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Eruptive tempo of Emeishan large igneous province: relations to biotic crises and paleoclimate change around the Guadalupian-Lopingian boundary

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1. Field photographs and photomicrographs

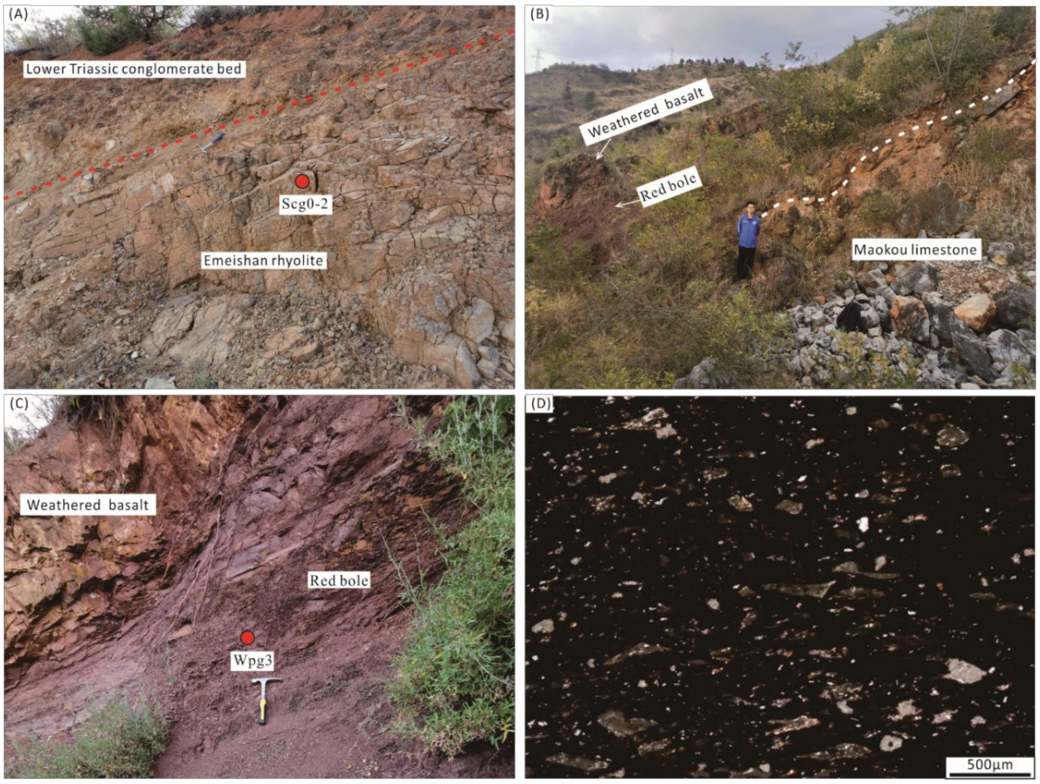

Figure DR1. Representative field photographs and photomicrograph of the volcano-sedimentary succession at Binchuan. (A) The contact between the Emeishan rhyolites (sample Scg0-2) and overlying Lower Triassic conglomerates at Shangcang. (B) The contact between the Maokou Formation and overlying red boles at the lowermost volcanic succession at Wase. (C) Red boles (sample Wpg3) at the lowermost volcanic succession at Wase. (D) Photomicrograph of sample Wpg3 under the plane-polarized light.

