Wotzlaw, J.F., et al., Tracking the evolution of large volume silicic magma reservoirs from assembly to supereruption

Supplementary Methods

CA-ID-TIMS U-Pb geochronology - A total of 58 zircon crystals were analyzed as single grains by isotope-dilution-thermal ionization mass spectrometry (ID-TIMS) at the University of Geneva. Prior to dissolution, all crystals were annealed by heating to 900 °C for 48 h in a muffle furnace, transferred into 3 ml savillex beakers and chemically abraded in HF + trace HNO3 at 180 °C for 15 h in parr bombs (Mattinson et al., 2005). Subsequently, zircons were rinsed with water, fluxed for several hours in 6N HCl and ultrasonically cleaned with water, acetone and 3N HNO3. Single crystals were loaded in 200 µl Savillex capsules, spiked with ~3-5 mg of the EARTHTIME ^{202}Pb-^{205}Pb-^{233}U-^{235}U tracer solution (http://www.earth-time.org/) and dissolved in ~70 µl HF at 210 °C for 48 h in Parr bombs. After dissolution, samples were dried down and redissolved in 6N HCl at 180 °C overnight, dried down again and redissolved in 3N HCl. U and Pb were separated using a modified HCl-based single-column anion exchange chemistry (Krogh, 1973). The Zr, Hf, and trace element fractions ("wash") were collected for trace element and Hf isotope analyses (see below). The U-Pb fraction was loaded on outgassed Re filaments with a Si-Gel emitter (Gerstenberger and Haase, 1997). U and Pb isotopic measurements were performed on a Thermo TRITON thermal ionization mass spectrometer. Pb was measured in dynamic mode on a MasCom secondary electron multiplier. Analyses employing the ET2535 tracer were corrected using the fractionation factor derived from the measured ^{202}Pb/^{205}Pb ratio assuming a true value of 0.99924. U was measured as U-oxide in static mode on Faraday cups equipped with 10^{12} Ω resistors. Measured isotopic ratios were corrected for interferences of $^{233}U^{18}O^{16}O$ on $^{235}U^{16}O_2$ using an $^{18}O/^{16}O$ of 0.00205, measured on large U500 loads, and for mass fractionation using

the measured $^{233}U/^{235}U$ ratio relative to a value of 0.99506 of the tracer. All common Pb in the zircon analyses was assumed to be procedural blank. U-Pb ratios and dates were calculated relative to a $^{235}U/^{205}Pb$ ratio of 100.23 ± 0.023% (1σ) and raw data were reduced using Tripoli and U-Pb_Redux software (Bowring et al., 2011) that employs algorithms of McLean et al. (2011). All uncertainties are reported at the 95% confidence level and exclude systematic uncertainties associated with tracer calibration and decay constants unless otherwise indicated.

Zircon trace element analyses – Trace elements in U-Pb dated zircons were analyzed following the approach of Schoene et al. (2010). After column chemistry, the washes were dried down, redissolved in ~750 µl 0.5 M HNO3 + 0.1 M HF doped with 1 ppb Ir, and transferred into pre-cleaned auto sampler microtubes. Trace element measurements were performed at ETH Zurich on an ICP-SF-MS (ELEMENT2, Thermo Fisher Scientific, Bremen, Germany) using an Aridus I desolvation nebulizer (CETAC, Omaha, USA) as sample introduction system and an autosampler (ASX-100, CETAC, Omaha, USA) for automated analysis. The instrumental parameters (gas flows, RF-power and ion lenses) were optimized for sensitivity (typically 1.4 x 106 cps/ppb In in medium resolution), low oxide rate (typically UO^+/U^+ below 0.03%) and low doubly charged rate (typically $^{137}Ba^{2+}/^{137}Ba^+$ 5%). The system was operated at medium resolution (typically m/Δm=4000) with a 10% mass window, 100 samples per peak with a dwell time of 10 ms each and 40 replicates per measurement. Instrumental blanks (HF-HNO3 solution doped with Ir), procedural blanks, calibration standards and samples were introduced into the Aridus desolvation system using a self-aspirating, micro-concentric PFA nebuliser (PFA-ST, Elemental Scientific, Omaha, USA) with an nominal uptake rate of 50 µL min-1 and a typical sample and auxiliary gas flow of 0.9 L min-1 and 0.82 L min-1 respectively. The Aridus desolvation system provides very low oxide rates using an Ar sweep gas of typically 2.50 L min-1 and a N_2 gas addition of 30 mL min-1. The low oxide rates allow to measure all elements in medium resolution, even the

HREE, which suffer under wet sample introduction from oxide interference by the LREE. In order to provide matrix-matched calibration, synthetic zircon solutions were prepared from single element ICP-MS standards. Iridium was used as internal standard for all solutions. Zr, Hf, Y, Sc, Nb, Ta, U, Th, Pb, Ti and REEs were mixed gravimetrically in the approximate proportions expected in natural zircons. The stock solutions (1000 mg/kg) were diluted into nine calibration solutions containing the elements from 5 ng/kg – 900 ng/kg, except for Hf (from 20 ng/g – 180 µg/kg) and Zr (from 50 µg/kg – 10 mg/kg), each calibration standard contained 1 µg/kg Ir. A typical measurement sequence consisted of measurements of the calibration standards, followed by an instrumental and a procedural blank. Subsequently 4 – 12 zircon samples were measured. In-between the samples the system was washed with a HF-HNO3 solution for 7 minutes. After every 4 - 12 zircon samples one of the calibration standards (centre concentration) was re-measured together with a procedural blank. In each measurement session typical 24 zircon samples were analysed and a session lasted for approximately 18 h, followed by a retuning (if necessary) of the instrument and start of a new measurement session.

