0	2.4	40.0	0.7
13	7	86	805	0.11	0.04178	0.00281	0.00613	0.00009	41.6	2.7	39.4	0.6
14	21	134	263	0.51	0.22023	0.01118	0.03341	0.00052	202	9.3	212	3.2
16	14	313	1346	0.23	0.04095	0.00255	0.00607	0.00011	40.8	2.5	39.0	0.7
17	12	476	768	0.62	0.04338	0.00268	0.00614	0.00009	43.1	2.6	39.5	0.6
18	18	262	2125	0.12	0.04111	0.00244	0.00591	0.00009	40.9	2.4	38.0	0.6
19	6	143	658	0.22	0.03925	0.00253	0.00599	0.00011	39.1	2.5	38.5	0.7
20	23	590	1975	0.30	0.04308	0.00279	0.00608	0.00012	42.8	2.7	39.1	0.7
06ZZ-12: Mean = 42.3 ± 1.3 Ma, n = 4, MSWD = 1.6												
01	29	216	293	0.74	0.24968	0.01329	0.03353	0.00061	226	10.8	213	3.8
02	121	879	1113	0.79	0.22004	0.00947	0.03485	0.00047	202	7.9	221	3.0
03	66	455	685	0.66	0.24611	0.01218	0.03561	0.00059	223	9.9	226	3.7
04	47	1302	3842	0.34	0.04234	0.00219	0.00602	0.00012	38.7	0.8	43.3	2.0
05	11	379	772	0.49	0.04095	0.00227	0.00648	0.00012	40.8	2.2	41.6	0.8
06	52	1613	4178	0.39	0.03968	0.00255	0.00585	0.00011	37.6	0.7	41.1	2.0
08	91	2678	6911	0.39	0.03834	0.00205	0.00623	0.00012	40.0	0.8	45.2	1.6

06TPH-10: Mean = 41.5 ± 0.3 Ma, n = 16 (spots 15 and 17 are not used), MSWD = 1.7												
01	19	432	1727	0.25	0.03995	0.00201	0.00607	0.00011	39.0	0.7	41.8	2.1
02	16	337	1480	0.23	0.04159	0.00261	0.00644	0.00011	41.4	2.5	41.4	0.7
03	18	412	1706	0.24	0.04418	0.00222	0.006662	0.00009	43.9	2.2	42.8	0.6
04	24	648	2252	0.29	0.04219	0.00229	0.00641	0.00011	42.0	2.2	41.2	0.7
05	28.5	654	2739	0.24	0.04354	0.00294	0.00650	0.000122	43.3	2.9	41.8	0.8
06	22	421	1985	0.21	0.04316	0.00302	0.00660	0.00013	42.9	2.9	42.4	0.8
07	27.3	391	2805	0.14	0.04273	0.00299	0.00632	0.000124	42.5	2.9	40.6	0.8
08	33.0	985	2216	0.44	0.04513	0.00128	0.00634	0.00006	44.8	1.2	40.8	0.4
09	20	398	2004	0.20	0.04316	0.00302	0.00660	0.00013	42.9	2.9	42.4	0.8
10	24.0	482	2314	0.21	0.04741	0.00149	0.00630	0.00006	47.0	1.4	40.5	0.4
11	23.5	610	2331	0.26	0.04527	0.00265	0.00636	0.00013	45.0	2.6	40.9	0.8
12	23	482	2436	0.20	0.04323	0.00202	0.00629	0.00009	43.0	2.0	40.4	0.6
13	17	339	1785	0.19	0.04417	0.00219	0.00666	0.00009	43.9	2.1	42.8	0.6
14	28.4	624	2538	0.25	0.04491	0.00222	0.00662	0.00010	44.6	2.2	42.5	0.6
15	39.7	1109	3239	0.34	0.04336	0.00211	0.00617	0.00009	43.1	2.1	39.7	0.6
16	19.9	396	1918	0.21	0.04045	0.00224	0.00632	0.00011	40.3	2.2	40.6	0.7
17	47	1302	3842	0.34	0.04064	0.00293	0.00684	0.00018	40.5	2.9	43.9	1.2
18	91	2678	6911	0.39	0.03834	0.00205	0.00623	0.00012	38.7	0.8	43.3	2.0
LQS-11: Mean = 39.8 ± 0.3 Ma, n = 18, MSWD = 1.5												
01	44	1798	2626	0.68	0.04011	0.00261	0.00615	0.00011	39.9	2.5	39.5	0.7
02	20	775	1338	0.58	0.04495	0.00407	0.00624	0.00011	44.6	4.0	40.1	0.7
03	23	615	1952	0.32	0.03728	0.00168	0.00605	0.00008	37.2	1.6	38.9	0.5
05	18	553	1311	0.42	0.03186	0.00778	0.00631	0.00013	31.8	7.7	40.5	0.8
06	7	105	834	0.13	0.04262	0.00230	0.00602	0.00008	42.4	2.2	38.7	0.5
07	7	155	677	0.23	0.03622	0.00231	0.00611	0.00010	36.1	2.3	39.3	0.7
08	22	705	1664	0.42	0.04175	0.00218	0.00608	0.00009	41.5	2.1	39.1	0.6
09	20	389	1954	0.20	0.03735	0.00201	0.00638	0.00010	37.2	2.0	41.0	0.7
10	8	96	855	0.11	0.04022	0.00293	0.00610	0.00011	40.0	2.9	39.2	0.7
12	45	1808	2776	0.65	0.03946	0.00270	0.00632	0.00013	39.3	2.6	40.6	0.8
13	16	367	1589	0.23	0.03928	0.00272	0.00614	0.00011	39.1	2.7	39.5	0.7
14	15	396	1256	0.32	0.04204	0.00227	0.00629	0.00009	41.8	2.2	40.4	0.6
15	12	479	784	0.61	0.04308	0.00279	0.00608	0.00012	42.8	2.7	39.1	0.7
16	10	233	909	0.26	0.04030	0.00331	0.00644	0.00013	40.1	3.2	41.4	0.8
17	14	454	1015	0.45	0.04169	0.00232	0.00632	0.00010	41.5	2.3	40.6	0.7
18	15	411	1206	0.34	0.04036	0.00233	0.00631	0.00009	40.2	2.3	40.6	0.6
19	11	322	806	0.40	0.04464	0.00276	0.00629	0.00011	44.3	2.7	40.4	0.7
20	13	313	1245	0.25	0.04423	0.00245	0.00618	0.00009	43.9	2.4	39.7	0.6
GJ-1: Mean = 605 ± 3 Ma, n = 24, MSWD = 0.36												
GJ-1-01	26.0	8.2	325	0.03	0.81006	0.01501	0.09852	0.00127	602	8	606	7
GJ-1-02	26.6	8.6	337	0.03	0.81119	0.01491	0.09876	0.00126	603	8	607	7
GJ-1-03	26.4	8.5	331	0.03	0.81232	0.01605	0.09878	0.00116	604	9	607	7
GJ-1-04	26.5	8.6	332	0.03	0.80935	0.01564	0.09825	0.00117	602	9	604	7
GJ-1-05	26.4	8.6	333	0.03	0.79249	0.01533	0.09827	0.00110	593	9	604	6
GJ-1-06	25.7	8.4	332	0.03	0.81856	0.01755	0.09898	0.00103	607	10	608	6
GJ-1-07	25.7	8.3	331	0.03	0.80137	0.01731	0.09829	0.00116	598	10	604	7
GJ-1-08	26.3	8.4	336	0.03	0.79961	0.01624	0.09782	0.00124	597	9	602	7
GJ-1-09	27.3	8.6	343	0.03	0.79364	0.01535	0.09807	0.00117	593	9	603	7
GJ-1-10	27.9	9.2	310	0.03	0.80009	0.01803	0.09839	0.00105	597	10	605	6
GJ-1-11	26.6	9.1	307	0.03	0.80631	0.01729	0.09863	0.00106	600	10	606	6

GJ-1-12	24.3	9.4	317	0.03	0.81363	0.01612	0.09817	0.00122	604	9	604	7
GJ-1-13	24.0	9.3	317	0.03	0.79579	0.01691	0.09792	0.00115	594	10	602	7
GJ-1-14	25.4	9.6	325	0.03	0.78549	0.01656	0.09788	0.00122	589	9	602	7
GJ-1-15	25.1	8.1	321	0.03	0.79396	0.01593	0.09855	0.00121	593	9	606	7
GJ-1-16	25.7	8.3	329	0.03	0.80362	0.01671	0.09766	0.00114	599	9	601	7
GJ-1-17	29.8	8.3	335	0.02	0.80940	0.01809	0.09850	0.00136	602	10	606	8
GJ-1-18	26.4	7.7	314	0.02	0.80934	0.02385	0.09810	0.00168	602	13	603	10
GJ-1-19	26.1	8.2	327	0.03	0.81119	0.01491	0.09876	0.00126	603	8	607	7
GJ-1-20	26.5	8.5	333	0.03	0.81232	0.01605	0.09878	0.00116	604	9	607	7
GJ-1-21	26.3	8.5	332	0.03	0.80935	0.01564	0.09825	0.00117	602	9	604	7
GJ-1-22	26.6	8.5	333	0.03	0.79249	0.01533	0.09827	0.00110	593	9	604	6
GJ-1-23	26.3	8.4	328	0.03	0.81856	0.01755	0.09898	0.00103	607	10	608	6
GJ-1-24	28.2	8.5	332	0.03	0.80137	0.01731	0.09829	0.00116	598	10	604	7

Table S2-Lu-Hf and O isotope data for zircon grains from the EARs

Sample	$^{176}Yb/^{177}Hf$	$^{176}Lu/^{177}Hf$	$^{180}Hf/^{177}Hf$	± 2σ	$^{178}Hf/^{177}Hf$	± 2σ	$^{176}Hf/^{177}Hf$	± 2σ	$(^{176}Hf/^{177}Hf)_i$	$\varepsilon_{Hf}(t)$	$\delta^{18}O$	± 2σ
06DYH-19 Dacite (SiO2 = 63.1 wt%; Mg# = 61.8)												
@01	0.015	0.001	1.88721	0.00024	1.46724	0.00033	0.282756	0.000021	0.282756	0.3	5.3	0.2
@02	0.019	0.001	1.88644	0.00027	1.46695	0.0002	0.282732	0.000013	0.282731	-0.6	5.6	0.2
@03	0.026	0.001	1.88648	0.00028	1.46694	0.00024	0.282727	0.000027	0.282727	-0.7	5.3	0.3
@04	0.015	0.001	1.88682	0.00022	1.46713	0.00029	0.282813	0.000021	0.282813	2.2	5.2	0.3
@05	0.016	0.001	1.88722	0.00024	1.46736	0.00028	0.282756	0.000024	0.282755	0.3	5.8	0.2
@06	0.020	0.001	1.88694	0.00023	1.46717	0.00025	0.282729	0.000026	0.282728	-0.7	6.0	0.2
@07	0.021	0.001	1.88686	0.00024	1.46721	0.00016	0.282733	0.000043	0.282732	-0.5	6.1	0.2
@08	0.012	0.000	1.88676	0.0002	1.46692	0.00025	0.282780	0.000033	0.282780	1.1	5.6	0.2
@09	0.023	0.001	1.88704	0.00021	1.46701	0.00015	0.282694	0.000015	0.282694	-1.9	6.2	0.2
@10	0.021	0.001	1.88650	0.00016	1.46724	0.00024	0.282799	0.000012	0.282798	1.9	5.6	0.2
@11	0.019	0.001	1.88771	0.0002	1.46742	0.00024	0.282697	0.000014	0.282697	-1.8	5.9	0.2
@12	0.010	0.000	1.88679	0.00032	1.46718	0.00022	0.282688	0.000019	0.282688	-2.2	5.9	0.3
@13	0.022	0.001	1.88623	0.00023	1.46764	0.00027	0.282695	0.000027	0.282695	-1.9	6.3	0.2
@14	0.009	0.000	1.88790	0.00018	1.46723	0.00032	0.282685	0.000025	0.282685	-2.2	6.5	0.2
@15	0.020	0.001	1.88627	0.0003	1.46671	0.00026	0.282707	0.000021	0.282706	-1.5	6.1	0.3
@16	0.010	0.000	1.88563	0.00025	1.46656	0.00018	0.282719	0.000024	0.282719	-1.0	6.1	0.2
@17	0.019	0.001	1.88665	0.00024	1.46725	0.00023	0.282718	0.000014	0.282718	-1.0	6.2	0.2
LQS-01 Andesite (SiO2 = 62.0 wt%; Mg# = 65.9)												
@01	0.016	0.001	1.88694	0.00027	1.46722	0.00028	0.282760	0.000020	0.282760	0.3	5.9	0.2
@02	~~0.046~~	~~0.002~~	1.88695	0.00022	1.46720	0.00026	~~0.282813~~	~~0.000021~~	~~0.282811~~	~~2.3~~	~~6.3~~	~~0.3~~
@03	0.011	0.000	1.88664	0.00023	1.46675	0.00028	0.282722	0.000017	0.282722	-1.0	6.1	0.3
@04	~~0.014~~	~~0.001~~	1.88704	0.00026	1.46724	0.00026	~~0.282569~~	~~0.000015~~	~~0.282569~~	~~-6.3~~	~~6.6~~	~~0.2~~
@05	0.012	0.001	1.88780	0.00025	1.46749	0.00033	0.282850	0.000012	0.282850	3.6	5.5	0.2
@06	0.032	0.001	1.88788	0.00024	1.46710	0.0002	0.282782	0.000012	0.282781	1.2	5.4	0.2
@07	0.034	0.002	1.88797	0.0002	1.46732	0.00018	0.282754	0.000017	0.282753	0.2	5.9	0.2
@08	0.043	0.002	1.88644	0.00024	1.46713	0.00029	0.282797	0.000018	0.282795	1.7	5.9	0.2
@09	0.010	0.000	1.88730	0.0002	1.46710	0.00025	0.282631	0.000016	0.282631	-4.1	7.6	0.2
@10	0.020	0.001	1.88668	0.00032	1.46719	0.00023	0.282838	0.000016	0.282837	3.2	5.2	0.2
@11	0.018	0.001	1.88620	0.00024	1.46722	0.00023	0.282850	0.000013	0.282849	3.6	6.2	0.2
@12	0.011	0.000	1.88675	0.00021	1.46718	0.00021	0.282775	0.000012	0.282774	1.0	6.6	0.2
@13	0.056	0.002	1.88722	0.00018	1.46708	0.00021	0.282812	0.000016	0.282810	2.2	5.7	0.2
@14	~~0.036~~	~~0.002~~	1.88583	0.00018	1.46681	0.00018	~~0.282780~~	~~0.000015~~	~~0.282779~~	~~1.1~~	~~6.1~~	~~0.2~~
@16	0.015	0.001	1.88663	0.00029	1.46684	0.00018	0.282845	0.000013	0.282844	3.4	5.7	0.2
@17	0.026	0.001	1.88660	0.00026	1.46687	0.00038	0.282861	0.000018	0.282860	4.0	5.3	0.2
@18	0.005	0.000	1.88701	0.00039	1.46751	0.0003	0.282730	0.000014	0.282729	-0.6	5.4	0.3
@19	0.023	0.001	1.88683	0.00024	1.46739	0.0002	0.282848	0.000015	0.282847	3.3	5.3	0.2
@20	0.025	0.001	1.88764	0.00031	1.46724	0.00033	0.282801	0.000014	0.282800	1.4	5.9	0.3
LQS-11 Rhyolite (SiO2 = 71.7 wt%; Mg# = 37.5)												
@01	0.029	0.001	1.88649	0.00028	1.46781	0.00024	0.282828	0.000015	0.282827	3.0	5.1	0.2
@02	0.033	0.001	1.88720	0.00034	1.46711	0.00019	0.282840	0.000012	0.282839	3.3	5.2	0.3
@03	0.041	0.002	1.88756	0.00026	1.46712	0.00029	0.282863	0.000015	0.282862	3.9	5.6	0.2
@05	0.024	0.001	1.88783	0.00026	1.46759	0.00024	0.282840	0.000014	0.282839	3.1	6.1	0.2
@06	0.040	0.002	1.88789	0.00023	1.46716	0.00022	0.282751	0.000018	0.282750	0.1	7.4	0.2
@07	0.023	0.001	1.88780	0.00039	1.46733	0.00017	0.282819	0.000019	0.282818	2.6	5.8	0.3
@08	0.002	0.000	1.88736	0.00019	1.46716	0.00021	0.282845	0.000015	0.282845	3.1	5.7	0.3
@09	0.047	0.002	1.88631	0.00022	1.46728	0.00028	0.282874	0.000013	0.282873	4.3	5.9	0.3
@10	0.042	0.002	1.88643	0.00035	1.46716	0.00032	0.282769	0.000017	0.282767	-0.1	6.1	0.3
@12	0.037	0.001	1.88639	0.00021	1.46700	0.00024	0.282715	0.000026	0.282714	-1.1	6.3	0.3
@13	0.067	0.003	1.88692	0.00026	1.46714	0.00026	0.282834	0.000037	0.282832	3.1	5.1	0.3
@14	0.023	0.001	1.88684	0.00031	1.46773	0.00031	0.282795	0.000014	0.282794	1.6	6.1	0.2
@15	0.011	0.000	1.88734	0.00025	1.46711	0.00024	0.282789	0.000015	0.282789	1.6	5.3	0.2
@16	0.034	0.001	1.88658	0.00023	1.46708	0.00018	0.282595	0.000015	0.282594	-5.4	7.6	0.2
@17	0.039	0.001	1.88673	0.00027	1.46706	0.00023	0.282572	0.000013	0.282571	-6.1	6.1	0.3
@18	0.016	0.001	1.88828	0.00031	1.46746	0.00026	0.282804	0.000014	0.282803	1.9	5.6	0.2
@19	0.023	0.001	1.88798	0.00025	1.46743	0.00028	0.282875	0.000015	0.282874	4.7	5.3	0.3
@20	0.002	0.000	1.88745	0.0003	1.46734	0.00024	0.282829	0.000016	0.282829	2.8	5.4	0.3
06TPH-10 Andesite (SiO2 = 60.2 wt%; Mg# = 49.1)												
@01	0.014	0.001	1.88576	0.00025	1.46706	0.0002	0.282745	0.000016	0.282745	0.0	5.6	0.2
@02	0.016	0.001	1.88595	0.00026	1.46740	0.00018	0.282708	0.000017	0.282707	-1.6	6.4	0.3
@03	0.017	0.001	1.88590	0.00028	1.46720	0.00025	0.282652	0.000014	0.282652	-3.5	7.0	0.2

