Data Repository Item

Table DR1 SHRIMP U-Pb zircon data for sample 05YY-2

Spot #	U (ppm)	Th (ppm)	$^{232}Th/^{238}U$	f_{206} (%)	$^{206}Pb^*/^{238}U$ (±1σ%)		$^{207}Pb^*/^{235}U$ (±1σ%)		$^{207}Pb^*/^{206}Pb^*$ (±1σ%)		$^{206}Pb^*/^{238}U$ age (Ma) (±1σ)		$^{207}Pb^*/^{206}Pb^*$ age (Ma) (±1σ)	
-1	260	500	1.99	0.17	0.137	1.46	1.02	1.94	0.0653	1.17	827	17	784	25
2	420	98	0.24	0.29	0.142	1.42	1.31	1.62	0.0672	0.78	855	12	844	16
-3	478	228	0.49	0.10	0.137	1.42	1.24	1.69	0.0660	0.93	826	12	807	19
-4	1724	195	0.12	0.03	0.138	1.38	1.25	1.43	0.0659	0.40	831	11	803	8
-5	130	143	1.13	0.24	0.140	1.53	1.29	2.27	0.0664	1.67	847	15	819	35
-6	167	87	0.54	0.12	0.138	1.51	1.31	1.93	0.0690	1.20	831	13	899	25
-7	336	110	0.34	0.08	0.145	1.43	1.34	1.67	0.0671	0.85	873	12	841	18
-8	186	305	1.70	0.40	0.135	1.48	1.26	1.88	0.0676	1.16	819	16	856	24
-9	173	136	0.81	0.27	0.134	1.50	1.26	1.96	0.0681	1.26	810	13	872	26
-10	60	48	0.83	0.47	0.141	1.71	1.25	2.73	0.0644	2.13	850	16	755	45
-11	283	120	0.44	0.02	0.144	1.44	1.32	1.73	0.0662	0.96	869	13	813	20
-12	414	156	0.39	0.26	0.144	0.63	1.38	1.03	0.0698	0.81	864	5	923	17
-13	633	250	0.41	0.10	0.141	0.59	1.30	0.90	0.0668	0.68	851	5	832	14
-14	706	58	0.08	0.14	0.146	0.57	1.38	0.84	0.0684	0.61	881	5	881	13
-15	342	83	0.25	0.11	0.141	0.68	1.30	1.42	0.0669	1.24	850	6	835	26
-16	1058	722	0.70	0.42	0.144	0.56	1.33	0.79	0.0671	0.55	867	5	841	11
-17	1212	269	0.23	0.11	0.141	0.55	1.33	0.74	0.0682	0.49	849	5	875	10
-18	671	469	0.72	0.68	0.142	0.60	1.28	0.97	0.0651	0.77	857	6	778	16
-19	357	157	0.46	0.13	0.328	0.64	5.09	0.81	0.1125	0.50	1830	11	1840	9
-20	254	63	0.26	0.43	0.136	0.75	1.27	1.35	0.0675	1.12	825	6	853	23
-21	493	131	0.27	0.60	0.140	0.97	1.27	1.31	0.0655	0.88	847	8	790	18
-22	469	201	0.44	0.13	0.145	0.71	1.40	1.08	0.0702	0.82	871	6	934	17
-23	119	148	1.29	1.12	0.275	0.94	3.64	1.43	0.0960	1.07	1566	16	1548	20
-24	346	198	0.59	0.21	0.146	0.73	1.31	1.24	0.0651	1.01	880	7	778	21
-25	931	112	0.12	0.19	0.134	0.62	1.23	0.88	0.0666	0.63	809	5	825	13
-26	124	109	0.90	1.77	0.136	1.00	1.24	2.20	0.0663	1.96	820	9	816	41
-27	816	359	0.45	0.08	0.143	0.70	1.33	1.15	0.0672	0.91	864	6	844	19
-28	105	118	1.16	0.43	0.133	1.30	1.28	2.30	0.0701	1.90	804	12	931	39
-29	1276	1350	1.09	0.08	0.143	0.64	1.29	1.15	0.0657	0.96	860	6	797	20
-30	353	173	0.51	0.36	0.143	0.80	1.28	1.46	0.0652	1.23	860	7	781	26
-31	433	293	0.70	0.46	0.137	0.79	1.20	1.34	0.0635	1.08	829	7	725	27

Zircons were separated from the samples using standard density and magnetic separation techniques. All zircon grains analysed were documented using both optical photomicrographs and cathodoluminescence (CL) images. U-Th-Pb isotopoes were analysed using the SHRIMP II system at the Beijing SHRIMP Center, Chinese Academy of Geological Sciences. Zircon standard SL13 (U = 238 ppm) was used for calibrating the U content, and zircon standard TEMORA ($^{206}Pb/^{238}U$ = 0.0668 corresponding to 417 Ma) were used to calibrate the $^{206}Pb/^{238}U$ ratios. Measured compositions were corrected for common Pb using the ^{208}Pb-method. The SQUID and ISOPLOT/Ex software packages (Ludwig, 2003) were used for data reduction.