Zircon Hf isotope analyses - Lutetium-Hafnium isotopes of a subset of U-Pb dated zircons were analyzed employing a Thermo NEPTUNE multi collector–ICP-MS at Goethe-University Frankfurt. Solutions remaining after trace element analyses were introduced into the plasma employing an Aridus desolvation nebulizer with a nominal uptake rate of 100 µl/min. Isotopic ratios were measured in static mode on Faraday detectors equipped with 10^{10} (for mass 180) or 10^{11} Ω (all other masses) resistors. ^{172}Yb, ^{173}Yb and ^{175}Lu were measured to correct for isobaric interferences of Yb and Lu on mass 176 assuming a ^{176}Yb/^{173}Yb ratio of 0.79502 and a ^{176}Lu/^{175}Lu ratio of 0.02656. Yb and Hf isotopic ratios were corrected for mass fractionation by normalizing to ^{172}Yb/^{173}Yb of 1.35351 and ^{179}Hf/^{177}Hf of 0.7325 using an exponential law. Mass fractionation of Lu was assumed to follow that of Yb (Gerdes and Zeh, 2006). Accuracy and reproducibility of this protocol were assessed by repeat analyses of 10 ppb JMC 475

standard solutions ($^{176}Hf/^{177}Hf$=0.282148 ± 5, 2SD, n=21) bracketing unknowns. Initial $^{176}Hf/^{177}Hf$ ratios and εHf were calculated using the $^{206}Pb/^{238}U$ date of the respective crystal and the CHUR parameters of Bouvier et al. (2008; $^{176}Lu/^{177}Hf$=0.0336; $^{176}Hf/^{177}Hf$=0.282785). All uncertainties are given at the 2σ level and include the reproducibility of the JMC 475 solution propagated by quadratic addition.

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Table DR1. U-Pb isotopic data