@04	0.039	0.001	1.88682	0.00023	1.46677	0.0003	0.282676	0.000015	0.282675	-2.6	6.7	0.2
@05	0.017	0.001	1.88644	0.00024	1.46687	0.00027	0.282737	0.000016	0.282736	-0.4	5.6	0.2
@06	0.032	0.001	1.88640	0.00021	1.46727	0.00018	0.282648	0.000020	0.282647	-3.5	6.7	0.2
@07	0.021	0.001	1.88639	0.00019	1.46744	0.0003	0.282753	0.000016	0.282753	0.2	6.2	0.3
@08	0.023	0.001	1.88710	0.00024	1.46708	0.00027	0.282699	0.000014	0.282699	-1.7	7.1	0.2
@09	0.018	0.001	1.88586	0.0003	1.46672	0.00036	0.282708	0.000015	0.282708	-1.4	6.8	0.2
@10	0.023	0.001	1.88577	0.00028	1.46680	0.00019	0.282694	0.000016	0.282693	-1.9	6.2	0.3
@11	0.021	0.001	1.88719	0.00021	1.46727	0.00029	0.282688	0.000017	0.282687	-2.2	6.7	0.1
@12	0.029	0.001	1.88778	0.00039	1.46747	0.00024	0.282695	0.000015	0.282695	-2.0	6.1	0.3
@13	0.026	0.001	1.88576	0.00034	1.46706	0.00024	0.282667	0.000014	0.282666	-2.9	6.4	0.3
@14	0.017	0.001	1.88595	0.00021	1.46740	0.00031	0.282665	0.000015	0.282665	-3.0	6.6	0.2
@15	0.029	0.001	1.88651	0.0002	1.46736	0.00027	0.282677	0.000014	0.282677	-2.5	6.4	0.3
@16	0.022	0.001	1.88740	0.00026	1.46712	0.00028	0.282709	0.000016	0.282709	-1.4	5.9	0.2
@17	0.035	0.001	1.88773	0.00023	1.46740	0.00024	0.282690	0.000019	0.282689	-2.1	6.8	0.3
@18	0.027	0.001	1.88572	0.00024	1.46700	0.0002	0.282696	0.000017	0.282695	-1.8	6.7	0.2
06ZZ-12 Dacite (SiO2 = 64.1 wt%; Mg# =52.6)												
@04	0.024	0.001	1.88555	0.0002	1.46748	0.00022	0.282813	0.000016	0.282812	2.3	5.3	0.1
@05	0.023	0.001	1.88665	0.00026	1.46768	0.00021	0.282827	0.000015	0.282826	2.8	4.7	0.2
@06	0.019	0.001	1.88686	0.00028	1.46758	0.00022	0.282808	0.000016	0.282807	2.3	5.4	0.1
@08	0.024	0.001	1.88722	0.0002	1.46767	0.00028	0.282776	0.000014	0.282775	1.1	5.8	0.2
GJ-1 zircon standard grains for Lu-Hf isotope analyses												
GJ-1@01	0.007	0.000	1.88693	0.00028	1.46719	0.00027	0.281984	0.000015				
GJ-1@02	0.007	0.000	1.88686	0.00021	1.46709	0.00028	0.281986	0.000016				
GJ-1@03	0.007	0.000	1.88693	0.00021	1.46725	0.00029	0.281995	0.000016				
GJ-1@04	0.008	0.000	1.88686	0.00031	1.46703	0.00021	0.281982	0.000017				
GJ-1@05	0.009	0.000	1.88684	0.0003	1.46733	0.00022	0.282019	0.000016				
GJ-1@06	0.009	0.000	1.88667	0.00031	1.46714	0.00021	0.282021	0.000017				
GJ-1@07	0.008	0.000	1.88700	0.0002	1.46720	0.00034	0.282018	0.000019				
GJ-1@08	0.009	0.000	1.88664	0.00022	1.46725	0.0002	0.281980	0.000019				
GJ-1@09	0.009	0.000	1.88697	0.00031	1.46718	0.00026	0.282015	0.000019				
GJ-1@10	0.008	0.000	1.88661	0.00024	1.46726	0.00023	0.282011	0.000018				
GJ-1@11	0.008	0.000	1.88684	0.00033	1.46712	0.00027	0.281992	0.000016				
GJ-1@12	0.007	0.000	1.88714	0.00027	1.46721	0.00028	0.282017	0.000018				
GJ-1@13	0.008	0.000	1.88703	0.00035	1.46722	0.00024	0.282013	0.000017				
GJ-1@14	0.008	0.000	1.88669	0.00021	1.46729	0.00023	0.282017	0.000020				
GJ-1@15	0.007	0.000	1.88668	0.00033	1.46710	0.00026	0.281992	0.000016				
GJ-1@16	0.007	0.000	1.88657	0.00017	1.46721	0.00023	0.281998	0.000017				
GJ-1@17	0.007	0.000	1.88671	0.00026	1.46715	0.00022	0.282022	0.000016				
GJ-1@18	0.007	0.000	1.88676	0.00025	1.46727	0.00015	0.281999	0.000016				
GJ-1@19	0.007	0.000	1.88700	0.00026	1.46703	0.00025	0.282015	0.000017				
GJ-1@20	0.007	0.000	1.88676	0.00022	1.46723	0.00016	0.282017	0.000014				
GJ-1@21	0.007	0.000	1.88695	0.00025	1.46697	0.00028	0.281995	0.000015				
GJ-1@22	0.008	0.000	1.88690	0.00023	1.46690	0.00027	0.282022	0.000016				
GJ-1@23	0.008	0.000	1.88708	0.00039	1.46694	0.0003	0.281982	0.000016				
GJ-1@24	0.008	0.000	1.88670	0.00024	1.46718	0.00021	0.281995	0.000017				
GJ-1@25	0.007	0.000	1.88700	0.00016	1.46714	0.0002	0.281995	0.000017				
GJ-1@26	0.007	0.000	1.88687	0.00031	1.46717	0.00016	0.282004	0.000018				
GJ-1@27	0.008	0.000	1.88666	0.00029	1.46727	0.00023	0.282025	0.000018				
GJ-1@28	0.007	0.000	1.88673	0.0002	1.46714	0.00026	0.282019	0.000019				
GJ-1@29	0.008	0.000	1.88673	0.00018	1.46714	0.00024	0.282021	0.000016				
GJ-1@30	0.008	0.000	1.88691	0.00025	1.46695	0.0002	0.282006	0.000014				
GJ-1@31	0.008	0.000	1.88698	0.00028	1.46705	0.00018	0.282024	0.000016				
GJ-1@32	0.007	0.000	1.88687	0.00028	1.46717	0.00026	0.282011	0.000017				
PengLai zircon standard grains for Lu-Hf isotope analyses												
Penglai@01	0.022	0.000	1.88639	0.00023	1.47425	0.00019	0.282907	0.000020				
Penglai@02	0.021	0.000	1.8861	0.00018	1.47493	0.00029	0.282869	0.000016				
Penglai@03	0.019	0.000	1.88627	0.00019	1.47485	0.00027	0.282895	0.000018				
Penglai@04	0.022	0.000	1.88579	0.00031	1.47465	0.00022	0.282902	0.000018				
Penglai@05	0.023	0.000	1.88580	0.00024	1.47496	0.00025	0.282903	0.000017				
Penglai@06	0.023	0.000	1.88632	0.00024	1.47478	0.00025	0.282897	0.000016				
Penglai@07	0.021	0.000	1.88616	0.00025	1.47418	0.00023	0.282887	0.000020				
Penglai@08	0.022	0.000	1.88642	0.00019	1.47424	0.00027	0.282896	0.000022				
Penglai@09	0.023	0.000	1.88600	0.00016	1.47393	0.00025	0.282893	0.000024				
Penglai@10	0.021	0.000	1.88603	0.00032	1.47409	0.00026	0.282903	0.000021				

Penglai@11	0.024	0.000	1.88617	0.00018	1.47352	0.00025	0.282918	0.000022				
Penglai@12	0.027	0.000	1.88605	0.00026	1.47519	0.00021	0.282921	0.000017				
Penglai@13	0.023	0.000	1.88631	0.00019	1.47473	0.0002	0.282889	0.000018				
Penglai@14	0.023	0.000	1.88649	0.00021	1.47461	0.00018	0.282880	0.000018				
Penglai@15	0.019	0.000	1.88621	0.00022	1.47480	0.00025	0.282901	0.000018				
Penglai@16	0.014	0.000	1.88594	0.00031	1.47484	0.0002	0.282896	0.000018				
PengLai and Qinghu zircon standard grains for O isotope analyses												
										Penglai@1	5.56	0.18
										Penglai@2	5.27	0.27
										Penglai@3	5.10	0.18
										Qinghu@1	5.40	0.21
										Penglai@4	5.39	0.16
										Penglai@5	4.98	0.16
										Qinghu@2	5.16	0.12
										Penglai@6	5.34	0.32
										Penglai@7	5.17	0.27
										Qinghu@3	5.11	0.18
										Penglai@8	5.12	0.19
										Penglai@9	5.17	0.20
										Qinghu@4	5.38	0.22
										Penglai@10	5.38	0.22
										Penglai@11	5.45	0.24
										Qinghu@5	5.29	0.20
										Penglai@12	5.41	0.25
										Penglai@13	5.47	0.28
										Qinghu@6	5.54	0.17
										Penglai@14	5.52	0.26
										Penglai@15	5.03	0.28
										Qinghu@7	5.20	0.17
										Penglai@16	5.10	0.14
										Penglai@17	5.58	0.22
										Qinghu@8	5.31	0.24
										Qinghu@9	5.53	0.34
										Penglai@18	5.39	0.16

										Peng lai@ 19	5.29	0.28
										Peng lai@ 20	5.24	0.24

$\varepsilon_{Hf}(t) = 10000 \times \{[(^{176}Hf/^{177}Hf)_S - (^{176}Lu/^{177}Hf)_S \times (e^{\lambda t} - 1)]/[(^{176}Hf/^{177}Hf)_{CHUR,0} - (^{176}Lu/^{177}Hf)_{CHUR} \times (e^{\lambda t} - 1)] - 1\}$; where $\lambda = 1.867 \times 10^{-11}$ year^{-1} (Soderlund et al., 2004), $(^{176}Lu/^{177}Hf)_S$ and $(^{176}Hf/^{177}Hf)_S$ are measured values from the samples, $(^{176}Lu/^{177}Hf)_{CHUR} = 0.0332$ and $(^{176}Hf/^{177}Hf)_{CHUR,0} = 0.282772$ (Blichert-Toft and Albarède, 1997).