2. Analytical methods and results

Thousands and hundreds of zircons were obtained from the rhyolite and red bole samples, respectively. Zircons were extracted from the samples by standard separation methods and were annealed at 900 °C for 48 h. For sample Wpg3 zircon grains were put on a glass slide with double sided sticky tape for U-Pb laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). The LA-ICP-MS U-Pb isotopic data for sample Wpg3 are presented in Table DR1. The concordia diagram and ranked $^{206}Pb/^{238}U$ age plots of zircons analyzed are illustrated in Figure DR2. No LA analyses were performed for samples Scg2-3 and Scg0-2, which had no inherited zircons based on the previous LA-ICP-MS dating (Huang et al., 2022). We selected zircons from the youngest group identified in LA for Wpg3 and randomly for the other samples. Prior to chemical abrasion in concentrated HF and HNO_3 for 15 h at 190 °C the surface of the zircons was cleaned in acetone and 3M HNO_3. After the chemical abrasion step, the single zircons were rinsed with MilliQ water, treated with 6M HCl on a hotplate and subsequently rinsed with alternating MilliQ water and HNO_3. This step is followed by dissolution in concentrated HF in a Parr dissolution vessel for 48 h at 220 °C in the presence of a ^{202}Pb-^{205}Pb-^{233}U-^{236}U tracer (Huyskens et al., 2016). After dissolution, the solution was dried down, redissolved in HCl prior to standard HCl ion exchange chemistry (Krogh 1973). The Pb fraction was loaded onto zone refined Re filaments with a silicagel activator (Huyskens et al., 2012) and Pb isotopic composition was analyzed using a *Triton Plus* TIMS (thermal ionization mass spectrometer) at UC Davis. For the majority of zircons, the amount of Pb was small and the measurements were performed in peak jumping mode on a secondary electron multiplier. For the larger samples, Pb was also measured with ^{204}Pb in the axial SEM, while all other isotopes (^{202}Pb, ^{205}Pb, ^{206}Pb, ^{207}Pb, and ^{208}Pb) were collected simultaneously in Faraday cups coupled with 10^{13} Ω resistor amplifier boards. The SEM yield compared to the Faraday cups was determined by additional measurement of ^{205}Pb in the axial SEM. Uranium-isotope dilution measurements were performed on a *Neptune Plus* MC (Multi-collector) -ICP-MS at UC Davis using an ESI APEX introduction system. Faraday cups measuring ^{238}U and ^{235}U were coupled with 10^{12} Ω resistors and the tracer isotopes ^{233}U and ^{236}U were coupled with 10^{11} Ω resistors. Samples were bracketed with the U-isotopic standard CRM 112a and measurements were corrected for instrumental mass dependent fractionation using an exponential law based on the known ^{233}U/^{236}U ratio of IRMM-3636 (Verbruggen et al., 2008).

U–Pb ages and uncertainties were calculated using the algorithms of Schmitz and Schoene (2007). The Temora zircon standard was measured 4 times during this study. Three of those analyses are in good agreement with a weighted mean ^{206}Pb/^{238}U age 417.270 ± 0.091 Ma (MSWD = 0.15, 95% confidence), while the fourth grain is slightly older at 417.69 ± 0.17 Ma. This variation in age for single Temora zircons grains has been observed before (Schaltegger et al., 2021). Complete Pb and U isotopic data by the CA-ID-IRMS method are given in Table DR2. The concordia and corresponding ranked ^{206}Pb/^{238}U age plots were generated using IsoplotR (Vermeesch, 2018).

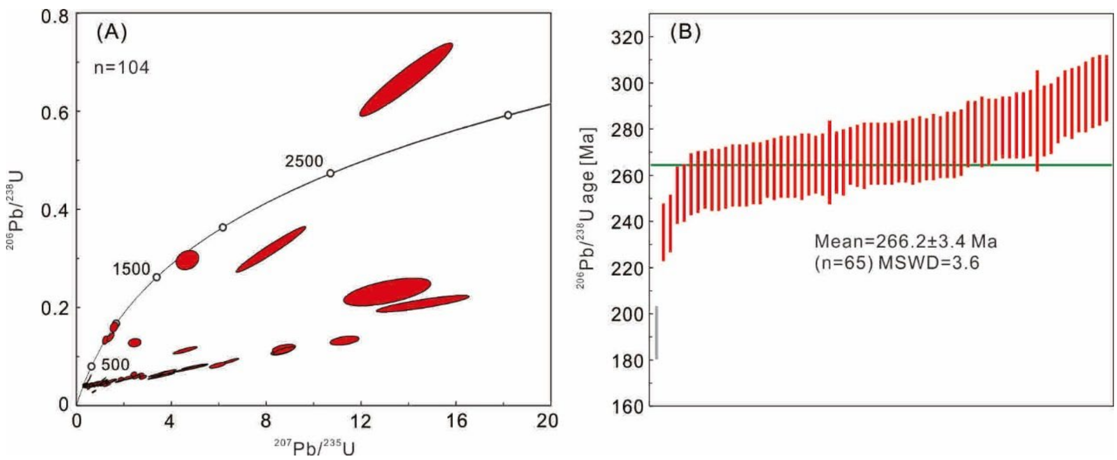

Figure DR2. Concordia diagram (A) and ranked ^{206}Pb/^{238}U age plots (B) of zircons analyzed by LA-ICP-MS for sample Wpg3. All youngest analyzed zircons are included in the ranked $^{206}Pb/^{238}U$ age plots, regardless of concordance. A high number (> 90 %) of discordant grains is caused by both Pb loss and incorporation of common Pb on the surface of unpolished grains. These results were used as a guide to select the youngest grains for CA-ID-IRMS.

