Supplementary

Title: Jurassic zircons from the Southwest Indian Ridge

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Table S1. Representative major element compositions (wt %) of minerals in diorite.

SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total
Feldspar										
66.83	0.00	20.00	0.03	0.07	0.00	0.02	0.88	11.21	0.09	99.13
66.23	0.00	19.77	0.01	0.04	0.00	0.03	0.95	10.86	0.09	97.98
63.14	0.03	18.16	0.02	0.02	0.00	0.00	0.00	0.33	15.96	97.66
61.14	0.00	20.09	0.02	0.07	0.01	0.00	0.00	0.30	15.36	96.98
62.61	0.08	17.89	0.05	0.05	0.01	0.02	0.09	0.56	15.36	96.72
62.14	0.00	17.94	0.02	0.01	0.00	0.00	0.06	0.56	15.47	96.20
63.54	0.03	18.73	0.06	0.00	0.03	0.00	0.03	0.63	15.48	98.53
66.06	0.00	19.61	0.00	0.02	0.00	0.00	0.59	10.72	0.12	97.11
63.12	0.00	18.14	0.02	0.10	0.00	0.00	0.02	0.23	15.98	97.62
57.31	0.00	26.29	0.02	0.11	0.00	0.03	7.83	6.67	0.19	98.43
58.43	0.00	25.40	0.01	0.17	0.00	0.01	6.80	7.48	0.23	98.52
58.33	0.00	25.48	0.04	0.10	0.04	0.00	7.18	6.98	0.19	98.34
58.10	0.02	25.50	0.02	0.12	0.00	0.00	7.39	7.31	0.25	98.70
57.64	0.01	25.46	0.05	0.14	0.00	0.03	7.29	6.90	0.25	97.76
57.35	0.03	25.36	0.04	0.19	0.03	0.00	7.11	7.04	0.31	97.42
65.32	0.00	17.56	0.02	0.05	0.00	0.02	0.01	0.51	15.40	98.88
63.22	0.01	18.06	0.02	0.04	0.02	0.00	0.07	0.52	15.48	97.44
Amphibole										
49.16	0.09	4.36	0.08	15.29	0.41	12.00	11.32	0.70	0.27	93.68
48.47	0.00	4.43	0.06	15.41	0.43	12.21	11.46	0.74	0.27	93.46
48.97	0.07	6.44	0.08	17.14	0.36	11.87	11.28	1.04	0.41	97.65
48.67	0.15	5.35	0.02	16.51	0.43	11.79	11.35	0.72	0.34	95.35
48.53	0.22	4.22	0.10	16.96	0.38	11.32	11.34	0.65	0.31	94.02
49.08	0.21	4.21	0.02	16.42	0.33	12.19	11.74	0.55	0.25	95.01
46.64	0.06	5.53	0.04	16.88	0.40	11.28	11.20	0.82	0.42	93.26
49.66	0.19	4.70	0.00	16.78	0.35	12.07	11.46	0.65	0.36	96.23
47.97	0.16	5.10	0.30	16.40	0.25	11.44	11.28	0.81	0.43	94.13
48.68	0.23	5.11	0.00	17.70	0.40	11.09	11.27	0.85	0.39	95.71
50.32	0.08	3.15	0.01	16.08	0.43	13.08	10.86	0.67	0.21	94.90
49.37	0.42	3.84	0.08	15.16	0.41	13.17	11.72	0.78	0.25	95.20
49.37	0.12	3.94	0.03	16.55	0.45	12.49	10.51	0.91	0.23	94.59
49.06	0.07	4.14	0.02	15.94	0.33	12.27	10.75	1.02	0.27	93.87
49.59	0.02	4.05	0.05	16.71	0.48	12.50	10.95	0.84	0.25	95.45
48.92	0.08	3.81	0.05	15.75	0.52	12.69	10.97	0.78	0.26	93.82
49.06	0.42	4.15	0.04	17.27	0.49	11.88	11.00	0.92	0.28	95.51
49.98	0.36	5.52	0.05	16.91	0.40	11.42	11.14	0.82	0.72	97.31
48.77	0.15	6.21	0.07	17.45	0.45	12.49	11.33	0.96	0.44	98.31
48.21	0.06	7.24	0.13	17.23	0.32	12.03	11.05	1.16	0.43	97.87
48.33	0.20	4.79	0.07	16.43	0.35	11.65	11.25	0.79	0.35	94.21
50.69	0.25	3.34	0.01	15.79	0.35	11.87	11.45	0.53	0.22	94.49
48.59	0.29	4.83	0.07	17.07	0.44	11.53	11.21	0.70	0.43	95.16
Epidote										
38.75	0.08	27.43	0.02	6.13	0.07	0.06	22.99	0.07	0.14	95.73
38.04	0.08	27.17	0.00	6.02	0.08	0.09	22.77	0.07	0.14	94.46
37.45	0.02	26.36	0.03	7.66	0.39	0.02	22.20	0.00	0.00	94.13
37.51	0.04	25.72	0.00	8.56	0.05	0.09	23.09	0.00	0.01	95.07
38.93	0.00	24.97	0.04	9.29	0.10	0.06	22.72	0.05	0.01	96.17
37.12	0.02	22.86	0.00	12.07	0.03	0.00	22.96	0.04	0.01	95.08