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Blichert-Toft, J. and Albarède, F., 1997, The Lu–Hf geochemistry of chondrites and the evolution of the mantle–crust system. Earth and Planetary Science Letters 148, 24–258.

Soderlund, U., Patchett, P.J., Vervoort, J.D. and Isachsen, C.E., 2004, The ^{176}Lu decay constant determined by Lu–Hf and U–Pb isotope systematics of Precambrian mafic intrusions. Earth and Planetary Science Letters 219, 311–324.

Table S3-Bulk-rock major and trace element data for the EARs

Sample	06DYH-19	06TPH-10	LQS-1	LQS-5	LQS-07	LQS-10	LQS-11	LQS-13	LQS-15	LQS-16	LQS-17	LQS-18
Location	Dongyuehu	Taipinghu	Luanqingshan									
SiO_2	63.10	60.16	62.02	70.96	71.56	71.58	71.67	63.12	63.84	64.40	62.71	60.07
TiO_2	0.70	0.76	0.54	0.24	0.26	0.27	0.26	0.72	0.56	0.55	0.51	0.93
Al_2O_3	15.67	15.30	14.75	15.68	15.13	15.14	15.28	16.58	16.01	16.26	15.73	16.29
$Fe_2O_3^T$	4.52	5.37	4.78	1.99	2.07	1.93	1.87	5.20	4.38	4.56	4.29	5.47
MnO	0.06	0.10	0.04	0.02	0.02	0.02	0.02	0.04	0.06	0.05	0.10	0.07
MgO	3.66	2.59	4.63	0.66	0.62	0.67	0.79	2.88	2.73	2.26	2.21	4.22
CaO	4.73	5.20	5.16	2.41	1.98	2.03	2.16	4.52	4.99	4.56	7.04	5.88
Na_2O	3.69	3.84	3.81	4.03	3.96	4.13	3.97	3.86	4.13	4.29	4.09	3.80
K_2O	3.46	4.13	3.62	3.73	3.94	3.85	3.92	2.59	2.70	2.75	2.62	2.75
P_2O_5	0.28	0.54	0.33	0.03	0.01	0.01	0.03	0.23	0.15	0.03	0.16	0.25
LOI	1.35	1.02	1.53	1.26	0.90	0.65	0.72	1.45	1.42	1.05	4.59	0.65
total	100.21	99.2	99.68	99.76	99.55	99.64	99.97	99.74	99.53	99.69	99.46	99.74
Mg#	61.8	49.1	66.0	39.9	37.5	41.0	45.8	52.6	55.5	49.8	50.7	60.7
Cr	143	111.7	252	9.14	6.32	4.95	11.8	140	95.9	88.4	110	139
Ni	90.2	55.46	134	4.24	3.97	2.90	5.02	86.9	70.1	64.5	86.9	110
Rb	119	161.9	95.9	161	161	152	166	66.4	67.6	72.6	64.8	67.3
Sr	1036	2260	2198	432	415	483	454	1311	1202	1248	1376	1645
Y	12.7	13.12	12.5	4.91	4.53	3.95	4.68	12.3	10.6	7.77	10.8	13.3
Zr	255	350.6	186	144	145	151	134	208	159	157	144	216
Nb	10.5	14.98	7.86	3.33	3.65	3.51	4.00	7.79	5.64	5.53	5.07	14.0
Ba	1319	1968	1903	1190	1248	1259	1279	1619	1374	1456	1429	1383
La	57.9	109.2	77.7	21.2	29.7	31.9	30.3	47.0	27.2	18.2	26.1	48.6
Ce	107	207.9	139	36.0	51.0	54.0	51.5	84.3	48.8	30.3	48.9	91.6
Pr	11.6	23.65	16.1	3.94	5.34	5.64	5.49	9.71	5.80	3.43	5.77	11.2
Nd	40.8	83.81	56.7	13.4	17.1	18.7	18.0	35.4	21.5	13.0	22.1	42.1
Sm	5.97	12.04	7.93	2.14	2.54	2.64	2.74	5.71	3.76	2.45	3.91	6.83
Eu	1.46	2.85	1.91	0.49	0.51	0.55	0.53	1.38	0.99	0.88	0.95	1.61
Gd	4.38	8.232	4.03	1.44	1.44	1.43	1.62	3.59	2.66	1.79	2.74	4.08
Tb	0.501	0.92	0.57	0.21	0.22	0.20	0.24	0.55	0.41	0.29	0.42	0.61
Dy	2.45	4.38	2.59	1.03	0.97	0.88	1.03	2.83	2.18	1.62	2.05	2.92
Ho	0.433	0.80	0.43	0.18	0.17	0.14	0.17	0.50	0.40	0.31	0.42	0.53
Er	1.13	2.01	1.16	0.43	0.41	0.36	0.41	1.20	1.06	0.84	1.06	1.33
Tm	0.156	0.28	0.16	0.07	0.06	0.04	0.06	0.17	0.16	0.14	0.17	0.18
Yb	0.981	1.72	1.04	0.42	0.38	0.32	0.38	1.13	1.10	0.98	1.17	1.25
Lu	0.152	0.27	0.17	0.07	0.06	0.05	0.06	0.17	0.19	0.17	0.19	0.20
Hf	6.44	8.74	4.46	3.96	4.00	4.14	3.88	5.13	4.21	4.20	3.81	5.30
Ta	0.569	0.79	0.48	0.40	0.37	0.31	0.40	0.52	0.42	0.43	0.38	1.00
Th	20.0	29.94	21.1	14.5	19.3	18.5	20.6	13.8	9.48	8.73	8.24	13.3
U	4.76	6.011	3.21	5.42	5.48	5.07	6.10	2.34	3.05	2.70	2.63	3.55

Table S3-continued

Sample	LQS-19	LQS-20	06YJL-01	06YJL-02	06YJL-03	06YJL-04	06YJL-05	06YJL-06	06YJL-07	06YJL-08
Location	Luanqingshan		Yuejinla							
SiO_2	66.30	65.53	65.28	64.21	64.40	64.56	62.94	65.78	62.30	63.10
TiO_2	0.54	0.59	0.70	0.80	0.66	0.70	0.75	0.71	0.74	0.77
Al_2O_3	16.06	16.45	15.66	15.58	15.47	14.59	15.47	15.07	14.99	16.07
$Fe_2O_3^T$	3.71	3.47	3.87	4.39	4.15	4.59	4.67	4.01	4.98	4.79
MnO	0.05	0.05	0.06	0.08	0.06	0.07	0.06	0.05	0.07	0.05

MgO	2.30	2.62	2.20	2.78	3.05	3.64	3.64	2.86	4.27	3.15
CaO	3.66	3.72	3.46	4.39	3.88	3.57	4.27	3.27	4.38	4.00
Na_2O	3.92	4.03	3.41	2.84	3.09	2.55	3.07	3.12	2.79	3.28
K_2O	3.19	3.11	4.11	3.81	4.25	4.43	4.16	4.29	4.01	4.04
P_2O_5	0.18	0.10	0.03	0.24	0.12	0.10	0.13	0.03	0.10	0.06
LOI	1.34	2.19	0.76	1.23	1.16	1.74	1.08	0.62	1.43	1.22
total	99.9	99.7	99.5	100.4	100.3	100.5	100.3	99.8	100.1	100.5
Mg#	55.4	60.2	53.2	55.9	59.5	61.3	60.9	58.8	63.2	56.8
Cr	57.9	68.9	105	102	116	150	139	140	173	135
Ni	43.7	48.8	48.7	42.8	55.3	72.1	73.6	63.9	97.9	71.9
Rb	83.1	74.3	158	140	154	183	146	176	171	129
Sr	1014	1148	1262	1318	1121	1089	1456	1118	1517	1582
Y	9.49	8.30	5.85	14.1	9.88	13.3	10.9	8.89	11.8	9.17
Zr	253	268	266	257	258	273	269	287	276	284
Nb	6.50	7.59	10.9	11.5	10.8	12.8	11.4	13.2	12.7	11.7
Ba	1370	1517	1896	1890	1847	1872	2037	1888	2041	2259
La	55.4	48.7	37.2	68.8	62.0	62.7	64.7	43.6	68.1	56.9
Ce	95.4	84.0	63.6	119	104	114	117	76.4	122	93.0
Pr	10.6	8.95	6.18	13.3	10.3	12.3	12.3	7.99	12.6	10.5
Nd	36.8	30.4	20.2	46.5	34.3	42.1	41.9	26.2	43.6	36.0
Sm	5.38	4.38	3.02	6.55	4.83	6.02	5.89	3.75	6.30	4.90
Eu	1.21	1.05	1.39	1.69	1.27	1.40	1.58	1.42	1.51	1.73
Gd	3.09	2.66	1.57	3.80	2.81	3.70	3.41	2.20	3.35	2.85
Tb	0.44	0.37	0.25	0.55	0.43	0.54	0.49	0.34	0.49	0.42
Dy	2.06	1.82	1.22	2.85	2.03	2.70	2.34	1.84	2.47	1.95
Ho	0.36	0.32	0.22	0.53	0.37	0.49	0.41	0.34	0.42	0.35
Er	0.91	0.83	0.59	1.34	0.94	1.29	1.09	0.88	1.16	0.92
Tm	0.13	0.12	0.08	0.18	0.12	0.18	0.14	0.14	0.16	0.12
Yb	0.89	0.85	0.50	1.16	0.81	1.16	0.84	0.79	1.08	0.76
Lu	0.15	0.13	0.08	0.19	0.12	0.19	0.14	0.14	0.16	0.12
Hf	6.01	6.59	6.16	5.86	6.02	6.44	6.31	6.73	6.49	6.70
Ta	0.42	0.49	0.77	0.77	0.74	1.00	0.77	1.03	0.92	0.80
Th	18.7	17.5	17.3	21.5	21.5	22.4	22.4	20.0	23.6	19.6
U	3.73	3.70	4.87	5.34	5.93	6.42	5.72	6.00	6.24	5.60

Table S3-continued

Sample	06YJL-09	06YJL-10	06YJL-11	06YJL-12	06YJL-13	06YJL-14	06YJL-15	06YJL-16	06YJL-17	06YJL-18	06YJL-19
Location	Yuejinla										
SiO_2	64.20	66.73	65.83	61.18	61.67	62.10	64.81	66.82	59.23	61.30	61.97
TiO_2	0.66	0.63	0.64	0.84	0.77	0.85	0.60	0.63	0.91	0.78	0.78
Al_2O_3	15.23	14.96	14.85	15.23	15.22	15.44	14.92	15.74	14.50	15.09	15.22
$Fe_2O_3^T$	4.12	3.84	4.10	5.30	4.99	4.99	4.46	3.74	5.57	5.00	5.12
MnO	0.06	0.05	0.06	0.07	0.07	0.06	0.06	0.02	0.07	0.07	0.07
MgO	3.10	2.35	2.87	4.23	4.25	3.79	2.46	0.63	4.88	4.20	4.16
CaO	3.89	3.08	3.30	4.47	4.63	4.40	3.48	2.73	5.52	4.45	4.41
Na_2O	2.95	3.00	2.93	2.83	2.91	3.23	2.64	3.39	2.81	2.48	2.85

K_2O	4.28	4.38	4.36	4.42	4.20	4.29	4.65	4.55	4.71	4.54	4.47
P_2O_5	0.15	0.09	0.04	0.11	0.15	0.04	0.25	0.17	0.37	0.09	0.08
LOI	1.34	0.71	0.73	1.30	1.16	0.64	2.10	0.98	0.96	2.03	0.81
total	99.97	99.82	99.71	99.97	100.01	99.83	100.42	99.40	99.52	100.03	99.92
Mg#	60.1	55.0	58.3	61.5	63.0	60.3	52.5	25.2	63.7	62.7	61.9
Cr	123	109	116	170	162	163	77.8	55.2	230	167	177
Ni	61.4	47.5	52.8	89.4	94.1	75.3	32.6	38.2	149	89.8	90.1
Rb	162	184	173	160	156	171	176	180	137	171	158
Sr	1171	1204	1124	1540	1628	1623	1056	1153	1929	1571	1538
Y	9.96	10.6	11.7	11.2	12.0	9.08	14.6	11.5	15.5	11.5	10.5
Zr	264	270	258	295	271	306	265	289	374	277	276
Nb	10.7	14.0	13.5	14.3	12.6	14.7	13.6	14.3	12.6	13.1	12.8
Ba	1851	1727	1676	1955	2056	2144	1484	1709	2482	2023	2035
La	62.1	53.0	70.7	67.6	71.5	47.0	78.9	67.8	72.5	69.4	64.9
Ce	111	90.3	119	116	125	79.5	129	112	131	121	111
Pr	12.0	9.64	12.2	12.8	14.0	8.45	14.0	12.2	15.9	13.6	12.1
Nd	40.8	33.6	38.6	42.7	48.4	30.1	46.9	40.2	58.9	46.6	41.6
Sm	5.65	4.95	5.37	6.02	6.70	4.65	6.77	5.61	8.99	6.29	5.76
Eu	1.44	1.60	1.33	1.65	1.72	1.68	1.43	1.52	2.25	1.60	1.57
Gd	3.16	2.79	2.99	3.27	3.64	2.68	3.86	3.29	4.91	3.58	3.04
Tb	0.45	0.44	0.47	0.48	0.53	0.40	0.60	0.49	0.67	0.50	0.46
Dy	2.14	2.20	2.34	2.34	2.48	2.01	2.81	2.36	3.12	2.45	2.22
Ho	0.37	0.39	0.44	0.41	0.440	0.36	0.49	0.43	0.520	0.430	0.40
Er	0.96	1.06	1.16	1.06	1.15	0.89	1.26	1.05	1.38	1.11	1.05
Tm	0.13	0.15	0.17	0.14	0.15	0.13	0.19	0.16	0.190	0.150	0.14
Yb	0.81	0.93	1.06	0.92	0.93	0.76	1.25	1.01	1.22	0.93	0.84
Lu	0.13	0.15	0.18	0.14	0.14	0.12	0.20	0.160	0.19	0.15	0.14
Hf	6.21	6.44	6.46	6.77	6.21	6.84	5.86	6.45	8.07	6.36	6.41
Ta	0.710	1.18	1.21	1.11	0.90	1.07	1.17	1.31	0.740	0.95	0.93
Th	22.7	31.1	32.3	28.3	25.8	23.1	28.5	30.4	20.2	27.5	25.5
U	5.81	9.14	8.70	8.50	7.23	7.42	8.56	7.48	4.70	7.57	7.35