Figure DR3. Pictures show individual zircons used for CA-ID-IRMS before and after the chemical abrasion step. Images after chemical abrasion are denoted by the sample ID followed by the letter L. All images are at the same scale (see the last image for scale). Note that no image of TL1-1 was taken after chemical abrasion.

Table DR1: LA-ICP-MS U-Pb isotopic data of analyzed zircon grains from the sample Wpg3.

Sample spot	Analysis ID in CA-ID-IRMS	Compositional Parameters				Radiogenic Isotope Ratios							Isotopic Ages					
		U	Th	Pb	Th/U	$^{207}Pb/^{206}Pb$		$^{207}Pb/^{235}U$		$^{206}Pb/^{238}U$		rho	$^{207}Pb/^{206}Pb$		$^{207}Pb/^{235}U$		$^{206}Pb/^{238}U$	
		ppm	ppm	ppm		Ratio	±2σ	Ratio	±2σ	Ratio	±2σ		Age (Ma)	±2σ	Age (Ma)	±2σ	Age (Ma)	±2σ
Wpg3-a1		549	410	168	0.75	0.215	0.01	1.53	0.14	0.0511	0.0029	0.75	2937	75	932	52	321	18
Wpg3-a2		65	49	40	0.75	0.1137	0.0043	4.68	0.39	0.297	0.016	0.23	1862	72	1762	68	1675	80
Wpg3-a3	**TL1-1**	546	388	58	0.71	0.0811	0.0035	0.46	0.039	0.0412	0.0022	0.31	1204	85	382	26	261	14
Wpg3-a4		478	500	427	1.05	0.443	0.017	4.99	0.45	0.0795	0.0047	0.91	4060	59	1782	71	492	28
Wpg3-a5		1006	845	327	0.84	0.2248	0.0081	1.39	0.15	0.047	0.0048	0.99	3019	60	835	38	281	23
Wpg3-a6		294	204	59	0.69	0.14	0.011	0.94	0.11	0.0468	0.0025	0.78	2070	150	651	56	295	16
Wpg3-a7	**SB11-10**	418	282	35	0.67	0.0583	0.0025	0.331	0.027	0.0419	0.0022	0.38	493	88	288	20	265	13
Wpg3-a8		1085	988	142	0.91	0.0713	0.0027	0.547	0.071	0.0552	0.0064	0.99	966	75	410	28	336	33
Wpg3-a9		367	716	353	1.95	0.1791	0.0073	8.2	1.2	0.319	0.038	0.97	2626	67	1980	130	1660	170
Wpg3-a10		488	364	46	0.75	0.0538	0.0021	0.313	0.025	0.0423	0.0022	0.17	346	85	276	19	267	14
Wpg3-a11	**TL1-4**	674	526	105	0.78	0.1079	0.0041	0.658	0.053	0.044	0.0023	0.48	1758	69	512	32	278	14
Wpg3-a12	**SB11-7**	544	655	129	1.2	0.1253	0.0071	0.797	0.076	0.0458	0.0024	0.7	1980	110	589	44	289	15
Wpg3-a13		426	327	40	0.77	0.0528	0.0021	0.309	0.025	0.0421	0.0022	0.05	318	87	273	19	266	14
Wpg3-a14		557	285	109	0.51	0.066	0.0023	1.226	0.097	0.1344	0.007	0.33	807	73	812	44	813	40
Wpg3-a15	**SB11-9**	607	497	69	0.82	0.0672	0.0026	0.38	0.031	0.0413	0.0021	0.09	844	80	328	23	261	13
Wpg3-a16		413	164	375	0.4	0.291	0.013	4.59	0.41	0.1131	0.0061	0.89	3412	67	1729	75	691	35
Wpg3-a17		61	22	132	0.36	0.424	0.03	13.1	1.5	0.232	0.023	0.6	3900	110	2610	110	1320	110
Wpg3-a18	**TL1-5**	552	416	50	0.75	0.0538	0.0021	0.305	0.025	0.0411	0.0021	0.07	350	83	270	19	259	13
Wpg3-a19		377	299	181	0.79	0.1366	0.0071	2.46	0.22	0.1287	0.0067	0.13	2115	86	1232	59	781	38
Wpg3-a20		614	287	36	0.47	0.0554	0.0023	0.305	0.025	0.0402	0.0021	0.35	401	86	270	19	254	13
Wpg3-a21		832	675	189	0.81	0.1539	0.007	1.13	0.1	0.0534	0.0035	1	2377	76	763	47	335	21
Wpg3-a22		453	256	114	0.57	0.0749	0.0029	1.44	0.12	0.1397	0.0073	0.68	1076	75	904	49	843	41