	Composition				Isotopic Ratios													Dates (Ma)									
Fraction	Th/ U a	Pb* (pg) b	Pbc (pg) c	Pb*/ Pbc d	206Pb/ 204Pb e	206Pb/ 238U f	±2σ %	206Pb/ 238U <Th> fg	±2σ %	207Pb/ 235U f	±2σ %	207Pb/ 206Pb f	±2σ %	207Pb/ 206Pb <Th> fg	±2σ %	Corr. coef.	206Pb/ 238U h	±2σ abs	206Pb/ 238U <Th> g	±2σ abs	207Pb/ 235U	±2σ abs	207Pb/ 206Pb	±2σ abs	207Pb/ 206Pb <Th> g	±2σ abs
FCT																											
z1	0.65	1.68	0.78	2.1	143	0.0043859	0.20	0.004398	0.20	0.028488	3.3	0.047130	3.2	0.047002	3.2	0.848	28.212	0.056	28.289	0.058	28.52	0.94	55	76	48	76
z2	0.56	3.45	0.64	5.4	341	0.0044026	0.090	0.004415	0.10	0.028750	1.3	0.047383	1.3	0.047247	1.3	0.858	28.318	0.025	28.400	0.028	28.78	0.38	68	30	61	30
z3	0.79	2.45	0.72	3.4	211	0.0043726	0.12	0.004383	0.14	0.028063	2.3	0.046569	2.1	0.046453	2.1	0.874	28.126	0.034	28.196	0.038	28.10	0.62	26	51	20	52
z4	0.81	2.23	0.60	3.7	225	0.0043756	0.12	0.004386	0.14	0.028513	2.1	0.047283	2.0	0.047167	2.0	0.889	28.145	0.034	28.215	0.038	28.55	0.59	62	47	57	47
z5	0.55	2.69	0.64	4.2	271	0.0043999	0.12	0.004413	0.12	0.028737	1.8	0.047390	1.7	0.047254	1.7	0.801	28.302	0.033	28.383	0.035	28.77	0.50	68	40	61	40
z6	0.68	2.02	1.09	1.8	125	0.0043929	0.22	0.004405	0.22	0.028776	4.1	0.047530	3.9	0.047403	3.9	0.917	28.256	0.061	28.332	0.063	28.8	1.2	75	92	69	92
z7	0.48	9.96	1.39	7.1	452	0.0044101	0.081	0.004423	0.089	0.028550	0.97	0.046973	0.91	0.046832	0.91	0.766	28.367	0.023	28.452	0.025	28.58	0.27	47	22	40	22
z8	0.48	2.34	1.05	2.2	153	0.0043986	0.18	0.004412	0.18	0.028945	3.0	0.047747	2.8	0.047602	2.9	0.864	28.293	0.050	28.379	0.051	28.97	0.86	86	68	78	68
z9	0.74	6.47	0.55	11.7	684	0.0044411	0.067	0.004452	0.089	0.028743	0.69	0.046961	0.64	0.046842	0.64	0.725	28.566	0.019	28.638	0.025	28.77	0.20	46	15	40	15
z10	0.68	2.09	0.32	6.6	398	0.0044286	0.077	0.004440	0.093	0.028770	1.2	0.047137	1.2	0.047012	1.2	0.858	28.486	0.022	28.561	0.026	28.80	0.35	55	28	49	28
z11	0.87	5.34	0.65	8.2	470	0.0044237	0.070	0.004434	0.098	0.028506	0.97	0.046756	0.91	0.046648	0.91	0.781	28.454	0.020	28.520	0.028	28.54	0.27	36	22	30	22
z12	1.05	3.30	0.55	6.0	337	0.0043762	0.074	0.004385	0.11	0.028015	1.1	0.046451	1.0	0.046356	1.0	0.695	28.149	0.021	28.206	0.031	28.06	0.30	20	25	15	25
z13	0.59	7.98	0.54	14.9	897	0.0044112	0.051	0.004424	0.069	0.028652	0.55	0.047130	0.51	0.046998	0.51	0.644	28.374	0.015	28.454	0.020	28.68	0.15	55	12	48	12
z14	0.81	10.3	0.56	18.5	1050	0.0044172	0.049	0.004428	0.080	0.028317	0.49	0.046515	0.47	0.046402	0.48	0.427	28.413	0.014	28.482	0.023	28.35	0.14	23	11	17	12
z15	0.57	6.51	0.79	8.2	505	0.0043935	0.049	0.004406	0.066	0.028344	0.91	0.046810	0.89	0.046676	0.89	0.539	28.260	0.014	28.341	0.019	28.38	0.26	38	21	32	21
z16	0.71	3.02	0.52	5.7	346	0.0043798	0.074	0.004391	0.093	0.028127	1.4	0.046597	1.3	0.046475	1.3	0.796	28.173	0.021	28.246	0.026	28.17	0.38	28	32	21	32
z17	0.64	6.70	0.59	11.3	679	0.0044268	0.074	0.004439	0.089	0.028574	0.81	0.046836	0.76	0.046708	0.77	0.659	28.474	0.021	28.551	0.025	28.61	0.23	40	18	33	18
z18	0.83	6.96	0.93	7.5	434	0.0044157	0.088	0.004426	0.11	0.028536	1.1	0.046891	1.1	0.046779	1.1	0.689	28.403	0.025	28.471	0.031	28.57	0.32	43	25	37	26
z19	0.48	3.09	0.80	3.9	254	0.0044050	0.11	0.004418	0.11	0.028786	1.8	0.047416	1.7	0.047273	1.7	0.898	28.334	0.030	28.420	0.032	28.82	0.51	69	41	62	41
z20	0.54	4.06	0.60	6.8	423	0.0044131	0.14	0.004426	0.14	0.028380	1.4	0.046662	1.3	0.046527	1.3	0.926	28.386	0.040	28.468	0.041	28.42	0.40	31	31	24	31
z21	0.62	5.24	0.44	11.8	709	0.0044059	0.082	0.004418	0.095	0.028606	0.76	0.047112	0.70	0.046981	0.70	0.697	28.340	0.023	28.418	0.027	28.64	0.21	54	17	47	17
z22	0.87	2.68	0.51	5.2	307	0.0044339	0.091	0.004444	0.11	0.029122	1.5	0.047657	1.4	0.047547	1.4	0.878	28.520	0.026	28.586	0.032	29.15	0.44	81	34	76	34
z23	0.48	2.26	0.74	3.1	205	0.0044040	0.15	0.004417	0.16	0.028991	2.4	0.047765	2.3	0.047621	2.3	0.894	28.328	0.043	28.413	0.044	29.02	0.69	87	54	79	54
z24	0.49	3.73	0.51	7.3	460	0.0044044	0.081	0.004418	0.090	0.028481	1.1	0.046921	1.1	0.046781	1.1	0.725	28.330	0.023	28.415	0.025	28.52	0.32	44	26	37	26
NCD																											
z1	0.64	3.00	0.40	7.4	449	0.0043791	0.10	0.004391	0.11	0.027992	1.3	0.046380	1.2	0.046253	1.2	0.853	28.168	0.028	28.245	0.032	28.03	0.35	16	28	10	28
z2	0.59	2.96	0.49	6.1	376	0.0044305	0.076	0.004443	0.089	0.029041	1.2	0.047562	1.2	0.047429	1.2	0.824	28.497	0.022	28.577	0.025	29.07	0.36	76	28	70	28
z3	0.68	4.71	0.49	9.5	567	0.0044220	0.060	0.004434	0.081	0.028642	0.81	0.046998	0.76	0.046873	0.77	0.789	28.443	0.017	28.518	0.023	28.67	0.23	48	18	42	18
z4	0.51	6.56	0.45	14.7	906	0.0044015	0.047	0.004415	0.062	0.028345	0.56	0.046727	0.52	0.046589	0.52	0.737	28.311	0.013	28.395	0.018	28.38	0.16	34	12	27	13