Table S3-continued

`Sample	06YJL-20	06YJL-21	06YJL-22	06YJL-23	06YJL-24	06ZZ-12	06ZZ-13	06ZZ-14	06ZZ-15
Location	Yuejinla					Zhuozishan			
SiO_2	61.09	62.86	61.31	62.56	61.28	64.1	62.68	57.25	63.89
TiO_2	0.77	0.76	0.81	0.81	0.92	0.6	0.84	0.89	0.60
Al_2O_3	14.93	15.85	15.67	15.48	14.82	16.1	16.06	16.47	15.31
$Fe_2O_3^T$	5.04	4.91	5.44	5.24	5.29	4.5	5.26	6.26	4.29
MnO	0.07	0.06	0.08	0.07	0.07	0.1	0.07	0.11	0.07
MgO	4.42	3.29	3.68	4.02	4.31	2.5	3.35	4.99	3.51
CaO	4.65	4.28	4.39	4.43	5.01	4.8	4.42	6.39	4.21
Na_2O	2.40	3.41	3.19	3.22	2.92	4.2	3.50	3.35	3.58
K_2O	4.48	4.01	4.33	4.41	4.37	2.7	3.30	3.35	3.51
P_2O_5	0.09	0.10	0.25	0.15	0.82	0.1	0.06	0.09	0.16

LOI	1.92	0.58	0.28	0.18	0.43	1.2	0.90	1.07	0.81
total	99.85	100.11	99.43	100.57	100.24	99.6	100.43	100.22	99.93
Mg#	63.7	57.3	57.5	60.5	62.0	52.6	56.0	61.5	62.1
Cr	183	152	144	147	245	92.2	111	314	168
Ni	91.6	81.8	69.7	74.0	126	67.3	64.1	119	114
Rb	164	165	162	159	156	70.1	102	90.3	122
Sr	1609	1704	1723	1703	2147	1225	1051	1250	1495
Y	11.6	9.94	12.0	11.6	12.3	9.2	8.38	8.73	9.78
Zr	269	305	297	296	364	158	267	229	205
Nb	12.7	14.1	15.1	14.7	13.8	5.6	10.3	9.06	7.53
Ba	2039	2219	2179	2141	2731	1415	1619	1403	1705
La	70.5	58.6	77.2	72.9	45.4	22.7	43.9	22.5	52.4
Ce	123	100.2	138	124	86.3	39.6	73.3	40.7	94.3
Pr	14.0	11.1	15.1	13.8	10.4	4.6	7.68	4.82	10.2
Nd	47.2	38.3	52.3	46.3	40.5	17.3	25.4	18.4	35.5
Sm	6.53	5.40	7.02	6.49	6.76	3.1	3.69	3.22	5.14
Eu	1.59	1.74	1.86	1.74	2.14	0.9	1.33	1.37	1.39
Gd	3.50	3.02	3.92	3.61	3.65	2.2	2.08	2.30	2.70
Tb	0.520	0.441	0.558	0.507	0.561	0.4	0.34	0.33	0.40
Dy	2.47	2.11	2.59	2.40	2.68	1.9	1.69	1.86	2.03
Ho	0.430	0.387	0.446	0.412	0.469	0.4	0.31	0.35	0.38
Er	1.10	0.958	1.16	1.08	1.20	1.0	0.84	0.93	0.99
Tm	0.15	0.129	0.149	0.144	0.163	0.2	0.12	0.13	0.14
Yb	0.93	0.82	0.95	0.900	1.02	1.0	0.76	0.84	0.85
Lu	0.150	0.140	0.149	0.144	0.163	0.2	0.12	0.14	0.14
Hf	6.31	6.76	7.08	6.77	8.66	4.2	5.85	5.44	4.99
Ta	0.90	1.022	1.11	1.07	0.867	0.4	0.65	0.62	0.50
Th	26.7	27.1	28.1	26.1	21.3	9.1	19.8	12.3	18.6
U	7.27	8.11	8.32	7.90	5.29	2.9	4.53	3.81	4.92

Note: Loss on Ignition; $Fe_2O_3^T$ = Total Fe_2O_3 content; Mg# = molar 100 × Mg^{2+} / (Mg^{2+} + Fe^{2+}). Samples 06YJL-01~06YJL-20 are provided by Dr. Qiang Wang from Guangzhou institute of Geochemistry, Chinese Academy of Sciences.

Table S4-Bulk-rock Sr–Nd isotope data for EARs in this study

Sample	Rock Type	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	± 2σ	$(^{87}Sr/^{86}Sr)_i$	$^{143}Nd/^{144}Nd$	± 2σ	$(^{143}Nd/^{144}Nd)_i$	$\varepsilon_{Nd}(t)$
06DYH-19	Dacite	0.0900	0.707129	0.000012	0.7071	0.5123696	0.000007	0.512346	-4.69
06ZZ-12	Dacite	0.1102	0.707732	0.000010	0.7077	0.5123013	0.000007	0.512272	-6.13
06TPH-10	Andesite	0.0883	0.707757	0.000012	0.7077	0.5123038	0.000009	0.512281	-5.97
06YJL-01	Dacite	0.0919	0.707167	0.000013	0.7071	0.5123792	0.000006	0.512355	-4.51
06YJL-04	Dacite	0.0879	0.707078	0.000015	0.7070	0.5123918	0.000008	0.512369	-4.25
06YJL-05	Andesite	0.0864	0.707268	0.000015	0.7072	0.5123652	0.000004	0.512343	-4.76
06YJL-13	Andesite	0.0906	0.707855	0.000012	0.7078	0.5123024	0.000004	0.512279	-6.01
LQS-01	Andesite	0.0860	0.707550	0.000016	0.7075	0.5124802	0.000006	0.512458	-2.51
LQS-11	Rhyolite	0.0913	0.707769	0.000013	0.7077	0.512454	0.000009	0.512430	-3.05
LQS-10	Rhyolite	0.0868	0.707516	0.000011	0.7075	0.5124627	0.000006	0.512440	-2.86
LQS-16	Dacite	0.1159	0.706421	0.000014	0.7064	0.512459	0.000011	0.512429	-3.08

Note: $^{87}Rb/^{86}Sr$ and $^{147}Sm/^{144}Nd$ during inverse computation of initial isotope values were calculated using Rb, Sr, Sm, and Nd contents (Table S3) measured by inductively coupled plasma–mass spectrometry (ICP–MS).

Table S5-In-situ major elements for cpx measured by EPMA

Sample	YJL-24 (SiO_2 = 64.56 wt%, Mg# = 61.3)										
NO	0	10	20	30	40	50	60	70	80	90	100
SiO_2	53.65	53.60	53.79	53.35	53.77	53.15	53.93	53.19	51.99	51.89	51.53
TiO_2	0.32	0.31	0.32	0.37	0.34	0.46	0.25	0.65	0.75	0.79	0.65
Al_2O_3	1.76	1.94	1.85	2.27	1.79	2.68	1.59	2.38	2.23	2.34	2.69
FeO	4.82	4.75	4.75	5.35	5.08	5.13	6.48	10.00	10.01	10.10	10.12
MnO	0.11	0.12	0.07	0.14	0.15	0.14	0.19	0.18	0.24	0.23	0.22
MgO	17.37	17.34	17.35	17.48	17.55	17.11	16.78	14.52	14.74	14.71	14.48
CaO	20.61	20.29	20.62	19.71	20.13	20.27	19.27	18.12	18.70	18.48	18.44
Na_2O	0.48	0.50	0.47	0.49	0.52	0.34	0.47	0.74	0.67	0.68	0.77
K2O	0.01	0.00	0.01	0.02	0.01	0.03	0.02	0.01	0.01	0.01	0.00
Cr_2O_3	0.30	0.47	0.51	0.37	0.37	0.31	0.40	0.08	0.08	0.06	0.10
NiO	0.04	0.06	0.09	0.08	0.00	0.10	0.07	0.06	0.06	0.02	0.06
Total	99.46	99.37	99.84	99.63	99.72	99.69	99.47	99.93	99.47	99.31	99.06
Mg#	86.64	86.78	86.80	85.46	86.15	85.73	82.34	72.33	72.61	72.39	72.03
Melt Mg#(a)	63.85	64.15	64.16	61.56	62.87	62.05	55.93	41.58	41.92	41.65	41.22

Table S5-continued

Sample	YJL-04 (SiO_2 = 61.30 wt%; Mg# = 61.9)										
NO	0	10	20	30	40	50	60	70	80	90	100
SiO_2	53.66	53.72	53.33	52.72	51.86	52.02	51.56	51.43	52.28	52.86	53.27
TiO_2	0.27	0.51	0.37	0.70	0.66	0.77	0.75	0.67	0.71	0.71	0.71
Al_2O_3	1.71	2.56	2.42	2.03	2.25	2.13	2.51	2.33	2.75	2.42	2.77
FeO	4.30	5.52	5.00	7.14	7.01	7.26	10.07	9.53	9.60	9.62	8.98
MnO	0.13	0.12	0.13	0.17	0.16	0.18	0.24	0.18	0.15	0.20	0.22
MgO	17.83	16.79	17.45	15.73	16.02	15.99	14.39	15.05	14.29	14.39	14.85
CaO	19.83	19.82	19.54	20.54	20.46	20.39	18.60	19.28	18.93	18.89	18.25
Na_2O	0.52	0.45	0.41	0.45	0.47	0.43	0.76	0.68	0.69	0.76	0.68
K2O	0.00	0.03	0.00	0.01	0.03	0.00	0.00	0.02	0.00	0.00	0.00
Cr_2O_3	0.61	0.52	0.55	0.09	0.36	0.07	0.09	0.05	0.06	0.01	0.12
NiO	0.01	0.08	0.07	0.02	0.10	0.04	0.01	0.03	0.01	0.02	0.00
Total	98.89	100.1	99.29	99.59	99.38	99.26	98.98	99.29	99.48	99.87	99.87
Mg#	88.18	84.56	86.27	79.86	80.44	79.86	72.01	73.98	72.82	72.92	74.85
Melt Mg#	64.45	63.41	64.30	59.04	60.72	60.44	52.12	42.45	41.17	41.12	41.84

(a) The melt Mg# values are inversely calculated by using the Fe-Mg exchange coefficient (0.275 ± 0.067) between clinopyroxene and the equilibrated melt [$K_D(Fe–Mg)^{Cpx–melt}$ = $(Fe/Mg)^{Cpx}/(Fe/Mg)^{melt}$ where Fe and Mg are in molar fraction] of Putirka (1999) and Putirka et al. (2003).

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Putirka, K.D., Mikaelian, H., Ryerson, F., Shaw, H., 2003. New clinopyroxene–liquid thermobarometers for mafic, evolved, and volatile-bearing lava compositions, with applications to lavas from Tibet and the Snake River Plain, Idaho. American Mineralogist 88, 1542–1554.

Table S6-In-situ major and trace elements of cpx measured by LA-ICP-MS

No.	06YJL-04 (circle two)					06YJL-24 (circle one)							
Type	Rim	Core	Core	Rim	Rim	Rim	Rim	Rim	Core	Core	Core	Core	Core
SiO_2	52.17	51.14	51.20	51.19	51.00	52.19	51.79	50.96	50.74	51.10	50.07	50.6	50.5
TiO_2	0.41	0.53	0.71	0.57	0.66	0.28	0.33	0.50	0.62	0.56	0.74	0.66	0.73
Al_2O_3	2.30	2.68	3.38	3.45	2.60	1.53	2.07	2.54	2.48	2.52	2.45	2.41	2.73
FeO	6.70	8.73	9.43	7.48	7.37	5.76	5.31	7.16	8.85	7.87	9.68	9.91	9.83
MgO	16.95	15.72	14.04	15.61	16.27	18.28	17.82	16.67	15.88	16.32	15.47	15.4	15.1
MnO	0.16	0.21	0.22	0.17	0.17	0.15	0.13	0.17	0.21	0.20	0.23	0.24	0.25
CaO	19.85	19.72	19.26	20.06	20.82	20.72	21.26	20.71	19.88	20.17	20.11	19.5	19.5
Na_2O	0.59	0.64	0.76	0.73	0.47	0.36	0.42	0.56	0.63	0.59	0.66	0.71	0.73
K_2O	0.03	0.04	0.41	0.08	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
P_2O_5	0.01	0.03	0.06	0.01	0.00	0.03	0.01	0.00	0.04	0.01	0.02	0.00	0.01
Mg#	82.0	76.4	72.8	78.9	79.9	85.1	85.8	80.7	76.4	78.8	74.2	73.7	73.4
Melt Mg#	53.97	45.5	40.8	49.2	50.57	59.53	60.7	51.9	45.4	49.0	42.6	53.97	45.5
Li	25.86	33.59	38.27	41.30	29.03	52.07	34.99	46.81	38.20	33.13	44.53	20.6	48.1
Sc	39.53	55.84	55.51	46.25	50.76	36.00	34.02	46.83	56.44	50.28	51.64	54.6	59.3
V	145	206	210	161	154	90	107	166	188	180	191	199	226
Cr	3149	578	324	1122	1169	2271	3279	1979	1442	1681	639	850	887
Co	41.38	46.39	48.45	45.18	41.52	40.04	40.08	42.49	46.58	45.87	50.5	49.7	47.7
Ni	614	423	271	462	461	775	771	609	463	510	330	314	362
Cu	2.90	13.93	14.92	13.59	11.43	36.15	3.60	9.57	7.45	0.00	0.89	5.50	3.96
Zn	82.4	113.1	129.4	78.3	64.0	52.4	50.6	71.7	120	101.3	133	156	142
Rb	1.05	0.86	13.74	1.09	2.85	0.02	0.00	0.00	0.12	0.00	0.00	0.03	0.24
Sr	268	137	183	156	187	187	217	177	149	159	148	100	90
Y	20.2	31.7	38.4	27.0	23.1	8.5	8.9	24.1	36.3	32.5	39.8	45.0	48.6
Zr	74.8	107.5	128.6	84.1	58.4	12.7	19.6	70.7	105.8	91.8	110.8	121	157
Nb	0.13	0.37	1.29	0.21	0.12	0.03	0.03	0.02	0.13	0.15	0.16	0.20	0.20
Ba	13.4	5.4	180.1	87.9	18.9	0.3	0.2	0.6	0.10	0.20	0.20	0.0	8.0
La	12.7	21.7	32.1	20.3	18.5	5.2	6.0	16.5	27.8	22.7	32.7	33.5	34.1
Ce	50.2	86.3	115	72.7	64.9	21.1	24.2	65.3	102	82.9	123	128.	135
Pr	8.6	14.6	19.0	13.3	11.9	3.6	4.1	11.2	18.0	13.8	20.1	21.7	23.0
Nd	54.3	65.6	82.7	60.2	55.1	20.8	22.5	52.6	83.8	67.4	93.4	105	108
Sm	8.84	16.28	18.02	12.70	12.53	5.56	5.89	11.7	17.39	15.87	21.04	21.7	22.6