36.56	0.10	20.99	0.08	13.87	0.09	0.04	22.40	0.02	0.04	94.17
36.96	0.23	21.91	0.01	12.89	0.11	0.05	22.36	0.04	0.00	94.55
36.69	0.17	19.43	0.00	15.66	0.09	0.05	22.15	0.00	0.01	94.24
36.70	0.13	21.88	0.00	13.02	0.08	0.12	22.47	0.00	0.02	94.40
36.65	0.17	22.71	0.00	11.76	0.17	0.25	22.48	0.04	0.01	94.23
Chlorite										
26.82	0.04	17.28	0.15	24.70	15.36	0.33	0.06	0.09	0.07	84.88
26.66	0.00	17.25	0.12	24.40	15.28	0.28	0.13	0.16	0.09	84.35
26.40	0.04	17.02	0.03	24.86	14.96	0.25	0.01	0.05	0.02	83.64
26.41	0.02	17.15	0.00	25.01	14.89	0.29	0.05	0.00	0.04	83.86
25.95	0.48	17.30	0.08	24.98	14.42	0.28	0.52	0.09	0.07	84.16
26.56	0.10	17.81	0.08	25.66	14.82	0.29	0.09	0.07	0.14	85.61
26.48	0.00	16.81	0.04	25.47	14.90	0.15	0.04	0.00	0.10	83.99
26.10	0.00	17.73	0.04	23.78	14.12	0.27	0.00	0.13	0.08	82.23
26.25	0.02	17.80	0.01	24.51	14.60	0.28	0.07	0.07	0.09	83.71
26.10	0.06	17.84	0.12	25.35	14.74	0.34	0.04	0.00	0.01	84.58
26.07	0.03	17.96	0.06	25.09	14.55	0.28	0.00	0.01	0.06	84.09
26.59	0.05	16.96	0.03	23.88	15.37	0.29	0.04	0.02	0.03	83.24
25.35	0.05	17.36	0.09	24.87	14.47	0.24	0.06	0.01	0.03	82.53
27.70	1.98	16.24	0.07	22.27	14.01	0.26	2.52	0.03	0.17	85.25
26.72	0.03	16.92	0.00	26.50	14.28	0.29	0.00	0.02	0.04	84.80
Ilmenite										
0.05	46.00	0.03	0.19	44.48	2.65	0.07	0.00	0.00	0.00	93.48
Sphene										
29.74	31.47	2.72	0.05	1.48	0.04	0.04	26.93	0.07	0.01	92.55
30.58	23.08	9.08	0.06	1.91	0.00	0.07	28.63	0.06	0.01	93.48

Table S2. Zircon (sample D4-2-3) REE data obtained by LA-ICPMS.