z5	0.67	4.66	0.54	8.6	518	0.0044411	0.070	0.004453	0.087	0.028838	0.89	0.047117	0.83	0.046991	0.84	0.775	28.566	0.020	28.642	0.025	28.87	0.25	54	20	48	20
z6	0.58	8.47	0.50	17.0	1025	0.0044014	0.051	0.004414	0.069	0.028403	0.50	0.046823	0.47	0.046690	0.47	0.636	28.311	0.014	28.392	0.019	28.44	0.14	39	11	32	11
z7	0.72	2.96	1.16	2.6	164	0.0043733	0.14	0.004385	0.15	0.028201	2.6	0.046790	2.5	0.046668	2.5	0.879	28.130	0.039	28.204	0.042	28.24	0.72	37	59	31	59
z8	0.65	2.25	0.43	5.2	318	0.0043799	0.11	0.004392	0.12	0.028438	1.6	0.047112	1.5	0.046983	1.5	0.841	28.173	0.032	28.250	0.035	28.47	0.44	54	35	47	36
z9	0.62	2.97	0.40	7.4	449	0.0044077	0.066	0.004420	0.082	0.028496	1.0	0.046911	0.98	0.046781	0.98	0.778	28.352	0.019	28.430	0.023	28.53	0.29	44	24	37	24
z10	0.55	4.28	0.70	6.2	385	0.0044115	0.084	0.004424	0.094	0.028923	1.2	0.047572	1.1	0.047435	1.1	0.804	28.376	0.024	28.458	0.027	28.95	0.33	77	26	70	26
z11	0.66	2.54	0.73	3.5	221	0.0044207	0.13	0.004433	0.14	0.028648	2.1	0.047022	2.0	0.046896	2.0	0.788	28.435	0.036	28.511	0.039	28.68	0.59	49	48	43	48
z12	0.54	6.03	0.47	12.8	782	0.0043943	0.065	0.004407	0.078	0.028346	0.68	0.046807	0.63	0.046670	0.63	0.716	28.265	0.018	28.347	0.022	28.38	0.19	38	15	31	15
z13	0.69	4.32	0.42	10.4	617	0.0043920	0.063	0.004404	0.083	0.028328	0.80	0.046799	0.75	0.046675	0.75	0.790	28.251	0.018	28.326	0.023	28.36	0.22	38	18	32	18
z14	0.65	5.45	0.41	13.2	786	0.0044203	0.080	0.004432	0.095	0.028439	0.73	0.046684	0.67	0.046558	0.67	0.774	28.432	0.023	28.509	0.027	28.47	0.21	32	16	26	16
z15	0.70	4.01	0.40	10.1	597	0.0044081	0.063	0.004420	0.083	0.028545	0.81	0.046986	0.76	0.046863	0.76	0.780	28.354	0.018	28.428	0.024	28.58	0.23	47	18	41	18
MLX																											
z1	0.66	2.08	0.82	2.6	166	0.0044027	0.16	0.004415	0.17	0.029116	2.8	0.047963	2.7	0.047834	2.7	0.918	28.319	0.045	28.395	0.047	29.14	0.81	97	63	91	63
z2	1.06	5.87	0.54	10.9	591	0.0043921	0.093	0.004401	0.13	0.028549	1.1	0.047164	1.0	0.047070	1.0	0.758	28.251	0.026	28.308	0.035	28.58	0.30	56	24	52	24
z3	1.76	32.3	0.71	45.3	2065	0.0043845	0.054	0.004388	0.15	0.028212	0.28	0.046688	0.24	0.046652	0.28	0.625	28.203	0.015	28.224	0.043	28.249	0.079	32.2	6.0	30.4	6.9
z4	0.79	2.65	0.80	3.3	204	0.0044203	0.17	0.004431	0.18	0.028809	2.4	0.047290	2.3	0.047173	2.3	0.889	28.432	0.048	28.502	0.051	28.84	0.69	63	54	57	55
z5	0.73	3.68	0.44	8.4	498	0.0044130	0.089	0.004424	0.11	0.028735	1.3	0.047247	1.3	0.047126	1.3	0.742	28.386	0.025	28.458	0.030	28.77	0.38	61	30	55	30
z6	1.02	2.44	0.41	6.0	338	0.0044069	0.12	0.004416	0.15	0.028857	1.7	0.047514	1.6	0.047415	1.6	0.826	28.346	0.035	28.405	0.042	28.89	0.50	74	39	69	39
z7	0.77	2.27	0.29	7.9	461	0.0044326	0.077	0.004444	0.098	0.029166	1.0	0.047743	0.99	0.047624	0.99	0.799	28.511	0.022	28.582	0.028	29.19	0.30	85	23	80	24
z8	0.91	1.93	0.57	3.4	202	0.0044451	0.13	0.004455	0.15	0.029234	2.3	0.047721	2.1	0.047614	2.1	0.896	28.591	0.038	28.655	0.043	29.26	0.65	84	51	79	51
z9	0.75	5.09	0.51	9.9	581	0.0044327	0.062	0.004444	0.085	0.028832	0.81	0.047195	0.77	0.047076	0.77	0.674	28.512	0.018	28.584	0.024	28.86	0.23	58	18	52	18
z10	0.62	11.5	0.67	17.2	1029	0.0044147	0.059	0.004427	0.077	0.028625	0.46	0.047048	0.42	0.046918	0.42	0.642	28.397	0.017	28.475	0.022	28.66	0.13	51	10	44	10
z11	0.64	4.58	0.73	6.3	386	0.0044290	0.091	0.004441	0.10	0.028734	1.2	0.047074	1.1	0.046946	1.1	0.732	28.488	0.026	28.565	0.030	28.76	0.34	52	27	45	27
z12	0.79	2.34	0.65	3.6	219	0.0044078	0.12	0.004419	0.14	0.028942	2.1	0.047643	2.0	0.047525	2.0	0.888	28.352	0.035	28.422	0.039	28.97	0.61	80	48	75	48
z13	0.96	1.85	0.67	2.7	166	0.0043992	0.16	0.004409	0.17	0.028749	2.9	0.047418	2.7	0.047314	2.7	0.893	28.297	0.044	28.359	0.049	28.78	0.81	69	65	64	65
z14	0.70	9.22	1.78	5.2	315	0.0044168	0.12	0.004428	0.13	0.028626	1.5	0.047026	1.4	0.046903	1.4	0.642	28.410	0.034	28.485	0.037	28.66	0.42	49	34	43	34
z15	0.65	6.64	0.71	9.3	558	0.0044117	0.084	0.004424	0.098	0.028799	0.84	0.047365	0.79	0.047237	0.79	0.659	28.377	0.024	28.454	0.028	28.83	0.24	67	19	60	19
z16	0.77	1.84	0.57	3.2	199	0.0044370	0.14	0.004448	0.15	0.029078	2.5	0.047551	2.4	0.047433	2.4	0.894	28.540	0.040	28.611	0.043	29.10	0.71	76	56	70	56
z17	0.76	2.24	0.52	4.3	264	0.0044085	0.11	0.004420	0.12	0.028516	1.8	0.046934	1.7	0.046816	1.7	0.862	28.357	0.030	28.428	0.035	28.55	0.51	45	41	39	41
z18	1.17	2.43	0.71	3.4	193	0.0043825	0.13	0.004390	0.16	0.028479	2.4	0.047152	2.3	0.047067	2.3	0.841	28.189	0.038	28.241	0.046	28.51	0.68	56	55	52	55
z19	1.35	7.21	0.48	15.2	765	0.0043825	0.069	0.004389	0.13	0.028184	0.71	0.046664	0.67	0.046594	0.67	0.671	28.189	0.019	28.232	0.036	28.22	0.20	31	16	27	16