Wpg3-a23		493	34	22	0.07	0.0718	0.0027	1.59	0.13	0.1604	0.0083	0.3	983	77	964	49	959	46
Wpg3-a24		513	566	85	1.1	0.1845	0.0092	0.748	0.071	0.0292	0.002	0.9	2671	83	553	38	184	12
Wpg3-a25		135	92	368	0.68	0.1489	0.0063	13.9	1.6	0.665	0.061	0.95	2311	72	2630	110	3150	240
Wpg3-a26		1027	921	132	0.9	0.0714	0.0028	0.436	0.036	0.0438	0.0023	0.99	969	75	367	25	276	14
Wpg3-a27		245	141	24	0.58	0.0709	0.0039	0.422	0.038	0.0439	0.0023	0.2	880	110	357	27	277	14
Wpg3-a28		250	160	24	0.64	0.0659	0.0043	0.408	0.042	0.044	0.0023	0.5	710	120	335	26	278	14
Wpg3-a29	**TL1-2**	1161	1361	291	1.17	0.1576	0.0089	0.985	0.095	0.0462	0.0025	0.83	2419	94	694	48	291	15
Wpg3-a30	**TL1-3**	217	124	37	0.57	0.1386	0.0075	0.892	0.082	0.047	0.0024	0.55	2180	110	645	46	296	15
Wpg3-a31		769	654	111	0.85	0.1029	0.0045	0.602	0.052	0.0423	0.0022	0.68	1613	71	471	30	267	14
Wpg3-a32		184	249	474	1.35	0.481	0.027	14.6	1.6	0.208	0.014	0.86	4115	97	2650	120	1204	74
Wpg3-a33		803	762	155	0.95	0.1232	0.0053	0.733	0.076	0.0421	0.0034	0.95	1997	80	531	34	262	19
Wpg3-a34		592	174	97	0.29	0.169	0.012	1.18	0.12	0.0489	0.0036	0.81	2340	140	747	58	307	21
Wpg3-b1		74	50	51	0.68	0.4097	0.0092	3.67	0.18	0.0664	0.0039	0.78	3948	33	1557	38	414	24
Wpg3-b2		84	53	19	0.63	0.1797	0.0041	1.118	0.048	0.0454	0.0025	0.17	2635	36	759	23	286	15
Wpg3-b3	**SB15-6**	101	61	9	0.6	0.0755	0.003	0.407	0.022	0.0392	0.0022	0.24	1033	81	344	16	248	13
Wpg3-b4		100	63	15	0.63	0.1341	0.0034	0.764	0.035	0.0412	0.0023	0.38	2138	45	575	20	260	14
Wpg3-b5		61	34	37	0.56	0.361	0.018	3.53	0.4	0.065	0.0049	0.97	3658	74	1434	77	407	30
Wpg3-b6		86	49	12	0.57	0.1223	0.0078	0.713	0.058	0.0424	0.0024	0.8	1860	110	527	33	268	15
Wpg3-b7		112	79	14	0.71	0.1077	0.0048	0.547	0.036	0.037	0.0021	0.72	1733	84	436	22	234	13
Wpg3-b8		85	45	131	0.53	0.5658	0.0083	8.65	0.37	0.1112	0.0062	0.63	4419	21	2299	39	680	36
Wpg3-b9		85	66	8	0.78	0.0611	0.0025	0.34	0.019	0.041	0.0023	0.07	565	85	295	15	259	14
Wpg3-b10		87	60	9	0.69	0.0754	0.0029	0.411	0.022	0.0398	0.0022	0.32	1047	77	346	15	252	14
Wpg3-b11		79	39	6	0.49	0.0707	0.003	0.405	0.023	0.0426	0.0024	0.25	905	85	342	16	269	15
Wpg3-b12		201	159	24	0.79	0.0834	0.0032	0.457	0.025	0.0402	0.0022	0.2	1236	77	380	17	254	14
Wpg3-b13		77	53	8	0.69	0.0792	0.0033	0.442	0.025	0.0405	0.0023	0.26	1161	82	370	17	256	14
Wpg3-b14	**SB15-1**	56	49	7	0.88	0.0747	0.0029	0.415	0.022	0.0411	0.0023	0.04	1032	79	356	16	260	14