spot	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Ti
D4-2-3															
#1	1.72	79.0	2.13	25.8	34.8	1.85	148	44.0	497	163	702	124	1171	182	54.2
#2	0.27	85.2	2.20	32.8	49.1	1.67	183	52.0	578	184	787	140	1283	199	44.9
#3	0.08	89.4	1.88	27.5	42.9	1.93	175	49.8	565	183	795	144	1355	211	45.4
#4	0.32	70.9	2.85	37.8	50.5	2.41	181	49.3	548	176	734	129	1194	182	65.8
#5	0.14	89.4	0.11	4.69	11.4	0.54	60.4	19.9	253	89.0	418	81.0	825	136	31.9
#6	0.10	97.8	1.60	30.3	43.5	2.08	174	52.4	602	200	889	160	1513	241	56.4
#7	0.33	80.4	2.30	30.6	44.7	1.37	182	51.5	588	191	829	144	1321	206	48.9
#8	0.53	80.4	2.60	36.2	49.0	1.62	186	55.2	616	199	843	147	1373	211	42.5
#9	0.35	85.7	2.09	30.6	43.1	1.39	179	52.0	586	188	805	140	1322	204	79.4
#10	0.69	76.3	2.93	37.2	48.9	2.04	212	60.8	692	225	962	165	1532	239	31.1
#11	0.17	87.9	0.05	4.30	8.71	0.25	55.5	18.3	228	81.0	380	72.0	726	117	47.6
#12	0.20	95.2	2.34	33.6	46.9	2.13	195	58.0	656	215	916	164	1523	235	46.5
#13	0.26	92.2	1.79	31.3	49.1	1.57	188	53.7	620	202	868	155	1442	223	59.4
#14	4.18	93.4	3.14	32.9	44.8	1.90	172	49.2	556	179	761	135	1266	194	51.0
#15	0.35	74.0	2.58	36.6	48.2	2.55	189	55.8	603	196	823	144	1339	206	79.6
#16	0.57	96.3	2.23	31.8	44.8	1.88	190	58.8	698	239	1057	188	1742	277	52.5
#17	8.40	99.4	5.13	48.2	57.4	2.48	231	63.7	706	228	963	167	1514	236	56.5
#18	0.37	84.0	2.46	35.8	46.4	2.12	203	58.7	656	219	925	161	1501	232	65.9
#19	0.05	78.4	0.94	14.9	26.3	1.25	108	32.8	371	125	550	100	966	153	51.8
#20	0.27	88.9	2.21	32.2	47.9	1.69	191	53.6	599	190	799	144	1340	204	54.3
#21	0.01	82.3	0.60	11.4	24.6	1.23	123	38.4	440	145	639	117	1122	172	34.1
#22	0.50	66.6	1.94	24.7	34.9	1.82	149	42.0	467	152	653	115	1097	168	57.3
#23	0.08	85.0	2.72	39.9	48.5	1.95	203	60.8	662	218	925	162	1494	233	54.4

#24	0.01	60.4	1.16	20.2	27.4	1.11	119	32.9	380	121	526	96.0	919	143	46.8
#25	0.95	91.0	2.57	36.1	48.2	1.95	193	54.2	592	188	795	142	1318	202	52.4
#26	0.20	77.3	0.39	6.08	13.1	0.69	66.1	21.5	256	88.0	404	76.0	765	123	48.5
#27	0.01	69.2	0.37	7.27	14.2	0.80	69.5	22.3	271	92.0	412	79.0	784	124	40.6
#28	0.37	86.8	2.01	27.5	38.2	1.87	156	44.9	505	164	694	124	1168	182	40.4
D1401															
#1 ^{p}	0.26	45.4	0.06	3.20	9.29	0.96	46.0	40.6	676	297	1290	305	2551	451	5.35
#2 ^{p}	0.26	51.2	0.07	3.38	9.90	0.97	49.0	48.2	739	314	1470	336	2626	464	6.77
#3 ^{p}	0.17	47.4	0.13	2.79	7.21	0.65	35.0	32.3	562	236	1167	262	2089	352	8.12
#4 ^{p}	0.54	47.2	0.12	2.19	5.96	0.46	31.0	33.8	526	241	1218	285	2466	471	7.85
#5 ^{p}	0.69	47.6	0.06	5.12	8.72	0.75	39.0	36.4	581	253	1284	309	2568	490	6.78
#6 ^{p}	1.00	32.4	0.07	6.76	8.24	0.68	33.0	27.7	429	173	886	223	1933	379	8.06
#7 ^{p}	1.04	20.4	0.04	3.11	4.69	0.34	21.0	18.1	321	124	654	167	1503	294	6.82
#8	0.02	114	0.30	5.33	20.0	1.56	250	108	1461	606	2804	635	5398	921	7.67
#9	0.08	113	0.46	7.18	21.4	1.73	245	100	1316	551	2400	511	4081	691	9.69
#10	0.14	78.0	0.49	6.96	16.1	1.02	171	68.9	923	375	1677	360	2915	497	10.9
#11	0.09	69.8	0.28	4.26	11.3	0.83	136	58.0	801	320	1529	335	2777	481	9.43
#12	0.02	78.6	0.13	2.80	10.7	1.00	147	64.3	910	364	1744	385	3175	553	10.0
#13	0.02	75.1	0.13	2.80	10.6	1.05	143	62.3	864	350	1665	366	3005	523	5.85

Units: ppm. b.d. ^{p}: porous.

Table S3. LA–ICP-MS Lu–Hf isotope analysis of zircons.