a Th contents calculated from radiogenic 208Pb and the 207Pb/206Pb date of the sample, assuming concordance between U-Th and Pb systems.
b Total mass of radiogenic Pb.
c Total mass of common Pb.
d Ratio of radiogenic Pb (including 208Pb) to common Pb.
e Measured ratio corrected for fractionation and spike contribution only.
f Measured ratios corrected for fractionation, tracer and blank. Laboratory blanks were corrected using the average measured composition of 29 total procedural blanks analyzed during the course of this study: 206Pb/204Pb = 18.512 ± 0.172, 207Pb/204Pb = 15.473 ± 0.164, 208Pb/204Pb = 37.676 ± 0.382 (2 S.D.)
g Corrected for initial Th/U disequilibrium using radiogenic 208Pb and Th/U[magma] = 2.2 ± 0.5.
i Isotopic dates calculated using the decay constants λ238 = 1.55125E-10 and λ235 = 9.8485E-10 (Jaffey et al., 1971).

Table DR2. Zircon trace element geochemical data measured by solution ICP-SF-MS

Zr+Hf-normalized concentrations (a,b,c)	Y		Zr		La		Ce		Pr		Nd		Sm		Eu		Gd		Tb		Dy		Ho		Er		Tm		Yb		Lu		Hf		Th	
	ppm	±2σ	‰	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ	ppm	±2σ
FCT																																				
z1	1238	40	488	13	0.6	1.0	29.5	2.3	0.8	1.0	3.4	1.9	5.2	2.0	2.6	1.2	23.8	4.3	7.5	1.4	89.9	5.4	36.2	2.7	183.5	9.9	44.5	2.9	423	19	100.7	4.5	10487	229	176.4	7.0
z2	1095	39	487	12	0.18	0.66	40.0	2.3	0.19	0.67	2.1	1.2	4.3	1.6	1.68	0.85	20.0	2.9	6.55	0.85	77.3	3.7	31.6	2.2	166.3	5.8	40.4	2.2	404	13	97.9	3.6	10853	190	217.0	8.7
z3	1443	49	488	11	0.5	1.2	50.0	3.0	0.9	1.4	5.4	2.3	8.2	2.9	3.7	1.6	37.2	4.8	10.7	1.7	120.4	9.4	45.1	3.6	211	10	48.3	2.9	455	25	107.1	5.0	9412	238	324	12
z4	1808	64	488	14	2.5	6.4	56.5	3.2	0.9	1.2	7.4	2.3	11.2	2.9	4.4	1.4	48.3	5.7	14.0	1.8	157.1	8.5	56.6	3.1	266	12	59.0	3.2	534	23	117.7	5.5	9611	238	288	13
z5	851	28	487	12	0.9	1.3	43.3	2.9	0.3	1.2	1.6	1.5	2.4	1.6	1.1	1.1	11.7	3.4	4.1	1.3	54.5	5.0	23.5	2.6	135.1	8.3	34.9	2.9	365	16	94.4	3.3	11031	199	274	11
z6	1378	41	487	12	0.1	2.6	55.1	6.2	0.7	3.4	2.4	3.3	4.9	3.6	1.5	2.3	23.8	6.8	7.6	3.1	94.9	9.1	39.5	5.0	210	12	53.0	5.2	537	24	134.6	7.7	11126	228	394	17
z7	918	28	486	15	0.30	0.35	44.7	1.8	0.17	0.34	1.08	0.53	2.29	0.69	0.75	0.39	13.6	1.7	4.64	0.54	61.6	2.9	26.5	1.3	144.1	4.5	36.6	1.5	367	10	89.3	2.3	11832	257	217.5	5.6
z8	559	12	486	10	1.13	0.81	25.5	1.8	0.14	0.71	1.2	1.0	1.7	1.1	0.71	0.71	9.6	2.0	3.02	0.91	37.1	2.1	15.8	1.4	88.0	3.9	22.5	1.8	239.8	7.1	60.8	2.1	11707	207	111.1	3.6
z9	1580	29	489	10	0.42	0.21	41.8	1.1	0.37	0.21	5.29	0.64	8.27	0.83	3.01	0.37	39.8	1.7	12.24	0.51	140.5	3.4	52.3	1.3	239.8	4.5	51.4	1.3	447	10	92.9	2.0	9117	159	138.5	2.6
z10	1530	40	487	11	0.09	0.57	49.1	2.1	0.24	0.59	4.0	1.3	7.7	1.8	2.65	0.84	37.9	3.4	11.7	1.1	133.9	6.2	49.6	2.1	233.3	8.6	51.0	2.1	446	14	95.2	2.9	10165	214	177.7	5.5
z11	2044	207	488	49	0.93	0.92	82.7	6.2	0.50	0.74	6.6	1.9	10.9	2.4	4.1	1.2	50.8	4.9	15.2	1.7	177	10	65.4	4.3	299	13	65.2	2.5	584	25	126.6	5.6	10033	295	359	20
z12	1877	44	489	11	0.39	0.92	76.0	3.5	0.41	0.86	8.1	2.4	11.3	2.6	4.1	1.3	47.6	4.5	13.4	1.4	152.3	7.4	57.4	3.0	280	11	63.4	2.7	592	16	132.7	3.5	8945	177	371	11
z13	1550	23	486.3	9.4	0.71	0.50	54.8	1.9	0.31	0.43	4.0	1.1	6.0	1.3	2.17	0.59	32.5	2.8	10.10	0.81	122.1	4.0	47.6	1.7	238.1	5.9	55.2	2.0	512.9	8.6	116.1	3.0	11307	184	271.7	8.2
z14	2041	43	488	13	0.09	0.29	59.9	1.8	0.38	0.35	6.5	1.1	10.7	1.3	4.32	0.52	53.5	2.6	15.93	0.69	185.8	5.2	67.6	2.3	308.4	7.9	66.0	2.2	567	14	117.3	3.1	9349	222	240.7	6.1
z15	975	19	486.2	8.2	0.84	0.85	40.4	2.2	0.11	0.73	2.1	1.2	3.2	1.5	1.04	0.77	16.3	2.8	5.1	1.1	67.2	4.7	28.2	1.7	151.8	5.2	38.6	1.8	395	11	98.9	2.8	11450	210	238.2	5.7