Wpg3-b15		79	48	53	0.61	0.4	0.024	3.58	0.46	0.0607	0.0052	0.97	3858	92	1464	98	378	32
Wpg3-b16		101	54	23	0.53	0.1827	0.005	1.214	0.059	0.049	0.0027	0.39	2681	45	809	26	308	17
Wpg3-b17		60	41	22	0.68	0.2484	0.0065	1.868	0.089	0.0542	0.0031	0.39	3172	41	1066	31	340	19
Wpg3-b18		73	50	11	0.68	0.1281	0.0091	0.751	0.067	0.0427	0.0024	0.55	1690	140	550	39	270	15
Wpg3-b19	**SB15-7**	179	213	43	1.19	0.169	0.013	1.18	0.11	0.0466	0.0026	0.88	2110	160	720	52	294	16
Wpg3-b20		61	34	7	0.56	0.0969	0.0062	0.576	0.044	0.043	0.0025	0.43	1440	130	453	28	271	15
Wpg3-b21		159	101	21	0.64	0.1109	0.0028	0.623	0.03	0.0405	0.0022	0.22	1805	48	492	18	256	14
Wpg3-b22		62	33	43	0.53	0.395	0.014	3.89	0.26	0.0686	0.0042	0.89	3861	55	1568	56	427	25
Wpg3-b23		77	46	8	0.6	0.0799	0.0041	0.437	0.027	0.0401	0.0022	0.19	1065	99	360	18	253	14
Wpg3-b24	**SB15-4**	97	70	11	0.72	0.0754	0.0035	0.441	0.026	0.0421	0.0023	0.39	969	92	364	18	266	14
Wpg3-b25		87	61	18	0.7	0.1776	0.0044	1.053	0.048	0.0436	0.0024	0.32	2619	41	728	24	275	15
Wpg3-b26		70	42	14	0.6	0.1558	0.0073	1.032	0.07	0.0478	0.0027	0.73	2395	81	713	34	301	16
Wpg3-b27		67	32	10	0.48	0.1372	0.0085	0.795	0.059	0.0423	0.0024	0.46	2130	100	579	31	267	15
Wpg3-b28		69	45	18	0.65	0.19	0.015	1.32	0.14	0.0482	0.0029	0.9	2600	120	802	53	303	18
Wpg3-b29		131	68	25	0.52	0.172	0.015	1.16	0.13	0.0438	0.0025	0.85	2080	150	696	56	276	16
Wpg3-b30		60	33	10	0.55	0.145	0.0069	0.91	0.059	0.0442	0.0025	0.58	2271	83	637	30	279	15
Wpg3-b31		84	48	7	0.57	0.0674	0.0026	0.383	0.02	0.0412	0.0023	0.09	824	81	327	15	260	14
Wpg3-b32		99	54	13	0.55	0.0983	0.0074	0.577	0.051	0.0421	0.0023	0.57	1420	130	450	30	266	14
Wpg3-b33		91	62	101	0.68	0.51	0.01	6.44	0.33	0.0902	0.0052	0.93	4258	31	2026	47	556	31
Wpg3-b34		101	71	9	0.7	0.0667	0.0034	0.361	0.023	0.0391	0.0021	0.16	670	87	302	15	247	13
Wpg3-b35		152	104	34	0.68	0.188	0.011	1.17	0.093	0.0446	0.0025	0.85	2619	95	769	42	282	16
Wpg3-b36		88	63	8	0.72	0.0679	0.0034	0.376	0.024	0.0402	0.0022	0.4	687	85	313	15	254	14
Wpg3-b37		84	58	12	0.69	0.1028	0.0049	0.619	0.037	0.0442	0.0024	0.41	1611	87	482	23	279	15
Wpg3-b38		68	43	7	0.63	0.0814	0.0045	0.459	0.032	0.0415	0.0023	0.49	1090	100	375	20	262	14
Wpg3-b39		80	54	7	0.68	0.061	0.0023	0.343	0.018	0.0404	0.0022	0.16	609	80	299	14	255	14
Wpg3-b40		82	51	10	0.62	0.1019	0.0056	0.568	0.037	0.0406	0.0023	0.29	1550	100	447	23	257	14