Sample/	^{176}Yb/^{177}Hf	^{176}Lu/^{177}Hf	^{176}Hf/^{177}Hf	±σ	$\varepsilon_{Hf(0)}$*	$\varepsilon_{Hf(t)}$
D4-2-3						*t = 180 Ma*
#1	0.020842	0.000702	0.282593	0.000016	-6.8	-2.9
#2	0.028793	0.000947	0.282581	0.000015	-7.2	-3.3
#3	0.032526	0.001096	0.282593	0.000013	-6.8	-2.9
#4	0.015559	0.000534	0.282579	0.000013	-7.3	-3.4
#5	0.022760	0.000774	0.282609	0.000018	-6.2	-2.3
#6	0.027504	0.000906	0.282602	0.000013	-6.5	-2.6
#7	0.029386	0.000970	0.282607	0.000015	-6.3	-2.4
#8	0.025643	0.000863	0.282567	0.000016	-7.7	-3.8
#9	0.028221	0.000930	0.282581	0.000016	-7.2	-3.3
#10	0.022565	0.000755	0.282589	0.000014	-6.9	-3.0
#11	0.030480	0.001004	0.282608	0.000012	-6.3	-2.4
#12	0.022637	0.000749	0.282590	0.000012	-6.9	-3.0
#13	0.015820	0.000545	0.282575	0.000013	-7.4	-3.5
#14	0.024359	0.000800	0.282593	0.000019	-6.8	-2.9
#15	0.028060	0.000919	0.282579	0.000015	-7.3	-3.4
#16	0.027788	0.000919	0.282582	0.000017	-7.2	-3.3
#17	0.017960	0.000605	0.282547	0.000014	-8.4	-4.5
#18	0.014576	0.000496	0.282569	0.000016	-7.6	-3.7
#19	0.025626	0.000833	0.282604	0.000016	-6.4	-2.5
#20	0.029586	0.000958	0.282606	0.000019	-6.3	-2.4
#21	0.026933	0.000873	0.282595	0.000017	-6.7	-2.8
#22	0.030617	0.001035	0.282571	0.000019	-7.6	-3.7
#23	0.041134	0.001349	0.282599	0.000021	-6.6	-2.7
#24	0.018516	0.000619	0.282558	0.000017	-8.0	-4.1

#25	0.022318	0.000746	0.282588	0.000011	-7.0	-3.0
#26	0.028723	0.000941	0.282575	0.000019	-7.4	-3.5
#27	0.013482	0.000458	0.282586	0.000013	-7.0	-3.1
#28	0.025245	0.000844	0.282587	0.000023	-7.0	-3.1
#29	0.032456	0.001059	0.282569	0.000017	-7.6	-3.8
#30	0.026519	0.000869	0.282590	0.000017	-6.9	-3.0
#31	0.012555	0.000435	0.282585	0.000013	-7.1	-3.1
#32	0.012677	0.000432	0.282578	0.000017	-7.3	-3.4
#33	0.033723	0.001110	0.282582	0.000021	-7.2	-3.3
#34	0.023402	0.000780	0.282569	0.000020	-7.6	-3.7
#35	0.011203	0.000386	0.282583	0.000012	-7.1	-3.2
#36	0.027634	0.000919	0.282572	0.000016	-7.5	-3.6
#37	0.022819	0.000760	0.282582	0.000013	-7.2	-3.3
#38	0.027494	0.000896	0.282589	0.000012	-6.9	-3.0
#39	0.019472	0.000656	0.282578	0.000014	-7.3	-3.4
#40	0.010514	0.000369	0.282565	0.000015	-7.8	-3.8
D1401						*t = 5.4 Ma*
2-3-1-D1	0.099781	0.003581	0.283134	0.000104	+12.4	+12.5
2-3-1-D2	0.178358	0.005749	0.283163	0.000064	+13.4	+13.5
1A [p]	0.197347	0.006742	0.283132	0.000045	+12.3	+12.4
1B [p]	0.065594	0.002201	0.283199	0.000017	+14.6	+14.7
1C [p]	0.078027	0.002707	0.283215	0.000031	+15.2	+15.3
3A [p]	0.077844	0.003062	0.283196	0.000032	+14.5	+14.6
3B [p]	0.189956	0.006250	0.283192	0.000029	+14.4	+14.5
4 [p]	0.231781	0.007416	0.283226	0.000028	+15.6	+15.7
5 [p]	0.158412	0.005259	0.283204	0.000027	+14.8	+14.9
6	0.114039	0.003979	0.283172	0.000036	+13.7	+13.8

[*] $^{176}Hf/^{177}Hf_{CHUR(0)}$ = 0.282875 and $^{176}Lu/^{177}Hf_{CHUR(0)}$ = 0.0336 (Bouvier et al., 2008). $\lambda^{176}Lu = 1.867 \times 10^{-11}$ (Scherer et al., 2001; Söderlund et al., 2004). [p]: analysis on porous domain.

Table S4. Lu–Hf and Sm–Nd isotope data for sample D4-2-3.