z16	1300	30	487	11	-	-	47.6	2.9	0.06	0.90	4.2	1.9	6.4	2.0	2.3	1.1	32.5	3.6	9.3	1.4	107.0	5.6	40.3	2.5	195.5	7.7	45.2	2.3	425	14	97.2	4.0	10313	199	260.3	7.2
z17	1379	29	487	10	0.21	0.37	52.6	1.5	0.17	0.36	3.32	0.81	5.7	1.1	1.83	0.56	29.4	2.3	9.41	0.82	115.0	4.1	44.1	1.3	214.6	6.0	48.1	1.4	434.6	9.0	94.1	2.5	10212	159	174.0	3.8
z18	1183	64	486	27	3.1	1.2	98.4	5.0	0.4	1.0	5.1	2.1	5.6	2.1	0.99	0.92	24.9	4.1	7.6	1.3	99.4	5.9	40.9	3.3	221	12	56.1	3.0	563	23	134.9	6.3	12073	495	281	31
z19	596	37	486	27	-	-	39.8	3.8	-	-	1.1	1.9	1.7	1.9	0.2	1.1	10.6	3.7	3.3	1.8	43.9	4.6	18.9	2.7	111.5	7.7	29.7	3.1	319	14	79.0	5.9	11857	436	180.5	9.0
z20	1084	52	485	25	0.8	2.0	67.2	6.0	0.3	1.9	3.3	2.9	4.6	2.9	1.2	1.7	20.5	4.6	6.6	2.4	87.1	7.8	37.2	3.8	202	15	50.6	4.6	487	28	113.8	8.7	12782	713	278	17
z21	1019	52	486	30	0.06	0.83	58.1	4.0	0.20	0.84	2.8	1.5	4.9	1.8	1.5	1.0	23.0	3.5	7.1	1.4	92.0	6.6	36.8	2.9	186	11	44.2	3.5	420	24	97.8	6.4	11201	618	252	12
z22	1866	91	488	11	0.0	1.0	77.2	4.4	0.6	1.1	7.7	2.5	13.0	2.6	5.1	1.6	58.1	4.9	17.5	2.4	209.3	5.4	76.1	4.2	340	14	71.4	4.8	596	29	119.1	7.3	9879	393	195	11
z23	1009	37	486	19	1.51	0.79	53.3	3.5	0.54	0.67	2.2	1.0	2.7	1.1	0.88	0.68	13.6	2.1	4.9	1.0	61.6	4.1	27.6	2.4	157.8	9.2	41.5	3.0	425	22	108.6	5.8	11425	411	297	18
z24	711	48	485	37	0.8	1.6	46.8	4.9	0.1	1.4	1.9	2.0	2.4	2.1	0.5	1.2	11.9	3.7	3.6	1.6	50.0	5.5	22.6	2.8	135	13	36.7	3.9	379	24	97.0	6.7	12394	259	226	18
NCD																																				
z1	1017	67	487	36	0.8	1.1	29.7	4.5	0.16	0.86	3.8	2.0	4.6	2.3	2.5	1.1	25.9	5.7	8.1	1.6	91.5	8.5	36.6	3.8	179	12	45.0	3.7	416	26	101.4	6.4	10615	624	139.3	7.8
z2	1676	117	487	33	0.15	0.77	66.5	4.6	0.11	0.69	3.5	1.7	6.5	2.5	2.7	1.1	39.5	5.3	12.6	1.9	144	11	56.4	5.0	259	17	60.6	4.7	523	40	115.9	6.6	10212	508	197	16
z3	1669	124	487	31	0.14	0.42	55.7	4.7	0.22	0.43	4.8	1.4	8.7	1.7	3.56	0.91	44.0	4.4	14.0	1.6	160	13	60.5	5.2	269	25	61.1	5.2	523	40	115.2	8.9	10269	763	184	15
z4	904	59	487	30	4.5	2.0	55.2	5.3	0.7	1.0	4.4	2.3	2.2	1.7	1.1	1.0	13.9	3.7	4.8	1.5	63.3	8.5	27.4	2.4	157	12	42.2	5.0	431	24	113.1	6.6	11129	517	239	19
z5	1674	108	488	31	1.10	0.64	64.4	4.5	0.54	0.57	5.7	1.4	8.1	1.6	3.23	0.83	44.3	3.9	13.8	1.3	160	15	61.0	4.5	269	20	60.2	4.1	499	30	108.1	6.6	9327	536	175	10
z6	1108	52	486	28	1.97	0.86	58.0	4.2	0.32	0.59	2.8	1.4	2.8	1.3	1.37	0.72	19.1	3.0	6.42	0.93	82.0	7.5	35.2	2.5	183	11	48.6	3.4	484	22	121.5	5.9	11326	459	271	16
z7	798	52	488	25	-	-	22.3	2.2	0.03	0.53	3.1	1.4	4.9	1.3	2.43	0.91	23.6	4.3	6.8	1.3	74.3	5.6	27.4	2.5	128.0	8.0	31.2	3.0	287	14	67.6	3.2	9525	426	101.4	6.7
z8	1727	85	487	22	0.3	1.1	59.0	5.7	0.2	1.0	6.3	3.0	10.4	3.3	4.6	1.6	52.8	8.1	14.7	2.1	162	15	57.7	4.5	256	14	56.9	3.5	504	28	115.2	6.8	10838	472	246	11
z9	1061	84	487	29	-	-	28	11	-	-	7	11	5.8	7.9	3.9	5.5	28	15	8.6	7.0	97	25	35	11	196	26	45	12	452	47	113	18	11063	463	112	23
z10	1117	56	486	25	6.3	1.6	71.7	6.0	1.19	0.89	6.5	2.4	4.3	1.8	1.57	0.89	20.9	3.7	6.9	1.2	82.0	7.4	33.8	3.5	175	15	46.9	3.4	471	24	117.6	6.4	11836	592	294	24
z11	1661	78	488	23	0.5	1.0	75.2	5.9	0.11	0.76	4.5	1.7	7.3	2.3	2.6	1.2	39.8	5.7	12.4	1.8	147	13	56.4	4.8	265	14	59.7	4.5	511	19	111.9	5.9	10048	406	221	12
z12	744	38	486	32	3.9	2.7	44.9	5.7	0.4	1.8	4.4	3.7	2.0	2.3	1.3	1.6	12.5	5.4	4.3	2.2	54.6	9.5	22.8	3.6	133	12	35.6	4.4	370	30	98.3	8.6	11446	604	169	14
z13	1425	80	487	28	0.29	0.70	56.7	4.9	0.02	0.55	3.0	1.3	4.7	1.7	2.17	0.87	30.1	5.3	9.4	1.7	108.3	9.2	43.9	3.3	230	15	56.4	4.1	534	36	129.4	8.5	10835	564	318	20