Wpg3-b41		51	33	103	0.65	0.619	0.012	11.3	0.5	0.1329	0.0077	0.45	4550	28	2549	40	804	44
Wpg3-b42		69	49	31	0.71	0.264	0.019	2.3	0.23	0.0571	0.0035	0.91	3060	120	1119	72	357	21
Wpg3-b43		65	37	6	0.57	0.0762	0.0038	0.434	0.028	0.0414	0.0023	0.45	952	94	351	17	261	14
Wpg3-b44		86	49	40	0.57	0.3126	0.0062	2.7	0.12	0.0621	0.0034	0.31	3531	30	1328	32	388	21
Wpg3-b45		89	62	11	0.7	0.0994	0.0034	0.559	0.027	0.0407	0.0023	0.07	1614	64	450	18	257	14
Wpg3-b46		132	64	33	0.48	0.227	0.011	1.343	0.084	0.0438	0.0024	0.7	3020	77	842	36	276	15
Wpg3-b47		49	33	80	0.67	0.55	0.012	8.74	0.4	0.1166	0.0071	0.48	4381	34	2312	39	713	40
Wpg3-b48		194	155	69	0.8	0.235	0.02	1.89	0.2	0.0514	0.0031	0.95	2600	170	941	73	322	19
Wpg3-b49	**SB15-5**	102	67	22	0.66	0.1564	0.008	0.922	0.056	0.0427	0.0023	0.17	2304	83	645	28	269	14
Wpg3-b50		124	90	16	0.73	0.0958	0.006	0.548	0.04	0.042	0.0023	0.43	1400	120	436	26	265	14
Wpg3-b51		101	85	33	0.84	0.214	0.013	1.49	0.12	0.0506	0.0029	0.8	2855	92	910	46	318	18
Wpg3-b52		68	51	14	0.75	0.1462	0.0087	0.95	0.07	0.0458	0.0025	0.63	2150	110	655	37	289	16
Wpg3-b53		67	47	10	0.7	0.1221	0.0068	0.746	0.054	0.0446	0.0025	0.51	1950	100	558	30	281	16
Wpg3-b54		267	262	136	0.98	0.2743	0.0043	2.42	0.1	0.0644	0.0036	0.29	3330	25	1250	30	402	22
Wpg3-b55		92	57	43	0.62	0.3183	0.009	2.54	0.13	0.059	0.0033	0.77	3563	42	1283	39	370	20
Wpg3-b56		114	83	16	0.73	0.1052	0.0089	0.639	0.063	0.0428	0.0024	0.7	1410	140	468	34	270	15
Wpg3-b57		88	49	43	0.56	0.351	0.0061	2.81	0.12	0.058	0.0032	0.61	3708	26	1356	32	364	19
Wpg3-b58		101	60	21	0.59	0.174	0.011	1.151	0.095	0.0463	0.0026	0.83	2480	120	749	46	292	16
Wpg3-b59		89	54	81	0.61	0.373	0.027	4.8	0.57	0.0759	0.0059	0.98	3500	130	1510	110	469	35
Wpg3-b60	**SB15-2**	143	110	18	0.77	0.0822	0.0033	0.478	0.027	0.0422	0.0024	0.4	1255	79	394	18	266	14
Wpg3-b61		71	42	18	0.59	0.2029	0.0086	1.208	0.067	0.0425	0.0023	0.24	2828	69	786	30	268	14
Wpg3-b62		48	25	5	0.52	0.0933	0.0068	0.521	0.04	0.0411	0.0025	0.16	1370	140	421	27	260	15
Wpg3-b63		63	46	98	0.73	0.5575	0.0091	8.75	0.37	0.1125	0.0062	0.79	4400	24	2307	40	687	36
Wpg3-b64		129	83	18	0.64	0.1012	0.0063	0.509	0.039	0.0363	0.0021	0.46	1454	99	399	23	230	13
Wpg3-b65		63	40	8	0.63	0.1061	0.005	0.605	0.038	0.0419	0.0024	0.4	1683	86	481	24	265	15
Wpg3-b66		147	66	155	0.45	0.521	0.012	5.96	0.29	0.0826	0.0048	0.73	4308	35	1971	41	511	29

Wpg3-b67	91	67	16	0.74	0.1309	0.006	0.818	0.051	0.0444	0.0025	0.51	2081	80	593	27	280	15
Wpg3-b68	72	53	9	0.74	0.0869	0.0031	0.498	0.026	0.0414	0.0024	0.08	1369	70	409	17	262	15
Wpg3-b69	68	43	28	0.63	0.269	0.013	2.18	0.16	0.0573	0.0033	0.82	3234	80	1139	51	359	20
Wpg3-b70	100	67	8	0.67	0.0534	0.0018	0.298	0.015	0.0406	0.0023	0.04	322	69	263	12	256	14

Table DR2: U-Pb isotopic data of CA- ID-IRMS analyzed single zircon grains.