Eu	1.87	2.59	3.94	3.01	3.71	1.62	1.57	2.66	3.36	2.93	3.95	4.06	3.89
Gd	5.59	10.24	12.11	7.52	8.29	3.52	3.66	7.23	11.72	10.84	14.12	14.1	14.1
Tb	0.93	1.52	1.63	1.22	1.19	0.43	0.38	1.21	1.87	1.45	1.75	1.96	2.14
Dy	5.39	6.67	8.73	5.77	5.60	2.29	2.14	5.37	8.06	7.40	8.29	10.1	10.5
Ho	0.78	1.19	1.52	0.97	0.90	0.34	0.35	0.87	1.40	1.25	1.32	1.63	1.77
Er	2.07	3.88	3.35	2.98	2.29	1.20	0.99	2.40	3.68	3.19	3.82	4.64	5.10
Tm	0.28	0.42	0.48	0.33	0.25	0.10	0.09	0.28	0.43	0.41	0.51	0.56	0.63
Yb	1.78	2.45	3.44	2.17	2.11	0.63	0.66	1.90	2.98	2.37	3.19	3.98	3.49
Lu	0.20	0.30	0.38	0.28	0.21	0.07	0.07	0.28	0.45	0.35	0.45	0.51	0.50
Hf	2.73	3.38	4.48	2.58	2.29	0.72	0.72	2.82	3.71	3.39	3.46	3.86	5.52
Ta	0.02	0.01	0.09	0.01	0.04	0.01	0.00	0.02	0.02	0.02	0.01	0.02	0.02
Pb	1.15	1.75	6.10	2.17	1.45	0.43	0.43	0.75	1.27	0.96	1.47	1.56	1.58
Th	0.38	0.46	3.05	0.70	0.66	0.05	0.10	0.21	0.42	0.30	0.50	0.46	0.50
U	0.05	0.10	0.76	0.09	0.16	0.01	0.02	0.04	0.06	0.04	0.07	0.06	0.09
Melt Mg#	53.97	45.5	40.8	49.2	50.57	59.53	60.7	51.9	45.4	49.0	42.6	53.97	45.5
Melt Sr	1340	685	915	780	935	935	1085	885	745	795	740	500	450
Melt Y	1340	685	915	780	935	935	1085	885	745	795	740	500	450
Melt Sr/Y	60	20	22	26	37	100	111	33	19	22	17	10	8

Table S6-continued

No	YJL-24 (circle two)							YJL-04 (circle one)					
Type	Rim	Rim	Rim	Rim	Core	Core	Core	Rim	Rim	Rim	Rim	Core	Core
SiO_2	52.06	52.28	52.34	52.83	51.30	51.88	50.71	52.61	52.18	52.29	51.41	50.13	50.64
SiO_2	52.06	52.28	52.34	52.83	51.30	51.88	50.71	52.61	52.18	52.29	51.41	50.13	50.64
TiO_2	0.36	0.39	0.42	0.36	0.67	0.69	0.70	0.30	0.55	0.52	0.68	0.66	0.71
Al_2O_3	1.79	2.64	3.28	2.18	3.52	2.51	2.49	1.76	2.76	2.60	3.73	3.51	4.00
FeO	5.44	4.73	4.81	4.82	7.58	8.82	8.76	5.04	5.85	6.00	5.99	8.26	8.17
MgO	18.31	17.54	16.90	17.87	15.03	14.79	14.86	18.70	16.51	16.56	16.00	14.74	14.01
MnO	0.15	0.13	0.13	0.14	0.18	0.24	0.24	0.14	0.16	0.16	0.14	0.19	0.18
CaO	20.85	20.86	20.53	20.54	19.70	19.76	20.61	20.09	21.04	20.90	20.87	21.29	20.62
Na_2O	0.38	0.53	0.63	0.46	0.69	0.70	0.70	0.44	0.47	0.48	0.54	0.63	0.74
K_2O	0.00	0.00	0.11	0.01	0.72	0.03	0.00	0.04	0.02	0.04	0.08	0.03	0.28

P_2O_5	0.02	0.04	0.04	0.02	0.04	0.02	0.30	0.03	0.02	0.02	0.07	0.02	0.04
Mg#	85.84	86.98	86.34	86.98	78.12	75.12	75.34	86.97	83.55	83.24	82.78	76.25	75.52
Li	33.15	2.53	65.94	34.17	47.82	43.30	45.62	10.66	14.99	39.09	26.92	0.00	36.93
Sc	36.66	37.79	38.24	37.27	44.95	58.55	56.49	31.11	41.12	39.52	43.81	46.92	40.50
V	100	127	141	109	161	217	213	97	153	141	181	169	168
Cr	2061	3752	3138	3071	1038	785	805	3113	747	669	790	804	895
Co	42.04	36.88	34.88	39.77	40.51	52.15	49.93	40.39	44.15	43.62	40.55	43.69	42.26
Ni	751	782	797	800	418	379	347	820	594	586	577	337	261
Cu	6.44	4.24	2.21	8.02	15.45	22.27	7.86	158.37	26.81	8.27	5.34	5.21	0.32
Zn	62.2	53.5	59.9	56.8	82.3	148.0	151.4	71.5	61.7	50.2	62.7	116.3	121.5
Rb	0.00	0.00	3.81	0.49	16.03	1.02	0.02	1.31	0.76	1.41	4.64	2.60	13.87
Sr	181	212	267	194	187	109	108	181	217	219	257	126	141
Y	11.2	11.8	13.4	9.6	29.2	40.2	43.7	8.9	15.6	17.0	18.2	29.4	29.6
Zr	24.5	25.1	32.2	19.2	116.4	117.9	116.5	17.4	39.7	40.5	55.7	102.5	120.2
Nb	0.00	0.09	0.38	0.00	1.74	0.28	0.26	0.09	0.29	0.18	0.33	0.36	1.25
Ba	5.6	0.3	63.5	0.8	81.3	2.6	0.6	5.7	1.2	17.0	10.7	9.8	87.6
La	6.9	6.8	9.8	5.8	27.9	26.2	38.5	4.6	9.8	11.9	13.6	16.6	19.3
Ce	27.5	26.4	31.5	22.9	90.6	100.8	129.4	18.7	38.2	43.3	49.8	63.7	76.7
Pr	4.9	5.0	5.8	4.0	14.9	17.5	21.3	3.2	7.5	7.6	8.8	10.9	14.0
Nd	23.5	25.2	29.1	21.5	65.5	81.7	91.4	17.1	32.9	40.5	46.5	54.9	71.8
Sm	6.41	5.28	6.26	4.91	14.38	18.46	20.98	4.94	7.61	7.93	9.92	12.09	15.94
Eu	1.67	1.71	2.06	1.74	3.16	3.54	4.03	1.35	2.59	2.62	2.75	2.65	3.33
Gd	4.15	2.83	4.12	3.23	9.02	11.95	13.28	2.39	5.44	5.97	6.10	11.81	15.80
Tb	0.60	0.54	0.58	0.39	1.35	1.62	1.81	0.36	0.65	0.83	0.88	1.44	2.16
Dy	2.83	2.69	3.21	2.89	5.86	8.48	9.09	2.26	3.37	4.34	4.56	7.12	10.51
Ho	0.42	0.45	0.48	0.44	1.15	1.34	1.55	0.29	0.56	0.66	0.74	1.24	1.84
Er	1.10	1.09	1.36	0.97	2.58	4.11	4.47	0.90	1.52	1.66	1.79	3.27	4.54
Tm	0.11	0.16	0.13	0.11	0.43	0.44	0.52	0.11	0.14	0.18	0.17	0.54	0.82
Yb	0.84	0.72	0.91	0.87	2.16	3.65	3.75	0.54	1.13	1.45	1.35	2.84	4.08
Lu	0.12	0.12	0.10	0.11	0.25	0.55	0.47	0.09	0.16	0.21	0.18	0.33	0.40
Hf	0.72	1.12	1.29	0.89	3.83	3.67	4.12	0.67	1.55	1.56	2.29	3.24	3.18
Ta	0.01	0.01	0.05	0.00	0.13	0.04	0.01	0.01	0.02	0.03	0.01	0.07	0.13
Pb	0.79	1.34	2.58	1.47	6.79	1.77	2.00	1.22	0.69	1.00	1.54	1.73	4.51
Th	0.11	0.08	0.74	0.10	4.12	0.40	0.82	0.09	0.16	0.37	0.56	0.96	3.66

U	0.02	0.02	0.20	0.01	0.91	0.06	0.14	0.03	0.04	0.07	0.15	0.15	0.84
Melt Mg#	60.93	63.22	61.95	63.21	47.89	43.73	44.01	63.23	56.67	56.12	55.31	45.27	60.93
Melt Sr	905	1060	1335	970	935	545	540	905	1085	1095	1285	630	705
Melt Y	12.3	13.0	14.7	10.5	32.1	44.2	48.0	9.8	17.1	18.7	20.0	32.3	32.5
Melt Sr/Y	74	82	91	92	29	12	11	93	63	59	64	20	22

Table S6-continued

No.	06YJL-24	06YJL-24	06YJL-04	06YJL-04	06YJL-04	06YJL-04
Type	Unzoned					
SiO_2	51.75	52.45	52.53	52.68	51.74	51.24
TiO_2	0.30	0.48	0.31	0.29	0.36	0.70
Al_2O_3	2.28	2.43	2.45	1.79	2.48	3.05
FeO	5.06	5.68	6.31	5.22	4.97	6.52
MgO	18.62	16.98	18.66	18.93	17.98	16.21
MnO	0.14	0.15	0.16	0.15	0.13	0.16
CaO	20.57	20.94	18.43	19.74	20.92	21.10
Na_2O	0.42	0.44	0.39	0.45	0.52	0.47
K_2O	0.00	0.01	0.02	0.01	0.02	0.03
P_2O_5	0.02	0.01	0.02	0.03	0.02	0.03
Mg#	86.89	84.33	84.19	86.71	86.70	81.73
Li	43.11	21.49	46.15	23.14	44.75	37.63
Sc	19.25	37.09	0.00	33.21	37.19	48.54
V	154	146	164	109	131	169
Cr	3963	622	2832	2593	3331	796
Co	39.05	43.30	42.21	40.19	39.02	42.89
Ni	251	628	257	850	808	540
Cu	3.93	4.51	5.21	4.81	9.81	7.24
Zn	60.1	56.1	83.0	55.3	42.3	58.0
Rb	0.11	0.00	0.61	0.17	0.80	1.06
Sr	148	218	167	172	209	208
Y	6.9	13.9	8.5	9.5	10.5	21.7
Zr	11.5	33.0	16.8	18.4	21.7	62.3

Nb	0.01	0.10	0.11	0.06	0.08	0.06
Ba	0.1	0.3	3.2	1.4	1.3	2.6
La	4.6	8.9	7.1	4.8	7.1	14.8
Ce	16.2	33.4	23.1	17.9	25.8	57.4
Pr	2.6	6.3	3.5	3.3	4.8	10.0
Nd	14.4	27.9	15.2	15.4	21.0	51.4
Sm	2.78	8.03	3.46	4.76	5.60	10.77
Eu	0.83	2.06	0.98	1.48	1.85	3.28
Gd	2.90	5.14	3.62	2.94	3.77	7.59
Tb	0.44	0.68	0.40	0.42	0.46	1.04
Dy	2.68	3.19	2.57	2.27	2.78	5.21
Ho	0.35	0.51	0.42	0.31	0.37	0.92
Er	0.81	1.32	0.91	0.86	1.03	2.32
Tm	0.14	0.15	0.19	0.07	0.10	0.29
Yb	0.73	0.82	0.87	0.57	0.79	1.74
Lu	0.09	0.12	0.10	0.10	0.10	0.22
Hf	0.56	1.37	0.77	0.77	1.01	1.96
Ta	0.00	0.01	0.01	0.00	0.00	0.03
Pb	0.45	0.65	0.67	0.89	1.23	1.07
Th	0.07	0.16	0.38	0.06	0.11	0.34
U	0.02	0.02	0.06	0.03	0.03	0.07
Melt Mg#	63.04	58.08	57.81	62.70	62.64	63.04
Melt Sr	740	1090	835	860	1045	740
Melt Y	7.6	15.3	9.3	10.4	11.5	7.6
Melt Sr/Y	98	71	89	82	91	98

The melt Mg# values are inversely calculated by using the same methods of Table S5. The melt Sr and melt Y refer to inversely calculated concentrations of melt in equilibrium with the cpx. Partition coefficients between andesite/trachyte and cpx (0.20 for Sr and 0.91 for Y) are used because the composition of the EARs (see GERM (Geochemical Earth Reference Model) home page, http://www.earthref.org/).