z14	1748	107	487	29	0.04	0.48	65.7	5.3	0.23	0.48	5.6	1.7	9.3	2.3	3.63	0.83	47.1	4.5	14.4	1.5	164	14	61.4	4.3	283	18	65.2	4.7	566	26	128.2	6.0	10181	486	241	17
z15	1560	105	487	34	1.15	0.87	64.3	5.7	0.45	0.63	6.3	1.7	8.6	2.7	3.7	1.2	41.8	6.2	12.3	1.8	137	14	50.8	4.5	241	17	58.4	5.5	529	30	125.0	9.6	10208	647	290	25
MLX																																				
z1	1002	28	487	13	2.8	1.4	51.8	3.3	1.1	1.3	9.9	2.5	12.7	2.9	4.4	1.7	40.3	4.8	9.5	1.7	87.3	6.0	28.2	2.6	131.4	7.2	31.4	2.4	322	14	81.9	3.8	11127	199	241.2	8.6
z2	3070	75	488	20	-	-	132.9	5.2	0.5	1.1	9.7	2.6	16.5	3.2	6.8	1.6	76.0	5.6	23.5	2.0	283	11	104.2	6.2	490	18	109.6	6.1	953	30	196.6	6.1	9471	267	894	30
z3	5431	106	488.2	9.1	-	-	443	10	0.89	0.65	19.3	2.9	35.0	3.2	14.5	1.6	156.2	5.3	44.6	1.8	485	10	172.2	4.7	775	17	166.0	4.2	1424	26	281.8	4.9	9470	144	4559	90
z4	2277	48	488.2	7.4	-	-	71.0	4.4	0.1	1.3	7.0	2.7	11.4	3.3	4.0	1.8	61.5	5.7	18.3	2.4	208.3	7.5	75.0	3.8	341	11	71.8	3.3	616	15	127.6	4.5	9480	176	271.4	6.4
z5	2026	32	487.1	8.2	0.13	0.62	67.2	2.9	0.28	0.66	5.9	1.7	10.1	2.0	3.6	1.0	50.8	3.9	15.3	1.2	174.7	7.1	65.7	2.4	309.0	7.4	67.4	2.1	604	17	131.5	3.6	10517	153	260.9	6.6
z6	2581	56	489	10	-	-	75.8	4.2	0.30	0.92	9.5	2.1	16.0	2.9	6.5	1.4	75.0	6.5	21.7	1.9	242.4	9.2	85.4	4.2	382	13	80.5	3.2	679	19	140.1	4.5	8862	206	340.4	9.1
z7	1455	30	488	10	-	-	46.3	1.6	0.13	0.43	4.4	1.0	7.7	1.4	2.72	0.60	36.7	2.6	11.25	0.90	129.6	5.6	47.5	1.7	219.3	5.9	47.0	1.5	413	10	87.0	2.5	9277	201	152.1	4.2
z8	1903	39	488.7	8.5	-	-	43.1	2.5	-	-	5.1	2.2	9.5	2.8	4.7	1.4	52.4	4.6	15.1	1.7	171.6	7.2	62.2	2.8	286.3	9.2	60.7	2.4	521	12	108.6	4.1	8953	129	222.9	7.0
z9	2097	44	487.4	8.7	-	-	62.4	2.1	0.30	0.40	7.3	1.2	12.1	1.4	4.44	0.70	56.0	2.8	16.7	1.0	188.3	5.8	68.8	2.0	313.9	6.7	67.7	2.2	582	11	121.2	2.9	10201	183	236.0	5.1
z10	1451	28	486	10	1.18	0.26	60.5	1.2	0.37	0.22	3.90	0.63	5.68	0.76	1.75	0.35	28.6	1.5	9.08	0.40	135.1	2.9	43.8	1.0	222.4	4.9	53.0	1.0	513	10	118.7	2.1	11570	146	292.4	6.8
z11	1097	56	488	19	0.01	0.32	54.4	2.6	0.09	0.33	3.10	0.78	5.8	1.2	2.03	0.53	30.0	1.9	9.4	1.0	114.2	6.0	43.2	2.0	207.5	8.7	45.6	2.5	395	18	82.4	3.7	9532	398	121.5	5.9
z12	3181	83	487	12	0.42	0.82	75.7	3.5	0.30	0.81	8.3	2.0	14.4	2.5	5.9	1.4	71.0	6.2	23.0	1.6	271.9	7.8	103.4	3.2	492	14	108.9	3.9	980	27	214.5	6.8	10211	237	291.1	7.9
z13	1638	85	487	27	-	-	69.6	5.8	-	-	10.5	4.3	14.6	4.9	5.4	2.5	55.3	8.8	15.0	3.4	175	13	60.9	5.2	292	16	64.8	4.8	600	28	130.2	9.0	10653	404	361	19
z14	1714	74	487	21	0.12	0.67	68.3	3.4	0.23	0.68	6.9	1.6	11.2	2.1	3.7	1.0	51.3	4.9	15.3	1.3	185.1	9.2	66.9	3.4	317	14	69.8	3.2	610	27	127.4	7.1	10474	382	230	12
z15	1342	46	486	23	-	-	78.8	5.5	-	-	3.7	2.0	6.4	2.3	1.7	1.1	32.2	4.6	9.9	1.6	143.5	7.3	48.0	3.4	247	11	58.9	3.5	557	24	124.0	6.6	11507	494	325	16
z16	1221	42	486	36	2.3	3.7	66.5	7.9	0.3	3.2	7.5	5.3	7.0	4.7	1.8	2.9	32	10	9.4	4.1	117	14	44.9	7.5	229	20	52.0	7.5	484	45	109	12	10237	988	184	22
z17	3254	155	488	23	-	-	145	10	0.7	2.3	17.2	4.9	28.3	7.3	10.7	3.1	122	12	32.6	4.3	376	25	130.7	9.3	568	31	117.0	7.0	958	66	191	14	9709	534	599	40
z18	2382	118	487	25	-	-	167	15	-	-	9.4	6.7	15.8	7.6	5.5	4.5	69	14	20.2	5.7	238	21	89.9	9.8	420	29	91.2	9.2	801	54	169	13	10708	456	906	65
z19	2521	137	488	25	-	-	167	11	0.6	1.1	11.2	3.2	17.4	3.4	6.9	1.7	73.6	8.4	21.6	2.6	254	20	94.0	7.1	445	24	99.1	6.6	859	51	179	12	10014	657	982	68
average total procedural blank (d)	**ppt**	**±2SD**	**ppb**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**	**ppt**	**±2SD**
(± 2SD; n=18)	5.1	6.2	0.12	0.15	0.51	0.51	0.0	1.2	0.30	0.26	-0.23	0.91	-0.70	0.66	-1.23	0.32	-0.7	1.0	-1.30	0.32	1.2	1.2	0.08	0.57	0.61	0.80	-0.31	0.31	3.2	1.2	2.42	0.59	66	191	4.7	2.1