Table DR2 Geochemical data for the Yiyang basaltic rocks

Sample	05SC72-1	05SC72-2	05SC72-3	05SC72-4	05SC72-5	05SC72-6	05SC72-8	05SC74-2	05SC74-4	05SC74-5	05SC74-6	05SC74-7	05YY-2
Major element (wt%)													
SiO_2	56.4	47.6	50.0	50.5	53.1	52.6	49.3	50.7	49.9	49.5	52.1	49.4	61.1
TiO_2	0.74	0.50	0.60	0.66	0.55	0.55	0.56	0.51	0.53	0.57	0.55	0.53	0.35
Al_2O_3	16.2	10.6	13.0	14.3	12.3	12.0	11.7	11.3	11.8	11.6	12.7	12.2	15.5
Fe_2O_3	7.27	11.7	9.36	9.24	8.28	8.41	10.1	8.99	9.17	9.69	8.18	10.4	5.15
MnO	0.11	0.16	0.15	0.13	0.15	0.15	0.18	0.14	0.14	0.15	0.13	0.16	0.08
MgO	4.21	17.5	12.4	10.2	10.2	11.8	14.4	13.2	13.1	14.1	11.0	13.4	5.90
CaO	10.3	8.19	8.59	8.66	10.6	9.42	10.4	11.6	11.6	10.4	10.8	10.9	4.18
Na_2O	2.23	0.30	1.89	2.14	1.52	1.74	0.51	0.98	0.76	1.18	1.09	0.37	4.68
K_2O	0.20	0.63	0.52	0.84	0.87	0.27	0.43	0.29	0.44	0.10	1.23	0.61	0.86
P_2O_5	0.07	0.04	0.05	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.08
LOI	1.86	2.15	3.45	2.86	1.51	2.96	1.8	2.00	2.29	2.96	1.81	1.55	2.32
Mg#*	53.4	74.6	72.4	68.6	70.9	73.5	73.9	74.4	73.9	74.2	72.7	71.9	69.4
Total	99.6	99.6	100	99.6	99.1	99.9	99.8	99.8	99.8	100	99.6	99.6	100

Sample	05SC72-1	05SC72-2	05SC72-3	05SC72-4	05SC72-5	05SC72-6	05SC72-8	05SC74-2	05SC74-4	05SC74-5	05SC74-6	05SC74-7	05YY-2
Trace element (ppm)													
P	405	264	286	337	274	253	280	240	290	249	276	265	468
Sc	39.0	32.8	36.8	43.7	36.6	34.7	37.6	32.4	36.0	34.8	36.3	35.0	23.5
Ti	4442	2843	3273	3806	3157	3078	3272	2843	3178	3029	3254	3100	2250
V	189	177	199	236	197	185	199	172	195	185	188	187	103
Cr	227	1710	879	677	827	876	944	851	943	910	891	909	433
Mn	1005	1413	1242	1170	1380	1241	1656	1191	1351	1269	1176	1289	706
Co	50.9	76.9	57.1	50.1	51.7	52.5	71.4	60.5	71.5	60.6	66.1	69.2	26.8
Ni	39.0	661	329	183	246	263	379	317	358	324	336	365	121
Cu	23.5	64.0	43.8	69.3	62.2	70.8	59.8	61.0	77.7	57.9	83.9	65.0	29.1
Zn	66.1	66.4	63.8	97.3	52.4	66.2	81.9	55.4	61.2	57.9	52.6	61.3	66.1
Ga	21.0	10.1	11.7	13.6	11.6	10.3	11.1	12.5	12.6	10.4	12.8	12.6	19.5
Rb	6.32	26.6	20.7	34.7	32.9	9.52	16.6	9.12	15.6	2.35	47.4	20.0	29.9
Sr	80.7	36.1	65.7	171	115	26.8	46.9	63.3	59.3	10.9	116	154	118
Y	23.0	14.3	17.5	19.8	16.9	15.9	15.9	14.7	16.7	17.1	15.6	16.2	7.90
Zr	79.9	55.3	65.0	73.7	62.0	60.8	62.4	55.6	62.1	62.3	61.3	58.7	113
Nb	6.18	3.50	4.04	4.40	3.83	3.83	3.86	3.46	3.76	3.83	3.80	3.68	5.35
Cs	0.73	2.03	1.76	2.64	3.54	1.02	1.57	1.40	2.37	0.70	5.78	2.93	3.43
Ba	100	114	118	191	361	89.8	123	103	139	53.9	233	185	206
La	11.4	6.93	9.28	10.9	8.42	7.49	8.31	6.82	7.52	7.62	7.05	7.76	20.6
Ce	22.8	13.2	16.9	19.0	15.3	14.5	16.1	13.9	15.6	15.3	14.8	15.7	40.3
Pr	2.91	1.72	2.31	2.72	2.18	1.91	2.13	1.81	1.98	1.96	1.89	1.97	4.59
Nd	11.9	7.26	9.24	11.3	9.05	7.93	8.82	7.95	8.44	8.09	8.12	8.46	17.6
Sm	2.99	1.71	2.18	2.70	2.20	1.86	2.13	1.92	2.12	1.99	2.02	2.09	3.00
Eu	0.95	0.50	0.55	0.71	0.55	0.42	0.56	0.70	0.62	0.51	0.49	0.86	1.04
Gd	3.34	1.93	2.45	2.95	2.52	2.19	2.46	2.30	2.48	2.36	2.27	2.35	2.18
Tb	0.62	0.32	0.41	0.48	0.41	0.38	0.41	0.38	0.41	0.39	0.39	0.39	0.35
Dy	3.74	2.01	2.54	3.01	2.61	2.38	2.47	2.34	2.61	2.49	2.44	2.43	1.73
Ho	0.76	0.46	0.57	0.66	0.57	0.53	0.56	0.52	0.58	0.58	0.54	0.54	0.30
Er	2.19	1.25	1.59	1.86	1.62	1.54	1.55	1.45	1.65	1.62	1.50	1.53	0.83