Table S7-Published data for EARs

Samples	13SW 28-01	13SW 28-02	13SW 29-01	13SW29-02	13SW 29-03	13SW 30-1	13SW 30-2	13SW 31-1	13SW 31-2	13SW 32-1	13SW 33-1
Ref.	1	1	1	1	1	1	1	1	1	1	1
SiO_2	69.55	69.49	68.52	68.75	69.14	69.42	69.36	69.32	69.29	70.7	70.56
TiO_2	0.44	0.42	0.38	0.39	0.37	0.39	0.41	0.41	0.42	0.38	0.41
Al_2O_3	14.99	14.86	14.89	14.82	15.03	15.06	15.15	14.96	14.96	14.63	14.69
Fe_2O_3	3.2	3.4	2.58	2.5	2.55	3.36	3.38	3.42	3.36	2.99	3.09
MnO	0.03	0.03	0.06	0.06	0.07	0.02	0.02	0.03	0.03	0.04	0.03
MgO	0.4	0.41	0.46	0.5	0.54	0.43	0.36	0.36	0.36	0.37	0.42
CaO	1.94	1.94	2.06	2.1	2.08	1.96	2.03	2.01	2.01	1.54	1.43
Na_2O	3.26	3.22	3.14	3.13	3.06	3.44	3.42	3.58	3.5	3.17	2.86
K_2O	4.25	4.16	4.21	4.2	4.18	4.11	4.06	4.19	4.1	4.23	4.21
P_2O_5	0.15	0.15	0.13	0.13	0.12	0.12	0.12	0.13	0.13	0.13	0.14
Mg#	20	19	26	28	30	20	17	17	17	19	21
Cr	141	276	268	231	353	106	113	165	153	227	147
Ni	28.7	42.5	32.9	25.1	37.7	24.8	22.1	29.7	27.9	31	30.1
Rb	191	185	213	202	209	199	176	191	193	215	206
Ba	1445	1320	1316	1345	1338	1263	1147	1231	1261	1258	1271
Th	27.2	27	25.1	26.1	25.5	24.9	24.4	24.8	24.5	24.2	24.9
Nb	8.4	8.2	9.8	9.3	9.7	9	8.2	9.1	8.9	10.4	10
Ta	0.71	0.68	0.9	0.85	0.91	0.86	0.8	0.82	0.82	1.01	0.92
La	56.88	55.49	48.64	47.74	49.16	48.11	46.77	50.17	49.25	48.1	49.81
Ce	99.91	97.24	83.52	82.59	84.43	81.44	77.65	85.91	83.28	84.35	86.41
Pr	10.75	10.41	8.87	8.79	9	8.5	7.99	8.6	8.23	8.91	9.31
Sr	538	535	568	561	575	542	502	532	544	464	458
Nd	36.42	35.25	29.57	29.29	30.04	28.48	25.72	28.41	27.13	30.23	31.45
Zr	175	177	177	166	167	149	151	159	159	146	179
Hf	4.74	4.82	4.91	4.69	4.6	4.34	4.64	4.61	4.58	4.29	4.86
Sm	5.29	5.14	4.28	4.26	4.29	4.12	3.65	4.12	3.88	4.39	4.58
Eu	1.25	1.21	1	1	0.99	1.07	1.01	1.09	1.07	1.06	1.05
Gd	3.97	3.76	3.21	3.15	3.22	3.14	2.71	3.14	2.95	3.3	3.42
Tb	0.43	0.41	0.36	0.36	0.37	0.36	0.3	0.36	0.33	0.38	0.4
Dy	2.1	2	1.88	1.86	1.92	1.83	1.55	1.8	1.69	1.92	1.99
Y	9.9	9.34	9.64	9.35	9.81	8.89	7.48	8.6	8.23	9.24	10.07
Ho	0.38	0.36	0.36	0.35	0.36	0.34	0.29	0.34	0.31	0.36	0.37
Er	0.98	0.92	0.97	0.95	0.99	0.91	0.77	0.87	0.83	0.93	0.98
Tm	0.14	0.13	0.15	0.14	0.15	0.13	0.11	0.13	0.12	0.13	0.14
Yb	0.91	0.83	0.98	0.93	0.98	0.86	0.74	0.81	0.75	0.89	0.9
Lu	0.14	0.13	0.16	0.15	0.16	0.13	0.11	0.12	0.11	0.14	0.14
$(^{87}Sr/^{86}Sr)_i$	0.7077			0.7077		0.7078		0.7078		0.7077	
$(^{143}Nd/^{144}Nd)_i$	0.512322			0.512313		0.512323		0.512317		0.512331	
εNd(t)	-5.1			-5.3		-5.1		-5.2		-4.9	

Table S-7 continued

Samples	13SW 34-1	13SW 34-2	14QW 334-3	14QW 335-1	14QW 335-2	14QW 335-3	13SW 44-1	13SW 44-2	13SW 44-3	13SW 45-1	13SW 45-2
Ref.	1	1	1	1	1	1	1	1	1	1	1
SiO_2	69.52	69.6	68.98	69.04	68.99	69.31	64.98	64.44	66.05	65.61	65.13
TiO_2	0.38	0.39	0.4	0.31	0.3	0.3	0.6	0.6	0.66	0.58	0.57
Al_2O_3	15.35	15.36	15.44	14.7	14.6	14.73	15.31	15.37	15.71	15.57	15.66
Fe_2O_3	3.15	3.06	3.29	2.3	2.12	2.19	3.94	4.12	4.44	3.74	3.73
MnO	0.02	0.01	0.02	0.06	0.05	0.05	0.06	0.08	0.04	0.05	0.06
MgO	0.32	0.29	0.38	0.88	0.89	0.9	1.22	1.4	0.65	1.11	1.09
CaO	2.02	1.9	2.29	2.34	2.24	2.25	2.96	3.02	2.78	2.64	2.73
Na_2O	3.31	3.24	3.3	3.47	3.47	3.58	3.41	3.54	3.47	3.5	3.46
K_2O	4	3.97	3.96	4.52	4.47	4.38	4.11	4.03	4.49	4.13	4.13
P_2O_5	0.06	0.06	0.05	0.08	0.07	0.07	0.21	0.23	0.24	0.2	0.19
Mg#	17	16	19	43	45	45	38	40	23	37	37
Cr	82	68	76	294	155	192	143	267	214	147	141
Ni	28.2	25.5	29.9	27.8	20.9	19.9	16.9	27.1	29.1	17.6	24.7
Rb	201	199	193	232	223	225	142	158	142	158	155
Ba	1247	1173	1201	1306	1265	1285	1802	2239	1743	1953	1957
Th	27.3	27	26.4	29.8	27.1	70.1	23.8	25.7	22.7	25.3	26.2
Nb	6	5.8	5.6	7.7	7.3	6.9	11.3	12.6	9.9	12.1	12
Ta	0.5	0.49	0.46	0.72	0.68	0.66	0.91	0.96	0.9	0.96	0.95
La	43.69	45.95	40.72	42.38	35.07	39.65	80.29	89.01	67.53	80.57	90.84
Ce	79.16	80.41	72.21	74.55	60.52	69	149	159.3	125.4	143.3	160.9
Pr	8.28	8.52	8.01	7.67	6.56	7.09	15.93	17.14	12.91	15.2	16.92
Sr	376	352	420	428	409	410	1144	1293	1058	1314	1327
Nd	29.42	29.6	28.74	25.91	22.31	23.88	52.06	57.33	42.6	49.7	54.93
Zr	159	160	160	148	145	139	185	161	182	180	139
Hf	4.63	4.52	4.54	4.45	4.41	4.16	5.24	4.37	5.08	4.76	3.87
Sm	4.55	4.47	4.62	3.75	3.35	3.42	6.96	7.49	5.72	6.33	6.79
Eu	1.02	1.01	1.05	0.81	0.75	0.75	1.53	1.67	1.49	1.49	1.54
Gd	3.57	3.42	3.77	2.86	2.61	2.59	4.8	5.25	4.06	4.56	4.8
Tb	0.41	0.39	0.45	0.32	0.29	0.29	0.52	0.57	0.44	0.47	0.49
Dy	2.11	2	2.51	1.61	1.5	1.44	2.7	2.89	2.24	2.36	2.47
Y	9.94	9.61	15.28	7.97	7.41	7.09	12.67	14.17	10.71	11.83	12.28
Ho	0.4	0.37	0.52	0.3	0.28	0.27	0.5	0.55	0.42	0.44	0.47
Er	1.02	0.95	1.51	0.78	0.74	0.71	1.35	1.46	1.12	1.2	1.25
Tm	0.15	0.14	0.23	0.11	0.11	0.1	0.2	0.21	0.17	0.18	0.19
Yb	0.94	0.9	1.58	0.74	0.7	0.67	1.29	1.35	1.07	1.18	1.2
Lu	0.14	0.13	0.26	0.12	0.11	0.1	0.2	0.21	0.16	0.19	0.18
$(^{87}Sr/^{86}Sr)_i$								0.7076	0.7078		
$(^{143}Nd/^{144}Nd)_i$								0.512291	0.51228		
$\varepsilon Nd(t)$								-5.7	-5.9		

Table S. 7-continued

Samples	13SW 45-3	13SW 45-4	13SW 45-5	LQS -2	LQS -3	LQS -6	LQS -7	LQS -14	D50 85	D50 87
Ref.	1	1	1	2	2	2	2	2	2	2
SiO_2	64.96	65.33	64.96	61.76	63.29	58.05	57.53	67.7	58.59	62.01
TiO_2	0.59	0.54	0.56	0.51	0.55	0.77	0.78	0.45	0.79	0.84
Al_2O_3	15.42	15.49	15.35	14.87	15.03	15.49	15.56	15.96	15.22	15.4
Fe_2O_3	3.83	3.81	3.86	4.81	4.84	6.19	5.97	3.34	7.2	5.33
MnO	0.07	0.07	0.07	0.07	0.04	0.09	0.1	0.05	0.09	0.07
MgO	1.43	1.16	1.3	5.44	4.02	4.67	6.09	1.67	5.74	4.43
CaO	2.85	2.86	3.07	5.21	4.69	7.75	7.11	3.19	6.35	4.53
Na_2O	3.45	3.65	3.56	3.95	3.96	4.03	3.9	4.26	3.04	2.98
K_2O	4	4.02	4	3.32	3.53	2.5	2.47	3.25	2.93	4.33
P_2O_5	0.21	0.22	0.21	0.06	0.06	0.47	0.49	0.15	0.04	0.08
Mg#	43	38	40	69	62	60	67	50	61	62
Cr	138	211	198	212	253	209	211	33.7	368	176
Ni	17.1	29	23.2	146	125	150	152	23.9	173	92.2
Rb	156	161	95	84.2	95.1	56	56.6	98.8	84.6	157
Ba	1876	1961	1840	1741	1880	1520	1604	1296	1957	1923
Th	25.4	24.9	15	17	15.8	14.9	16	19.7	13.4	29.1
Nb	11.9	12	12	7.56	8.31	11.9	12.4	4.9	9.61	14.5
Ta	0.91	0.95	0.92	0.47	0.5	0.69	0.73	0.33	0.66	1.14
La	90.03	80.52	53.46	56.1	47.7	73.1	76.9	52.2	45	69.8
Ce	159.5	145.2	100.2	92.2	70	128	134	90	92.9	118
Pr	17.07	15.51	10.34	10.3	7.59	14.5	15.5	10.1	7.98	12.9
Sr	1234	1280	965	2276	2113	2118	2256	816	1876	1552
Nd	56.57	50.98	36.45	36.6	26.4	51.2	54.9	34.7	28.7	43.6
Zr	151	164	171	183	199	217	223	239	211	299
Hf	4.05	4.44	4.57	4.45	4.79	4.68	5	5.8	5.11	6.71
Sm	7.21	6.62	5.34	5.39	3.93	7.34	7.97	5.07	4.66	6.13
Eu	1.54	1.54	1.23	1.45	1.7	1.79	1.84	1.08	1.21	1.6
Gd	5.17	4.76	4.18	2.77	2.13	4.34	4.44	2.86	3.1	3.44
Tb	0.54	0.5	0.47	0.41	0.34	0.66	0.67	0.41	0.45	0.49
Dy	2.79	2.55	2.48	1.82	1.65	3.27	3.24	1.8	2.45	2.42
Y	13.87	12.81	13.02	8.99	7.85	16.6	16.9	8.49	12	11.7
Ho	0.53	0.49	0.48	0.32	0.29	0.59	0.61	0.33	0.49	0.43
Er	1.4	1.32	1.32	0.84	0.75	1.45	1.52	0.81	1.24	1.14
Tm	0.2	0.19	0.19	0.13	0.12	0.21	0.22	0.12	0.19	0.15
Yb	1.31	1.26	1.26	0.89	0.83	1.45	1.45	0.79	1.21	0.96
Lu	0.2	0.19	0.19	0.14	0.14	0.24	0.24	0.13	0.19	0.15
$(^{87}Sr/^{86}Sr)_i$	0.7076	0.7076		0.7065	0.7067	0.7068	0.7067	0.7072	0.7063	0.7070
$(^{143}Nd/^{144}Nd)_i$	0.512295	0.51228		0.512461	0.512454	0.51244	0.512463	0.512445	0.51237	0.512382
εNd(t)	-5.6	-5.9		-3.45	-3.59	-3.87	-3.41	-3.77	-5.23	-5