		Compositional Parameters				Radiogenic Isotope Ratios								Isotopic Ages					
Sample	Analysis ID	Th/U (a)	Pb*/Pb_c (b)	Pbc (pg) (b)	$^{206}Pb/^{204}Pb$ (c)	$^{208}Pb/^{206}Pb$ (d)	$^{207}Pb/^{206}Pb$ (d)	% err (e)	$^{207}Pb/^{235}U$ (d)	% err (e)	$^{206}Pb/^{238}U$ (d)	% err (e)	corr. coef.	$^{207}Pb/^{206}Pb$ (f)	± (e)	$^{207}Pb/^{235}U$ (f)	± (e)	$^{206}Pb/^{238}U$ (f)	± (e)
Scg0-2	YZ03-6	0.53	3.1	1.4	206.6	0.1676	0.0514	2.9	0.2896	3.2	0.04085	0.26	0.92	260	67	258.2	7.2	258.08	0.66
	YZ03-7	0.63	3.8	2.3	242.1	0.1955	0.0501	2.9	0.2809	3.1	0.04069	0.25	0.83	198	67	251.3	6.9	257.08	0.63
	YZ03-8	0.52	1.2	2.5	94.4	0.1607	0.0500	6.6	0.281	7.1	0.04066	0.57	0.89	196	153	251	16	256.9	1.4
	YZ03-9	1.1	4.1	4.1	233.7	0.3516	0.0515	2.2	0.2891	2.4	0.040737	0.22	0.83	262	51	257.9	5.4	257.4	0.55
	YZ03-10	0.52	1.7	2.2	123	0.1622	0.0501	5.3	0.281	5.7	0.04068	0.50	0.79	197	123	251	13	257.0	1.3
Scg2-3	YZ03-11	0.68	1.4	2.5	99.4	0.2131	0.0505	7.3	0.283	7.8	0.04056	0.62	0.77	219	170	253	17	256.3	1.6
	YZ03-12	0.70	3.00	3.7	190.7	0.2357	0.0547	3.1	0.307	3.3	0.04076	0.30	0.83	397	69	271.9	7.9	257.56	0.75
	~~YZ03-13~~	~~0.80~~	~~0.20~~	~~8.1~~	~~28.2~~	~~0.2148~~	~~0.043~~	~~43~~	~~0.24~~	~~45~~	~~0.0411~~	~~2.9~~	~~0.73~~	~~-199~~	~~1069~~	~~219~~	~~88~~	~~259.9~~	~~7.4~~
	YZ03-14	0.74	1.6	2.5	108.7	0.2322	0.0505	6.3	0.283	6.8	0.04069	0.53	0.84	219	146	253	15	257.1	1.4
	YZ03-15	0.74	1.5	2.7	106.2	0.2338	0.0510	5.4	0.286	5.9	0.04069	0.49	0.9	242	125	256	13	257.1	1.2
Wpg3	TL1-1	0.72	26	0.26	1541	0.2273	0.05165	1.2	0.2939	1.3	0.0412917	0.11	0.89	269	26	261.6	2.9	260.83	0.29
	TL1-2	0.85	40	0.32	2275	0.2674	0.05135	0.65	0.2913	0.71	0.0411676	0.065	0.87	256	15	259.6	1.6	260.07	0.16
	TL1-3	0.64	9.0	0.31	553	0.2006	0.0512	2.8	0.2910	3.0	0.04127	0.25	0.94	247	64	259.3	6.9	260.70	0.64
	TL1-4	0.76	11	0.33	660	0.2391	0.0511	2.2	0.2909	2.4	0.041301	0.20	0.94	245	50	259.3	5.4	260.89	0.51

TL1-5	0.74	78	0.44	4512	0.2350	0.05146	0.25	0.29247	0.27	0.041242	0.03	0.71	260	6	260.50	0.62	260.527	0.083
SB11-7	0.56	3.3	1.4	214	0.1787	0.0517	2.5	0.2920	2.7	0.041013	0.22	0.94	269	57	260.1	6.2	259.11	0.55
SB11-9	0.76	1.2	1.1	86	0.2377	0.0509	11	0.287	11	0.04092	0.75	0.77	235	251	256	26	258.5	1.9
SB11-10	0.75	6.7	0.67	403	0.2350	0.0510	2.2	0.2899	2.4	0.041229	0.19	0.92	241	51	258.5	5.5	260.44	0.50
SB15-1	0.61	2.9	0.70	190	0.1889	0.0506	4.5	0.288	4.8	0.04126	0.36	0.96	220	104	257	11	260.64	0.93
SB15-2	0.71	11	0.35	633	0.2254	0.0514	2.1	0.2918	2.3	0.041215	0.19	0.96	257	49	260.0	5.3	260.36	0.48
SB15-4	0.58	11	0.20	665	0.1839	0.0514	3.5	0.292	3.8	0.04123	0.32	0.97	258	81	260.2	8.7	260.46	0.80
SB15-5	0.72	2.9	0.46	188	0.2255	0.0505	6.3	0.287	6.8	0.04116	0.52	0.97	218	145	256	15	260.0	1.3
SB15-6	0.74	4.4	0.39	274	0.2310	0.0507	4.9	0.286	5.3	0.04096	0.42	0.94	227	113	256	12	258.8	1.1
SB15-7	0.77	5.2	0.68	317	0.2417	0.0508	2.8	0.2882	3.0	0.041198	0.23	0.93	229	64	257.1	6.8	260.25	0.58

(a) Model Th/U ratio calculated from radiogenic $^{208}Pb/^{206}Pb$ ratio and $^{207}Pb/^{235}U$ age.