Sample [a]	Lu (ppm)	Hf (ppm)	$^{176}Lu/^{177}Hf$ [b]	$^{176}Hf/^{177}Hf$ [c]	Sm (ppm)	Nd (ppm)	$^{147}Sm/^{144}Nd$ [b]	$^{143}Nd/^{144}Nd$ [c]
D4-2-3								
Amphibole	1.22	1.35	0.128	0.283050 ± 5	8.61	40.5	0.1287	0.512430 ± 10
Feldspar	0.021	0.165	0.0184	0.280319 ± 15	2.61	4.70	0.3355	0.512351 ± 12
Relics	0.182	0.279	0.0927	0.282749 ± 4	3.28	16.5	0.1206	0.515412 ± 10
whole rock	0.250	3.83	0.00928	0.282630 ± 7	4.39	73.5	0.0361	0.512375 ± 10
D1401								
Pyroxene	9.99	0.213	6.69	0.298238 ± 6	2.02	5.87	0.2082	0.512931 ± 9
Feldspar	0.020	0.062	0.0490	0.281913 ± 34	0.17	0.55	0.1869	0.513045 ± 10
Relics	0.111	0.365	0.0433	0.282916 ± 4	0.74	1.95	0.2297	0.513025 ± 7
whole rock	1.52	4.71	0.0517	0.283162 ± 6	0.98	2.62	0.2275	0.512981 ± 10

[a] Relics, mixture of remained minerals after picking of amphibole/pyroxene and feldspar.

[b] Uncertainties for $^{176}Lu/^{177}Hf$ and $^{147}Sm/^{144}Nd$ for the purpose of regressions and calculations is estimated to be 0.5%.

[c] Reported errors on the $^{176}Hf/^{177}Hf$ and $^{143}Nd/^{144}Nd$ are within-run 2σ, standard error, and are given in the 6th decimal place.

Figure S1. Photomicrographs of ancient quartz diorite (D4-2-3) from SWIR.

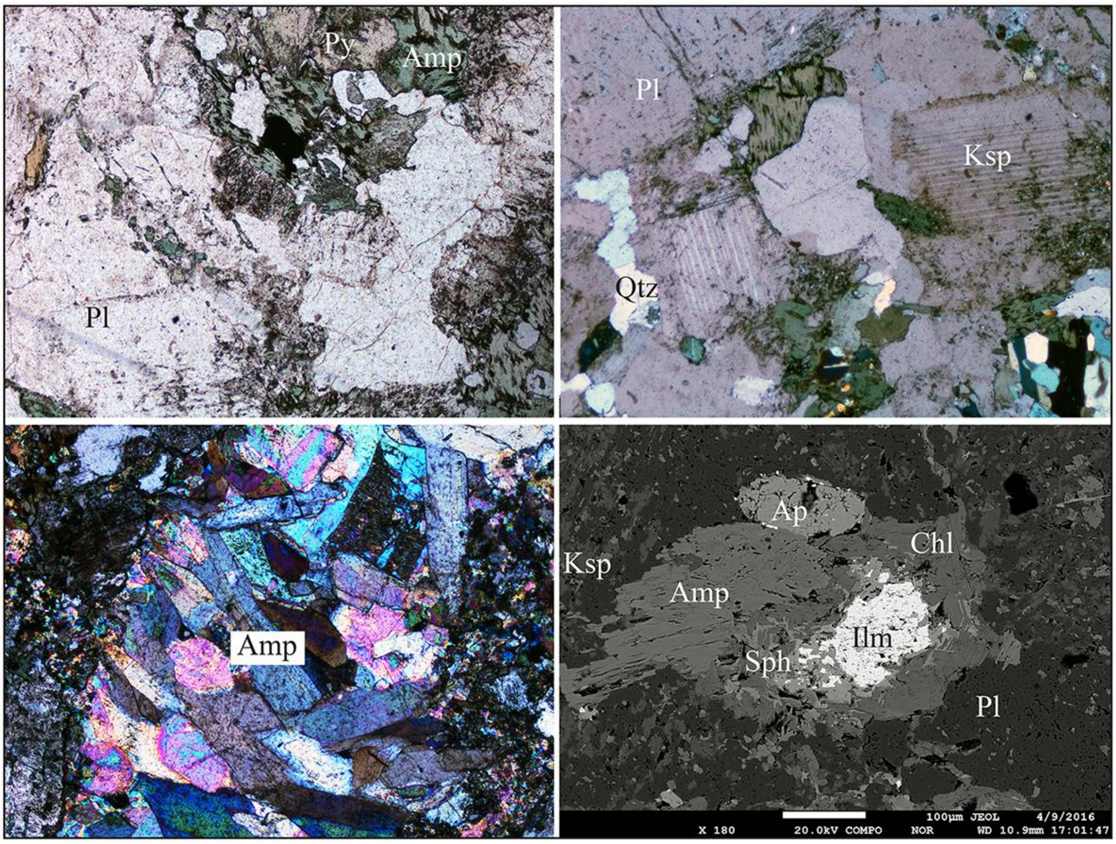

Figure S2. Zircon (D4-2-3-01#1 in Fig. 2) in the thin section.