Table S. 7-continued

Samples	D5096	D5079-1	D5136-3	D5137-2	9013-1	5079-5-1	7509-1	Z19H5	Z19H6	Z08H1
Ref.	2	2	2	2	4	4	4	3	3	3
SiO_2	63.03	65.32	61.31	58.6	62	62.35	59.78	65.27	64.99	62.54
TiO_2	0.83	0.71	0.92	0.91	0.79	0.74	1.13	0.4	0.39	0.69
Al_2O_3	15.9	14.76	16	16.85	15.3	15.14	15.15	15.13	14.95	15.3
Fe_2O_3	4.72	4.47	5.73	5.79	5.04	4.96	5.57	3.07	3.07	4.18
MnO	0.06	0.06	0.09	0.12	0.11	0.07	0.07	0.05	0.05	0.06
MgO	3.57	3.72	4.12	4.29	4.18	4.31	4.66	2.5	2.51	3.79
CaO	4.31	3.69	5.03	6.47	4.46	4.49	4.38	3.51	3.51	4.52
Na_2O	3.34	2.66	3.19	3.47	2.86	2.83	3.06	3.68	3.59	3.61
K_2O	4.17	4.52	3.4	3.43	4.41	3.92	4.96	3.75	3.76	3.3
P_2O_5	0.09	0.09	0.21	0.06	0.07	0.1	0.04	0.17	0.18	0.31
Mg#	60	62	59	60	62	63	63	62	62	64
Cr	159	151	162	307	162	178	196	69.2	71.4	243
Ni	82	73.6	85.8	97.5	94.5	94.9	118	43.1	42.9	148
Rb	158	181	113	86.3	159	151	194	153	153	115
Ba	2255	1844	1290	1447	2153	2128	1699	1161	1172	1732
Th	23.6	22.7	15.8	11.2	25.4	23.6	14	14.9	14.9	24
Nb	13.6	12.7	9.17	9.11	12.7	12.9	13.3	6.12	6.19	8.79
Ta	0.96	0.98	0.65	0.65	0.92	0.94	0.84	0.54	0.56	0.59
La	60.2	61.9	43.2	18.1	68.9	73.9	24.7	30.7	30.6	68.2
Ce	103	110	73.9	32.9	110	129	38.8	54.2	54.3	123
Pr	11.2	12.3	8.38	3.83	12	13.6	4.15	5.9	5.9	13
Sr	1747	1095	917	1281	1601	1607	1496	728	716	1151
Nd	38.4	41.4	30.2	15.1	41.5	46.6	15.2	21.4	21.7	48.9
Zr	306	282	228	231	271	279	431	138	144	204
Hf	7.09	6.54	5.41	5.51	6.33	6.6	10.6	3.66	3.79	5.08
Sm	5.22	5.93	4.82	2.8	5.86	6.45	2.92	3.57	3.68	7.36
Eu	1.66	1.43	1.41	1.39	1.52	1.56	1.6	0.94	0.96	1.82
Gd	2.84	3.38	3.16	2.17	3.09	3.78	2.12	2.84	2.94	5.79
Tb	0.43	0.54	0.47	0.31	0.45	0.51	0.33	0.38	0.38	0.68
Dy	2	2.68	2.44	1.74	2.23	2.56	1.79	1.84	1.92	3.37
Y	9.58	13.2	11.8	7.98	10.6	12.8	8.58	11	11.1	17.7
Ho	0.35	0.5	0.44	0.32	0.4	0.46	0.34	0.37	0.37	0.6
Er	0.93	1.32	1.13	0.84	1.04	1.24	0.84	0.94	0.95	1.62
Tm	0.12	0.19	0.16	0.12	0.14	0.17	0.14	0.15	0.15	0.24
Yb	0.79	1.17	1.01	0.76	0.86	1.05	1.01	0.93	0.94	1.43
Lu	0.13	0.19	0.16	0.13	0.13	0.17	0.16	0.14	0.14	0.21
$(^{87}Sr/^{86}Sr)_i$	0.7071	0.7077	0.7077		0.7070	0.7072	0.7068			0.7073
$(^{143}Nd/^{144}Nd)_i$	0.51236	0.512287	0.512369		0.512408	0.512353	0.512484			0.512369
εNd(t)	-5.42	-6.84	-5.24		-4.49	-5.56	-3			-5.25

Table S7-continued

Samples	D5139	D5140	D5141	D5130-2	D5130-3	D5131-1	D5132-1	D5132-2	D5135-1	D5135-2	D5135-3	D5136-1
Reference	2	2	2	2	2	2	2	2	2	2	2	2
SiO_2	63.17	66.16	62.19	56.1	61.73	62.8	64.4	64.28	61.29	63.82	65.17	60.86
TiO_2	0.85	0.56	0.68	1.03	0.75	0.84	0.69	0.69	0.88	0.8	0.7	0.87
Al_2O_3	15.96	15.41	14.69	15.4	15.69	16.23	16.09	16.25	16.13	16.21	16.02	16.1
Fe_2O_3	5.7	3.89	5.27	7.16	5.61	5.25	4.74	4.97	5.76	5.32	4.42	5.81
MnO	0.09	0.04	0.06	0.1	0.08	0.08	0.03	0.03	0.21	0.05	0.06	0.18
MgO	2.8	2.88	5.87	6.08	4.54	3.4	1.99	1.84	3.43	2.61	2.91	3.8
CaO	4.53	4.07	4.96	6.94	4.71	4.48	4.37	4.15	5.55	4.18	3.86	5.58
Na_2O	3.46	3.36	3.19	3.52	3.27	3.54	4.51	4.57	3.49	3.51	3.35	3.5
K_2O	3.31	3.58	3.05	3.4	3.55	3.33	3.13	3.18	3.18	3.35	3.49	3.15
P_2O_5	0.14	0.05	0.05	0.25	0.08	0.05	0.04	0.04	0.07	0.14	0.03	0.16
Mg#	50	60	69	63	62	56	46	43	54	50	57	57
Cr	235	169	383	362	206	116	121	127	224	132	110	239
Ni	86.2	103	183	144	101	67.3	59.3	56.6	87.5	72.7	56	110.5
Rb	127	117	90.4	86.6	118	100	98.5	103	94.1	107	109	99.4
Ba	1300	1483	1431	1786	1838	1757	1968	2064	1618	1356	1400	1563
Th	17.7	17.5	16.4	22.4	23	19.1	13.1	13.3	14.7	16.1	17.3	15.2
Nb	7.07	8.48	7.25	14.8	9.81	10.6	7.78	7.47	9.9	9.33	8.85	9.81
Ta	0.52	0.57	0.47	0.85	0.59	0.65	0.5	0.51	0.64	0.6	0.59	0.65
La	33.7	50.1	39.3	61.8	52.4	43.9	25.1	27.3	31.2	26.7	33.2	35.9
Ce	58	92.7	66.2	112	88.7	69.7	45.8	43.9	53.8	46.6	55	66.2
Pr	6.1	10.4	6.79	13	9.37	7.25	4.75	5.16	5.61	5.02	5.56	7.32
Sr	851	1220	1443	1669	1135	1073	959	1030	1188	892	878	1191
Nd	20.8	35.1	22.7	47.3	31.1	24.3	17.2	19.2	20.5	17.8	17.9	26.6
Zr	180	217	198	305	263	273	206	198	218	221	222	221
Hf	4.46	5.27	4.66	6.87	5.93	5.86	5.09	4.85	5.31	5.39	5.56	5.2
Sm	3.18	5.13	3.53	7.11	4.4	3.46	3.01	3.15	3.39	2.78	2.7	4.09
Eu	1	1.23	1.33	2.16	1.38	1.38	1.02	1.15	1.39	1.16	1.15	1.51
Gd	1.97	2.86	2.26	4.16	2.5	2.06	2.04	2.19	2.34	1.76	1.63	2.6
Tb	0.32	0.41	0.36	0.62	0.39	0.32	0.32	0.32	0.35	0.27	0.26	0.41
Dy	1.7	2.08	1.97	3.16	1.99	1.66	1.74	1.72	2	1.47	1.44	2.15
Y	8.82	10.3	9.77	15.4	9.89	8.07	8.47	8.36	9.61	6.63	6.96	10.3
Ho	0.33	0.38	0.38	0.6	0.37	0.31	0.34	0.34	0.39	0.28	0.28	0.41
Er	0.93	1.01	1	1.51	0.99	0.8	0.88	0.87	0.99	0.7	0.74	1.07
Tm	0.14	0.15	0.15	0.21	0.14	0.12	0.13	0.13	0.15	0.1	0.11	0.15
Yb	0.87	0.91	0.94	1.33	0.91	0.73	0.81	0.81	0.94	0.63	0.72	0.92
Lu	0.14	0.14	0.15	0.2	0.15	0.12	0.13	0.13	0.15	0.1	0.12	0.15
$(^{87}Sr/^{86}Sr)_i$		0.7069				0.7073		0.7070				
$(^{143}Nd/^{144}Nd)_i$		0.512436				0.512386		0.512434				
εNd(t)		-3.94				-4.92		-3.98				

Table S7-continued

Samples	D5144-2	D5144-3	D5144-4	D5144-5	D5144-7	3118	LQS-7	7509-1	9020-2	9020-6
Reference	2	2	2	2	2	4	4	4	4	4
SiO_2	60.29	63.52	64.32	64.58	60.57	61.01	57.31	59.78	64.85	60.13
TiO_2	0.89	0.55	0.61	0.61	0.83	0.58	0.78	1.13	0.6	0.92
Al_2O_3	16.35	15.54	15.46	15.45	15.93	15.28	15.5	15.15	14.88	14.67
Fe_2O_3	5.93	4.83	4.48	4.43	5.53	4.83	5.95	5.57	4.06	5.45
MnO	0.07	0.06	0.17	0.08	0.05	0.07	0.1	0.07	0.06	0.1

MgO	3.89	4.02	3.39	3.3	3.7	4.37	6.07	4.66	2.54	4.34
CaO	5.89	4.16	4.24	4.2	5.79	6.15	7.09	4.38	3.48	5.8
Na_2O	3.16	3.73	3.61	3.64	3.46	3.76	3.89	3.06	2.59	2.89
K_2O	3.33	3.55	3.59	3.63	4.12	3.61	2.46	4.96	4.65	4.63
P_2O_5	0.2	0.03	0.13	0.08	0.02	0.21	0.48	0.04	0.23	0.45
Mg#	57	62	60	60	57	64	67	63	56	61
Cr	291	194	183	171	206	108	211	196	79	228
Ni	104	124	132	121	88	101	152	118	33.4	137
Rb	109	124	127	114	105	81.5	56.6	194	184	142
Ba	1358	1554	1952	1672	2120	1676	1604	1699	1502	2635
Th	16.1	11.6	19.2	17.8	13.4	16.1	16	14	30.2	21.2
Nb	9.53	6.71	7.57	7.72	8.9	6.06	12.4	13.3	13.2	12.7
Ta	0.67	0.47	0.5	0.51	0.53	0.48	0.73	0.84	1.18	0.76
La	41.6	31.4	50.6	42.4	49.2	56	76.9	24.7	77.4	87.1
Ce	75.6	47.4	91.1	78	81.6	106	134	38.8	133	157
Pr	8.94	4.94	9.7	8.24	8.3	13	15.5	4.15	14.6	19.1
Sr	1152	1301	1519	1481	1907	2472	2256	1496	1085	2000
Nd	31.8	17.9	33.2	29	28.3	48.9	54.9	15.2	49.2	69.6
Zr	217	172	212	204	207	169	223	431	266	373
Hf	5.08	4.4	5.1	5.03	4.91	4.7	5	10.6	5.94	8.43
Sm	4.84	2.83	4.77	4.4	4.18	7.57	7.97	2.92	6.93	10
Eu	1.44	1.16	1.27	1.29	1.44	1.76	1.84	1.6	1.44	2.3
Gd	3	1.77	2.66	2.52	2.46	4.12	4.44	2.12	3.79	5.3
Tb	0.47	0.27	0.39	0.38	0.35	0.59	0.67	0.33	0.59	0.75
Dy	2.42	1.46	1.99	1.88	1.73	2.8	3.24	1.79	2.88	3.5
Y	12	7.86	10.14	9.15	8.33	13.9	16.9	8.58	14.8	16.6
Ho	0.45	0.29	0.37	0.34	0.33	0.54	0.61	0.34	0.51	0.61
Er	1.22	0.78	0.97	0.95	0.86	1.42	1.52	0.84	1.31	1.53
Tm	0.17	0.12	0.14	0.13	0.12	0.22	0.22	0.14	0.18	0.21
Yb	1.05	0.85	0.9	0.85	0.77	1.48	1.45	1.01	1.24	1.37
Lu	0.17	0.14	0.14	0.13	0.13	0.25	0.24	0.16	0.19	0.21
$(^{87}Sr/^{86}Sr)_i$					0.7065		0.7067	0.7068	0.7078	0.7066
$(^{143}Nd/^{144}Nd)_i$					0.512417		0.512463	0.512484	0.512327	0.512423
εNd(t)					-4.31		-3.41	-3	-6.07	-4.19

Table 7-continued

Samples	5079-6-1	8540	5132-4	5130-1	5130-4	5130-5	5131-2-1	5137-1	5141	5144-1
Ref.	4	4	4	4	4	4	4	4	4	4
SiO_2	64.48	59.62	63.13	55.33	61.96	61.95	62.9	57.25	61.58	63.89
TiO_2	0.66	0.88	0.67	1.01	0.84	0.82	0.8	0.89	0.67	0.6
Al_2O_3	15.32	15.1	15.22	15.11	15.48	15.34	15.48	16.47	14.55	15.31
Fe_2O_3	4.24	5.47	4.89	7.2	5.41	5.05	5.07	6.26	5.22	4.29
MnO	0.06	0.08	0.08	0.17	0.07	0.07	0.07	0.11	0.06	0.07
MgO	3.01	4.33	2.79	6.34	3.38	3.29	3.31	4.99	5.82	3.51
CaO	3.92	6.24	4.72	6.64	4.88	4.7	4.54	6.39	4.91	4.21
Na_2O	3.08	2.83	3.74	3.12	3.65	3.54	3.82	3.35	3.15	3.58
K_2O	4.14	4.07	3.15	3.34	3.12	3.5	3.46	3.35	3.02	3.51
P_2O_5	0.16	0.27	0.2	0.28	0.24	0.27	0.3	0.09	0.05	0.16
Mg#	59	61	53	64	56	57	57	61	69	62
Cr	116	215	135	354	109	114	103	314	383	168
Ni	54	105	82.2	154	67.1	65.1	62.8	119	183	114
Rb	142	150	112	88.3	100	109	113	90.3	90.4	122
Ba	1803	2329	1686	1845	1805	1715	1541	1403	1431	1705
Th	21.6	21.1	18	21.2	23.8	24.7	26	12.3	16.4	18.6
Nb	10.6	13.6	8.6	14.4	10.5	11.5	12.4	9.06	7.25	7.53