(b) Pb^* and Pb_c represent radiogenic and common Pb, respectively.

(c) Measured ratio corrected for spike and fractionation only.

(d) Corrected for fractionation, spike, and common Pb; all common Pb was assumed to be blank with the isotopic composition of $^{206}Pb/^{204}Pb$ = 18.59 ± 0.65%; $^{207}Pb/^{204}Pb$ = 15.79 ± 0.70%; $^{208}Pb/^{204}Pb$ = 38.54 ± 0.65% (1σ).

(e) Errors are 2-sigma, propagated using the algorithms of Schmitz and Schoene (2007) and Crowley et al. (2007).

(f) Calculations are based on the decay constants of Jaffey et al. (1971) and a $^{238}U/^{235}U$ ratio of 137.818 (Hiess et al., 2012).

Analysis YZ03-13 is rejected from further consideration due to Pb^*/Pb_c below 1.

References

Crowley, J.L., Schoene, B., and Bowring, S.A., 2007, U-Pb dating of zircon in the Bishop Tuff at the millennial scale: Geology, v. 35, p. 1123–1126.

Hiess, J., Condon, D. J., McLean, N., and Noble, S. R., 2012, $^{238}U/^{235}U$ Systematics in Terrestrial Uranium-Bearing Minerals: Science, v. 335, p. 1610–1614.

Huang, H., Cawood, P.A., Hou, M.C., Xiong, F.H., Ni, S.J., Deng, M., Zhong, H.T., and Yang, C.C., 2022, Zircon U-Pb age, trace element, and Hf isotopic constrains on the origin and evolution of the Emeishan Large Igneous Province: Gondwana Research, v. 105, p. 535–550.

Huyskens, M.H., Iizuka, T., and Amelin, Y., 2012, Evaluation of colloidal silicagels for lead isotopic measurements using thermal ionisation mass spectrometry: Journal of

Analytical Atomic Spectrometry, v. 27, p. 1439–1446.

Huyskens, M.H., Zink, S., and Amelin, Y., 2016. Evaluation of temperature-time conditions for the chemical abrasion treatment of single zircons for U-Pb geochronology: Chemical Geology, v. 438, p. 25–35.

Jaffey, A. H., Flynn, K. F., Glendeni.Le, Bentley, W. C., and Essling, A. M., 1971, Precision Measurement of Half-Lives and Specific Activities of ^{235}U and ^{238}U: Physical Review C, v. 4, p. 1889–1906.

Krogh, T., 1973, A low-contamination method for hydrothermal decomposition of zircon and extraction of U and Pb for isotopic age determinations: Geochimica et Cosmochimica Acta, v. 37, p. 485–494.

Schaltegger, U., Ovtcharova, M., Gaynor, S.P., Schoene, B., Wotzlaw, J., Davies, J.H., Farina, F., Greber, N., Szymanowski, D., and Chelle-Michou, C., 2021, Long-term repeatability and interlaboratory reproducibility of high-precision ID-TIMS U-Pb geochronology: Journal of Analytical Atomic Spectrometry, v. 36, p. 1466–1477.

Schmitz, M. D., and Schoene, B., 2007, Derivation of isotope ratios, errors, and error correlations for U-Pb geochronology using ^{205}Pb-^{235}U-(^{233}U)-spiked isotope dilution thermal ionization mass spectrometric data: Geochemistry Geophysics Geosystems, v. 8, Q08006.

Verbruggen, A., Alonso, A., Eykens, R., Kehoe, F., Kuhn, H., Richter, S., and Aregbe, Y., 2008, Preparation and certification of IRMM-3636, IRMM-3636a and IRMM-3636b: OPOCE, 24pp.

Vermeesch, P., 2018, IsoplotR: A free and open toolbox for geochronology: Geoscience Frontiers, v. 9, p. 1479–1493.

Villa, I.M., Bonardi, M.L., De Bièvre, P., Holden, N.E., and Renne, P.R., 2016, IUPAC-IUGS status report on the half-lives of ^{238}U, ^{235}U and ^{234}U: Geochimica et Cosmochimica Acta, v. 172, p. 387–392.