Notes: Sc, Ti, Nb and Ta are not reported. ^{45}Sc was affected by $^{90}Zr^{2+}$ interferences. Nb and Ta were found in variable amounts in the U-Pb fraction of standard solutions put through column chemistry. Ti was below detection limit in most solutions.

(a) concentrations normalized to Zr+Hf = 497464 ppm in stoichiometric zircon.

(b) all data were corrected for blank contribution using the average blank ± 2SD reported at the bottom of the table. Uncertainties on concentrations were propagated using uncertainty propagation techniques described in Schoene et al. (2010) and are reported at the 2σ confidence level.

(c) "-" indicates that concentrations in respective solutions were at or below the detection limit, given the magnitude of the blank correction.

(d) average total procedural blank given as unnormalized concentrations in blank solutions.

Table DR3. Lu-Hf isotopic data of U-Pb dated zircons analyzed by MC-ICPMS

	$^{176}Yb/^{177}Hf$ a	±2σ	$^{176}Lu/^{177}Hf$ a	±2σ	$^{178}Hf/^{177}Hf$	$^{180}Hf/^{177}Hf$	SigHf b (V)	$^{176}Hf/^{177}Hf$	±2σ c	$^{176}Hf/^{177}Hf(t)$d	εHf(t) d	±2σ c
FCT												
z1	0.1665	133	0.00591	35	1.46713	1.88665	23	0.282573	10	0.282570	-7.00	0.36
z2	0.0531	43	0.00199	12	1.46714	1.88662	12	0.282547	11	0.282546	-7.82	0.38
z3	0.0444	36	0.00183	11	1.46713	1.88666	17	0.282531	11	0.282530	-8.39	0.40
z4	0.0608	49	0.00226	14	1.46714	1.88662	44	0.282526	8	0.282525	-8.59	0.29
z5	0.0443	35	0.00152	9	1.46713	1.88658	83	0.282513	8	0.282512	-9.02	0.28
z6	0.0515	41	0.00207	12	1.46714	1.88665	31	0.282544	9	0.282543	-7.95	0.33
z7	0.0665	53	0.00258	16	1.46712	1.88655	19	0.282567	10	0.282566	-7.12	0.34
z8	0.0507	41	0.00191	11	1.46715	1.88657	19	0.282527	10	0.282526	-8.55	0.34
z9	0.0585	47	0.00223	13	1.46713	1.88660	10	0.282519	14	0.282518	-8.84	0.51
z10	0.0219	18	0.00097	6	1.46715	1.88660	20	0.282543	9	0.282542	-7.97	0.33
z11	0.0305	24	0.00108	7	1.46714	1.88665	49	0.282531	8	0.282530	-8.39	0.30
z12	0.0490	39	0.00185	11	1.46715	1.88670	6	0.282585	19	0.282584	-6.49	0.67
z13	0.0648	52	0.00258	16	1.46718	1.88668	5	0.282522	20	0.282521	-8.73	0.70
z14	0.0424	34	0.00180	11	1.46713	1.88663	18	0.282528	11	0.282527	-8.51	0.38
z15	0.0419	34	0.00170	10	1.46712	1.88670	10	0.282520	14	0.282519	-8.78	0.50
z16	0.0526	42	0.00195	12	1.46711	1.88668	12	0.282539	11	0.282538	-8.13	0.38
z17	0.0426	34	0.00180	11	1.46714	1.88662	19	0.282537	10	0.282536	-8.19	0.35
z18	0.0438	35	0.00172	10	1.46714	1.88668	11	0.282525	13	0.282525	-8.59	0.47
z19	0.0546	44	0.00208	13	1.46714	1.88668	11	0.282549	14	0.282548	-7.78	0.51
MLX												
z1	0.1040	83	0.00338	20	1.46712	1.88661	16	0.282526	11	0.282524	-8.62	0.41
z2	0.0448	36	0.00144	9	1.46714	1.88665	78	0.282537	8	0.282537	-8.16	0.30
z3	0.0474	38	0.00183	11	1.46714	1.88666	31	0.282530	9	0.282530	-8.41	0.31
z4	0.0673	55	0.00247	15	1.46713	1.88662	27	0.282555	11	0.282554	-7.56	0.38
z5	0.0606	48	0.00222	13	1.46712	1.88669	14	0.282545	11	0.282544	-7.92	0.38
z6	0.0547	44	0.00196	12	1.46712	1.88667	26	0.282532	10	0.282531	-8.37	0.34
z7	0.0980	78	0.00330	20	1.46712	1.88660	12	0.282539	13	0.282537	-8.13	0.45
z8	0.0522	42	0.00195	12	1.46714	1.88663	24	0.282529	13	0.282528	-8.47	0.45
z9	0.0832	67	0.00283	17	1.46716	1.88668	8	0.282531	20	0.282530	-8.40	0.71
z10	0.0571	46	0.00216	13	1.46714	1.88663	17	0.282529	12	0.282527	-8.49	0.41
JMC475 (n=21)	<0.00000		<0.00000		1.46718	1.88666	10	0.282148	5	0.282148	-22.52	0.18

Quoted uncertainties (absolute) relate to the last quoted figure. Accuracy and reproducibilty was checked by repeated analyses (n = 21) of 10 ppb solutions of JMC475.

(a) $^{176}Yb/^{177}Hf$ = ($^{176}Yb/^{173}Yb$)true x ($^{173}Yb/^{177}Hf$)meas x (M173(Yb)/M177(Hf))β(Hf), β(Hf) = ln($^{179}Hf/^{177}Hf$)true / ($^{179}Hf/^{177}Hf$)$_{meas}$ / ln (M179(Hf)/M177(Hf)), M=mass of respective isotope. The $^{176}Lu/^{177}Hf$ were calculated in a similar way by using the $^{175}Lu/^{177}Hf$ and β(Yb).

(b) Mean Hf signal in volt.

(c) Uncertainties are quadratic additions of the within-run precision and the daily reproducibility of the 10ppb-JMC475 solution. Uncertainties for the JMC475 quoted at 2SD (2 standard deviation).

(d) Initial $^{176}Hf/^{177}Hf$ and εHf calculated using the apparent U-Pb age determined by ID-TIMS (see Supplementary Table 1), and the CHUR parameters: $^{176}Lu/^{177}Hf$ = 0.0336, and $^{176}Hf/^{177}Hf$ = 0.282785 (Bouvier et al., 2008).