Ta	0.74	0.85	0.48	0.84	0.58	0.61	0.66	0.62	0.47	0.5
La	57.3	74.5	47.6	60.5	65.3	70.5	78.3	22.5	39.3	52.4
Ce	113	130	86.8	119	113	120	134	40.7	66.2	94.3
Pr	11.1	14.9	9.76	12.9	12.4	13.4	14.9	4.82	6.79	10.2
Sr	1089	1937	1109	1616	987	1047	1092	1250	1443	1495
Nd	38	51.7	34.2	46.8	42.8	45.1	49	18.4	22.7	35.5
Zr	255	308	201	314	242	258	266	229	198	205
Hf	6.07	6.63	5	7.02	5.82	5.91	6.19	5.44	4.66	4.99
Sm	5.27	7.19	5.43	7.13	6.22	6.44	7.01	3.22	3.53	5.14
Eu	1.27	1.81	1.12	2.11	1.28	1.32	1.45	1.37	1.33	1.39
Gd	2.83	4.11	4	4.44	4.08	4.15	4.01	2.3	2.26	2.7
Tb	0.43	0.61	0.51	0.62	0.52	0.54	0.55	0.33	0.36	0.4
Dy	2.08	2.9	2.8	3.18	2.69	2.63	2.61	1.86	1.97	2.03
Y	9.89	14.8	14.8	14.9	14	14.3	13.9	8.7	9.77	9.78
Ho	0.37	0.52	0.5	0.58	0.48	0.46	0.46	0.35	0.38	0.38
Er	0.95	1.33	1.3	1.48	1.21	1.2	1.19	0.93	1	0.99
Tm	0.13	0.19	0.21	0.2	0.18	0.17	0.17	0.13	0.15	0.14
Yb	0.77	1.25	1.19	1.25	1.08	1.05	1.01	0.84	0.93	0.85
Lu	0.12	0.22	0.2	0.21	0.18	0.17	0.16	0.14	0.15	0.14
$(^{87}Sr/^{86}Sr)_i$	0.7074	0.7071	0.7071	0.7073	0.7070		0.7068	0.7070	0.7057	0.7062
$(^{143}Nd/^{144}Nd)_i$	0.512356	0.512391	0.512426	0.512378	0.512413		0.512404	0.512478	0.512461	0.512494
εNd(t)	-5.5	-4.82	-4.13	-5.07	-4.4		-4.56	-3.12	-3.45	-2.81

Table S7-continued

Samples	7509-3	7509-4	CH-1A	Z02H1	Z07H1	Z07H2	Z07H3	Z07H4	Z07H5	Z07H6
Ref.	4	4	5	3	3	3	3	3	3	3
SiO_2	67.48	67.53	71.86	61.13	58.71	58.3	62.09	58.44	62.31	63.58
TiO_2	0.67	0.67	0.32	0.7	0.72	0.71	0.59	0.71	0.65	0.65
Al_2O_3	14.74	14.8	15.2	15.62	14.03	13.95	15.24	13.92	15.3	15.28
Fe_2O_3	3.96	4.03	1.36	4.6	5.28	5.31	5.09	5.14	4	4.85
MnO	0.05	0.05	0.01	0.06	0.08	0.08	0.08	0.08	0.06	0.05
MgO	2.06	2.13	0.19	3.75	5.42	5.86	4.18	5.47	4.23	3.61
CaO	3.43	3.49	0.23	5.6	5.99	5.9	4.89	6.31	4.62	4.58
Na_2O	3.46	3.47	0.69	3.79	2.89	3.09	3.47	2.96	3.12	3.41
K_2O	4.07	4.04	7.09	3.27	3.48	3.5	3.29	3.4	3.33	3.19
P_2O_5	0.2	0.2	0.1	0.38	0.35	0.36	0.21	0.36	0.26	0.25
Mg#	51	51	22	62	67	69	62	68	68	60
Cr	61.9	62.5	9	200	285	283	241	289	203	209
Ni	22.5	23.6	4.4	115	192	200	172	185	108	135
Rb	159	156	324	100	126	125	108	122	140	116
Ba	1009	1002	2570	1531	1690	1629	1877	1757	1589	1505
Th	29.1	28.3	28.4	22.6	22.7	22.7	21.4	22.5	22.9	22.3
Nb	9.5	9.49	14.2	10.6	9.23	9.21	7.01	9.29	8.35	8.07
Ta	0.56	0.53	0.58	0.68	0.63	0.62	0.47	0.64	0.58	0.6
La	67.6	67.9	62.8	75.1	68.8	68.7	50.4	69.4	59.2	58
Ce	113	115	97.1	137	127	127	90.8	128	107	104
Pr	11.9	12	9.12	14.3	13.6	13.6	9.55	13.6	11.1	11
Sr	524	511	690	1397	1238	1230	1068	1257	998	978
Nd	38.5	38.5	36.4	52.9	51.6	51.6	35.1	51.4	41.3	40.8
Zr	275	280	182	233	204	205	189	206	200	196
Hf	6.3	6.41	5.3	5.71	5.14	5.14	4.71	5.07	4.9	4.82
Sm	5.43	5.39	5.33	7.57	7.94	7.83	5.51	7.9	6.27	6.29
Eu	1.02	1.03	1.08	1.84	1.92	1.9	1.42	1.9	1.55	1.54
Gd	3.02	3.08	3.08	5.76	6.15	6.09	4.5	6.15	4.94	4.98
Tb	0.43	0.44	0.51	0.63	0.71	0.7	0.55	0.7	0.6	0.6
Dy	2.1	2.03	2.31	3.04	3.42	3.35	2.83	3.38	3.01	3.02
Y	10.9	10.6	11.1	15.2	17.4	17.1	16.1	17.7	16.5	15.9
Ho	0.35	0.34	0.47	0.53	0.62	0.61	0.56	0.61	0.56	0.55
Er	0.92	0.89	1.34	1.39	1.63	1.57	1.51	1.62	1.53	1.47
Tm	0.12	0.13	0.21	0.2	0.23	0.23	0.23	0.23	0.22	0.21
Yb	0.76	0.79	1.41	1.22	1.37	1.35	1.43	1.39	1.38	1.29
Lu	0.12	0.12	0.19	0.18	0.21	0.2	0.21	0.21	0.2	0.19

$(^{87}Sr/^{86}Sr)_i$	0.7082					0.7075	0.7075			0.7073
$(^{143}Nd/^{144}Nd)_i$	0.512356					0.512347	0.512375			0.512337
εNd(t)	-5.51					-5.68	-5.13			-5.87

Table S7-continud

Samples	Z08H5	Z12H1	Z12H2	CH-2A	CH-3A	CH-4A
Reference	3	3	3	5	5	5
SiO_2	64.69	60.24	62.94	70.52	69.81	70.48
TiO_2	0.72	0.73	0.78	0.31	0.36	0.34
Al_2O_3	16.23	15.82	17.09	14.48	14.89	14.62
Fe_2O_3	3.21	6.01	3.07	2.81	3.3	3.25
MnO	0.02	0.06	0.06	0.05	0.08	0.06
MgO	1.05	2	1.06	0.5	0.62	0.56
CaO	4.09	6.02	5.28	1.98	1.84	1.89
Na_2O	3.86	3.66	4.12	3.91	3.48	0.35
K_2O	3.55	2.98	3.24	4.2	4.32	4.59
P_2O_5	0.33	0.27	0.29	0.17	0.19	0.16
Mg#	40	40	41	26	27	26
Cr	278	241	258	10.2	12	30.5
Ni	81	125	78.5	9.4	8.25	8.4
Rb	118	110	117	166	171	173
Ba	1665	1280	1358	1290	1475	1450
Th	25.9	17	17.7	27.9	26	24.3
Nb	9.25	8.31	8.81	15.4	16	14.2
Ta	0.63	0.59	0.63	1.75	1.84	0.94
La	76.5	46.2	48.5	80.4	95.9	76.4
Ce	132	85	87.9	132	133	117
Pr	14.3	9.26	9.51	11.6	13	11.1
Sr	1228	927	972	1020	885	1010
Nd	54	35.4	36.1	44.1	49.3	41.3
Zr	217	179	184	197	195	181
Hf	5.5	4.51	4.73	5.38	5.46	4.71
Sm	8.09	5.84	5.76	6.3	7.11	5.97
Eu	1.97	1.55	1.62	1.27	1.46	1.28
Gd	6.32	4.83	4.63	3.85	4.7	3.93
Tb	0.73	0.61	0.57	0.57	0.81	0.62
Dy	3.5	3.25	2.82	2.74	3.36	2.97
Y	16.8	17.1	14.6	11.7	14.3	12.4
Ho	0.61	0.61	0.52	0.54	0.65	0.64
Er	1.54	1.67	1.32	4.41	1.86	1.84
Tm	0.22	0.24	0.2	0.23	0.28	0.28
Yb	1.28	1.5	1.1	1.48	1.74	1.51
Lu	0.18	0.22	0.16	0.19	0.22	0.21
$(^{87}Sr/^{86}Sr)_i$	0.7075		0.7074			
$(^{143}Nd/^{144}Nd)_i$	0.51235		0.512433			
εNd(t)	-5.62		-4			

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Table S8- Metadata of LA-MC-ICPMS for U-Pb and Lu-Hf isotope analyses used in this study

Sample Preparation	
Sample type/mineral	Magmatic zircons
Sample preparation	Conventional mineral separation, 1 inch resin mount, 1 mm polish to finish
Imaging	CL, Gatan CL4+ - FEI Quanta450, 10 nA, 17 mm working distance
LA-ICPMS U-Pb analyses	
Laboratory name	Guangxi Key Laboratory of Hidden Metallic Ore Deposits Exploration, Guilin University of Technology
Laser ablation system	
Make, Model and type	Coherent, GeoLas 193 ArF excimer
Ablation cell and volume	In-house built low-volume cell, volume *ca.* 14 cm^3
Laser wavelength (nm)	193 nm
Pulse width (ns)	15ns
Fluence (J cm^{-2})	10 J cm^{-2}
Repetition rate (Hz)	6 Hz
Ablation duration (s)	50S
Ablation pit depth / ablation rate	not available
Spot diameter (mm) nominal/actual	32 mm
Sampling mode / pattern	Static spot ablation
Carrier gas	100% He in the cell, Argon was introduced into the make-up gas via a T-connector
Cell carrier gas flow (l min^{-1})	*ca.* 0.70 L/min; fine-adjusted daily
ICP-MS Instrument	
Make, Model and type	Agilent, 7500a quadrupole ICP-MS
Sample introduction	dry aerosol by laser ablation
RF power (W)	1350W
Make-up gas flow (l min^{-1})	*ca.* 0.65 L/min; fine-adjusted daily
Detection system	dual (pulse and analog) electron multipliers

Masses measured	^{29}Si, ^{91}Zr, ^{202}Hg, ^{204}(Hg+Pb), ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{232}Th, ^{238}U
Integration time per peak/dwell times (ms); quadrupole settling time between mass jumps	5ms for 29, 91 and 202; 10ms for 232 and 238；; 20ms for 204, 206, 207 and 208; settling time are allocated automatically by Agilent ICPMS software
Total integration time per output data point (s)	0.2772s
'Sensitivity' as useful yield (%, element)	not available for quadrupole ICPMS
IC Dead time (ns)	30ns for EM of quadrupole ICPMS
Data Processing	
Gas blank	20 s on-peak zero subtracted
Calibration strategy	Plesovice zircon used as calibration standard, GJ-1 zircon used as quality control for validation
Reference Material info	Plesovice zircon (Slám et al., 2008) GJ-1 zircon (Jackson *et al*. 2004)
Data processing package used / Correction for LIEF	Commercial software *ICPMSDataCal was intially* developed by Prof. Yong-sheng LIU of GUG. LIEF correction assumes reference material and samples behave identically, namely standard-samples-standard bracketing (Liu et al., 2008; Liu et al., 2010).
Mass discrimination	not available
Common-Pb correction, composition and uncertainty	Using the method proposed by Andersen (2002).
Uncertainty level and propagation	Ages are quoted at 2s absolute, propagation is processed by the ICPMSDataCal software. Reproducibility and age uncertainty of reference material are propagated.
Quality control / Validation	GJ-1 – Weighted ave ^{206}Pb/^{238}U age = 605 ± 3 (2σ, MSWD = 0.4, n = 24) Systematic uncertainty for propagation is 1.5% (1*s*).
Other information	*ca.* 2m sample line from ablation cell to torch and washout time was *ca*. 10 s to 0.1% of peak signal.

LA-MC-ICPMS Lu-Hf analyses	
Laboratory and Sample Preparation	
Laboratory name	Guangxi Key Laboratory of Hidden Metallic Ore Deposits Exploration, Guilin University of Technology
Laser ablation system	
Make, Model and type	Coherent, GeoLas 193 ArF excimer
Ablation cell and volume	In-house built low-volume cell, volume ca. 14 cm3
Laser wavelength (nm)	193 nm
Pulse width (ns)	15ns
Fluence ($J\ cm^{-2}$)	$10J\ cm^{-2}$
Repetition rate (Hz)	6 Hz
Ablation duration (s)	47 s
Ablation pit depth / ablation rate	about 15μm
Spot diameter (mm) nominal/actual	44 μm
Sampling mode / pattern	Static spot ablation
Carrier gas	100% He in the cell, N_2 were introduced into the make-up gas via a T-connector
Cell carrier gas flow ($l\ min^{-1}$)	0.64 L/min
MC-ICP-MS Instrument	
Make, Model and type	Thermo, Neptune Plus MC-ICP-MS
Sample introduction	dry aerosol by laser ablation
Make-up gas flow ($l\ min^{-1}$)	*ca.* 0. 65/min; fine-adjusted daily
Detection system	Faraday cups
Masses measured	^{172}Yb, ^{173}Yb, ^{175}Lu,^{176}(Hf+Yb+Lu), ^{177}Hf, ^{178}Hf, ^{179}Hf， ^{180}Hf
Integration time per peak/dwell times (ms); quadrupole settling time between mass jumps	0.131s
Total integration time per output data point (s)	26-30s
‘Sensitivity’ as useful yield (%, element)	not available
IC Dead time (ns)	not available

Data Processing	
Gas blank	20 s on-peak zero subtracted
Calibration strategy	GJ-1 zircon used as external standard, PengLai zircon used as unknown sampels
Reference Material info	PengLai (Li et al., 2010) GJ-1 (Elhlou et al., 2006)
Data processing package used / Correction for LIEF	Commercial software *ICPMSDataCal was intially* developed by Prof. Yong-sheng LIU of GUG. LIEF correction assumes reference material and samples behave identically, namely standard-samples-standard bracketing (Liu et al., 2008; Liu et al., 2010).
Mass discrimination	$^{175}Lu/^{176}Lu$=0.02655, $^{172}Yb/^{176}Yb$＝0.5886, β_{Yb} = 0.8725×β_{Hf}
Uncertainty level and propagation	Isotope values are quoted at 2s absolute, propagation is processed by the ICPMSDataCal software. Reproducibility and age uncertainty of reference material are propagated.
Quality control / Validation	GJ-1 – Weighted ave $^{177}Hf/^{176}Hf$ = 0.282005 ± 0.000005 (2s; MSWD = 0.75; n = 32); PengLai -weighted ave 177Hf/176Hf = 0.282897 ± 9 (2s, n = 16, MSWD = 0.52). Systematic uncertainty for propagation is 0.0015% (1*s*).
Other information	*ca.* 2m sample line from ablation cell to torch and washout time was *ca*. 1s to 1% of peak signal.