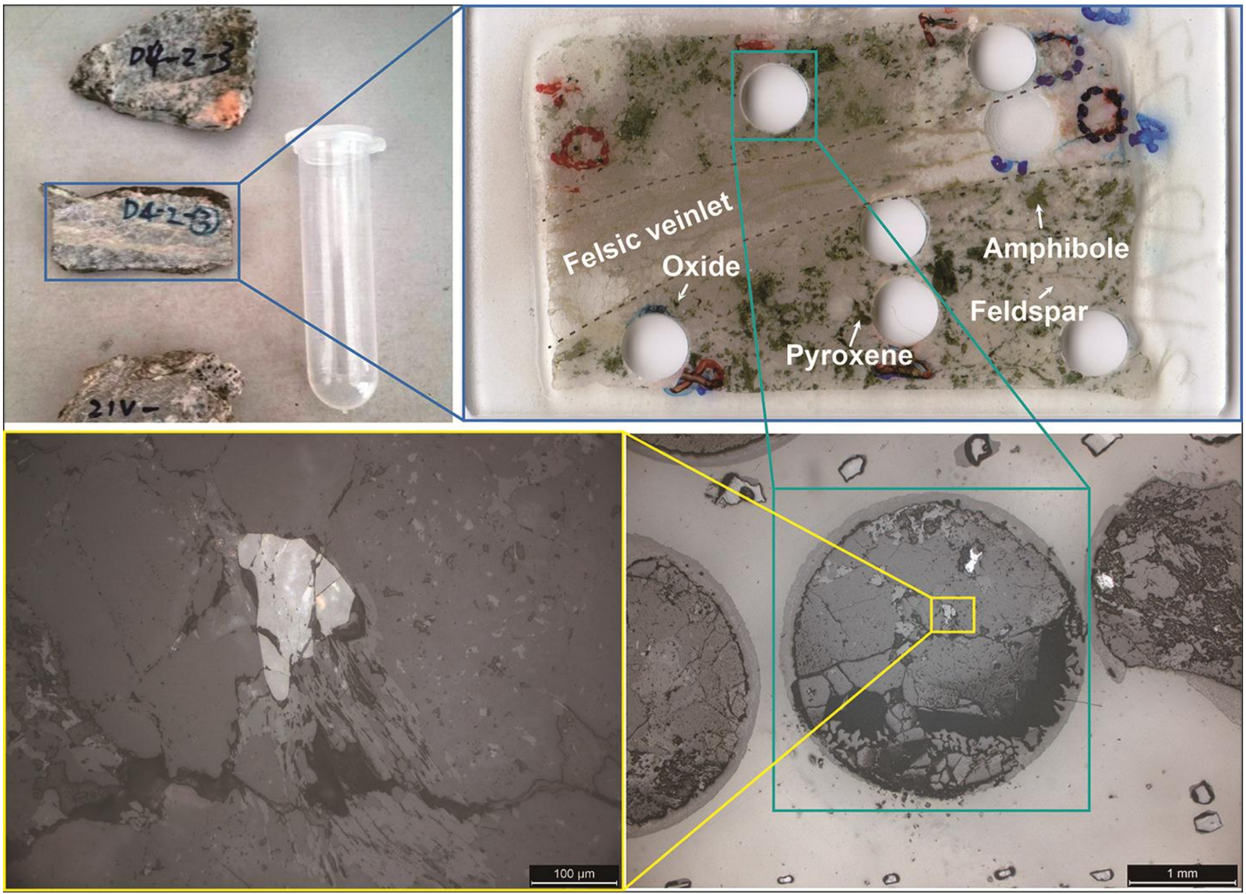

Figure S3. Representative CL images of zircon from sample D1401 and corresponding apparent ages (Ma).

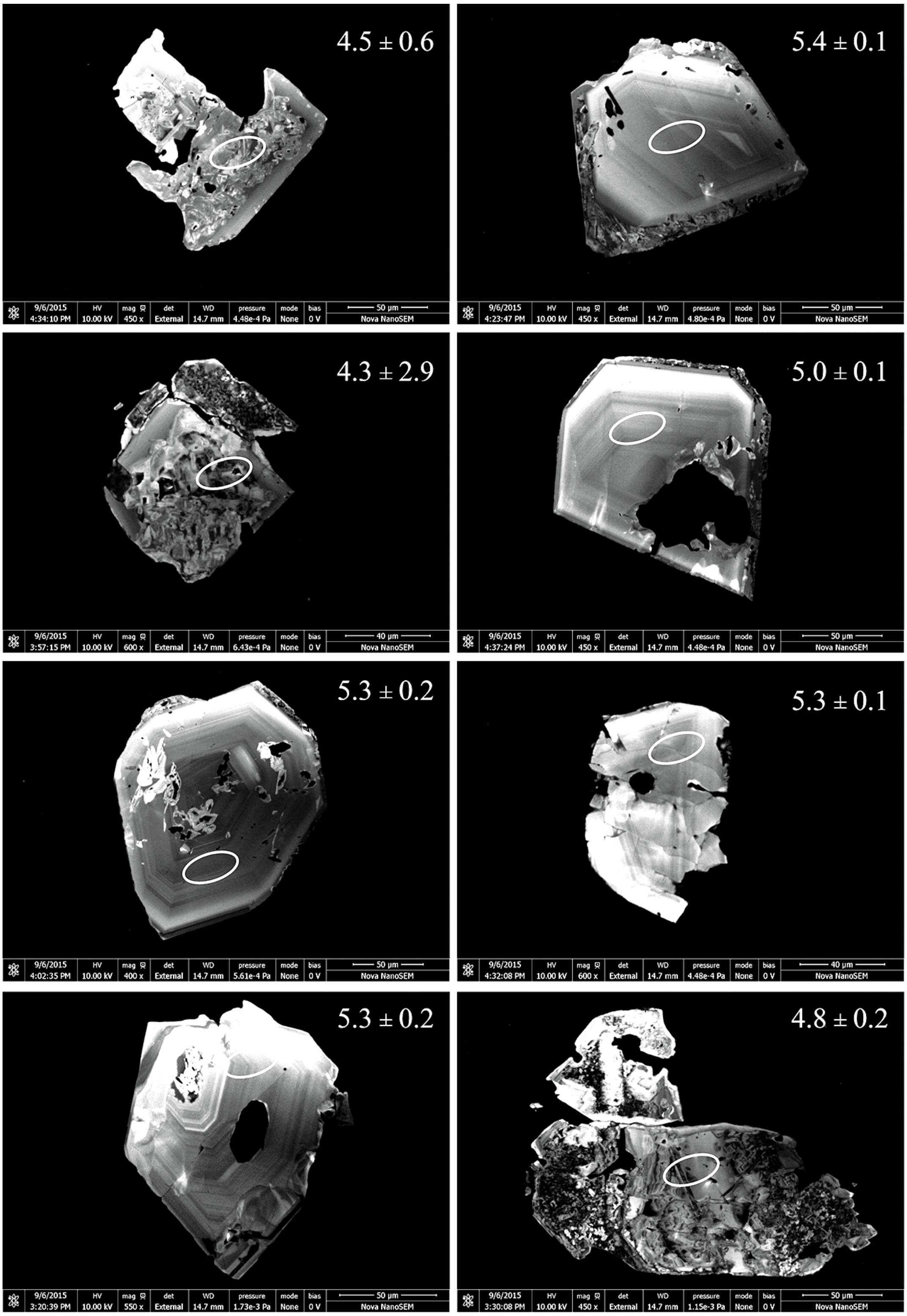

Figure S4. Representative CL images of zircon from sample D4-2-3 and corresponding apparent ages (Ma).

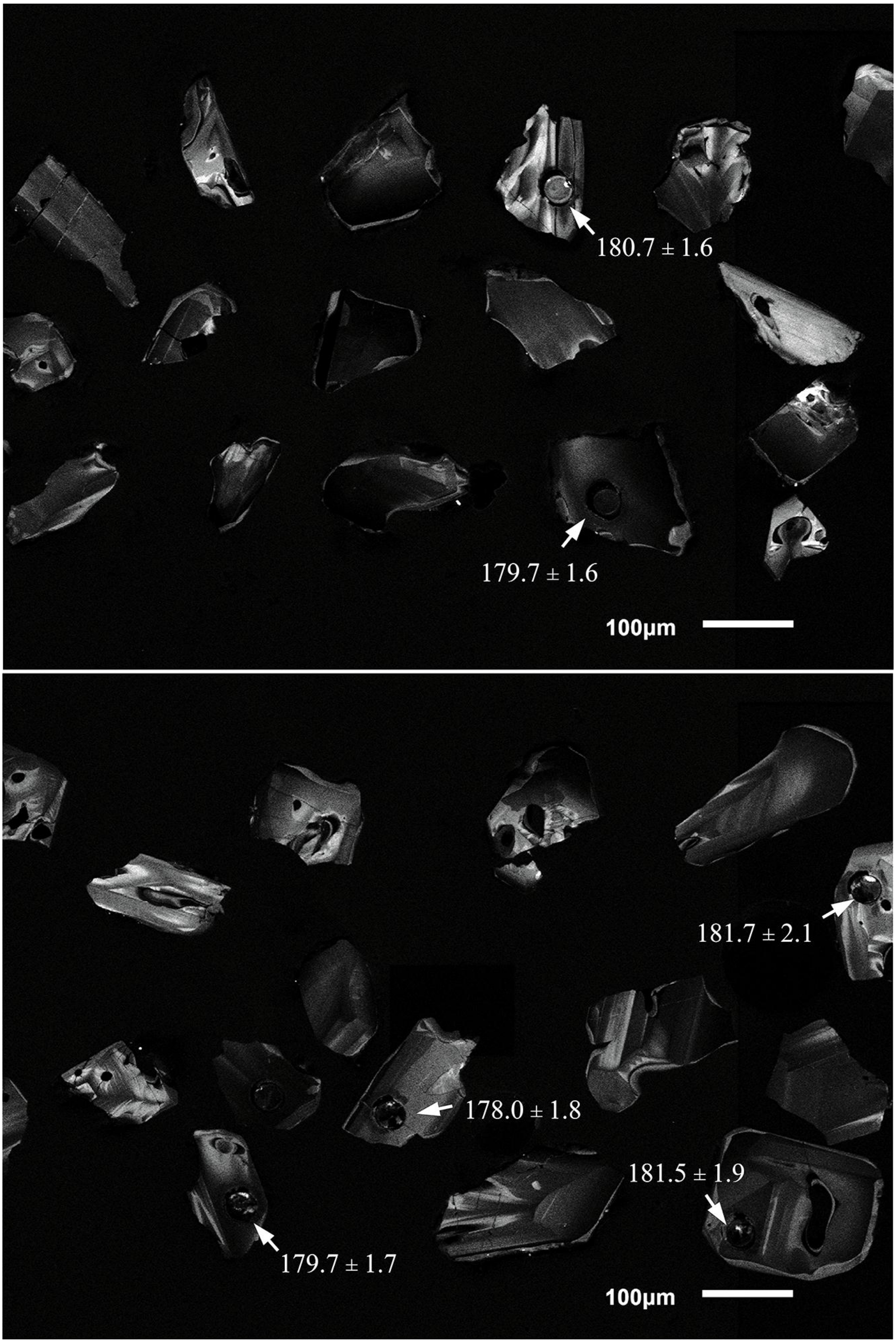

Figure S5. Analytical results for the ^{176}Hf/^{177}Hf isotope ratios on 91500 by LA−ICP-MS. Green line stands for the reference value (Wu et al., 2006).

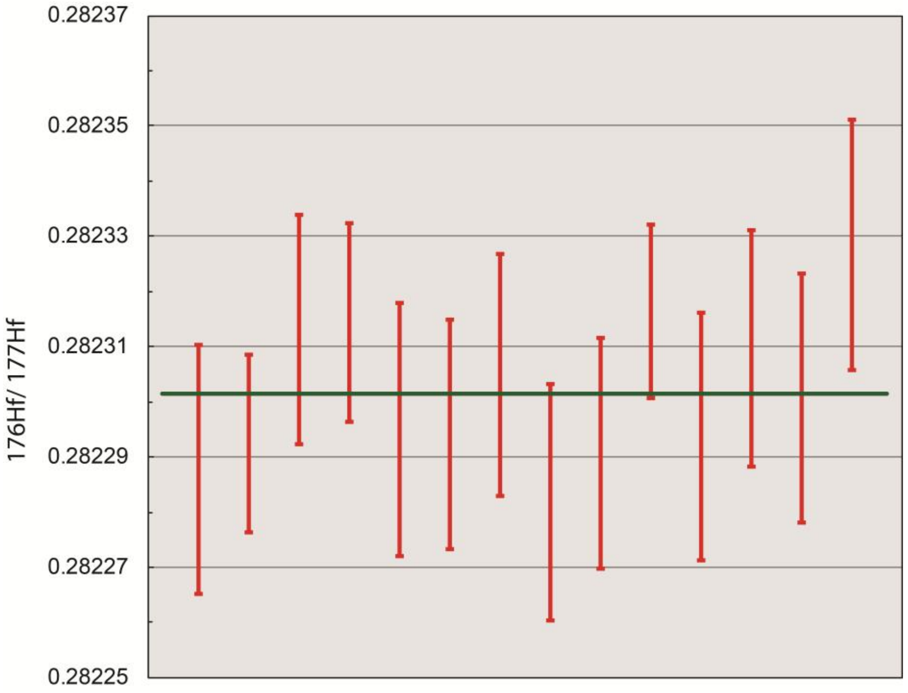

Figure S6. Plot of ^{176}Yb/^{177}Hf *vs*. ^{176}Hf/^{177}Hf.