Tm	0.36	0.20	0.25	0.29	0.26	0.24	0.25	0.21	0.26	0.26	0.24	0.23	0.14
Yb	2.17	1.23	1.60	1.84	1.62	1.55	1.58	1.39	1.60	1.64	1.53	1.48	0.86
Lu	0.32	0.19	0.25	0.28	0.24	0.24	0.25	0.22	0.24	0.25	0.23	0.23	0.12
Hf	1.97	1.34	1.66	1.86	1.60	1.57	1.65	1.56	1.63	1.60	1.58	1.52	2.53
Ta	0.45	0.24	0.28	0.30	0.27	0.27	0.28	0.25	0.28	0.28	0.28	0.27	0.33
Pb	12.4	4.25	4.83	4.90	6.65	6.46	6.12	4.85	5.28	4.57	5.47	4.92	10.0
Th	4.09	2.28	2.76	3.15	2.69	2.63	2.73	2.34	2.65	2.70	2.70	2.56	5.31
U	0.97	0.44	0.54	0.62	0.56	0.53	0.53	0.46	0.52	0.50	0.53	0.51	0.76
$(Gd/Yb)_N$ §	1.27	1.30	1.27	1.33	1.29	1.17	1.29	1.37	1.28	1.19	1.23	1.31	2.10

∗ Mg# = Mg / (Mg + Fe^{2+}), in atomic number, assuming Total iron as Fe^{2+}.

§ Subscript N denotes primitive mantle normalization.

After petrographic examination, the least-altered samples were selected for whole rock geochemical analyses at the Guangzhou Institute of Geochemistry, Chinese Academy of Sciences. The selected samples were crushed to 1-0.5 cm and leached alternately by 0.4~0.2mol/L HCl and 0.6~0.3mol/L HNO_3. After leaching, the rock chips were grinded to <200 mesh using a tungsten carbide ball mill. Major element oxides were analyzed using a Rigaku RIX 2000 X-ray fluorescence spectrometer (XRF) on fused glass beads. Analytical precision ranges from 1% to 5% for major elements.

Trace elements were analyzed by inductively coupled plasma mass spectrometer (Perkin-Elmer Sciex ELAN 6000 ICP-MS). About 40 mg sample powders were dissolved in high-pressure Teflon bombs using a HF+HNO_3 mixture. An internal standard solution containing the single element Rh was used to monitor signal drift during counting. The USGS standards GSR-1, GSR-2, GSR-3, W-2, G-2 and SY-4 were used for calibrating element concentrations of measured samples. Analytical precision and accuracy are better than 2% and 10%, respectively, for most of the trace elements except for transition metals. Reproducibility, based on replicate digestion of samples, varied from 1.5% to 3 % for most analyses.

Table DR3 Ni versus MgO regression function of arc basalts from 15 individual arcs

	a*	b	c	R^2	N†	Ni_{10}§	Ni_{12}
Arc #							
Aeolian	1.254	-2.544	9.683	0.776	920	110	160
Aleutian	1.980	-7.165	12.939	0.845	597	139	212
Andean	1.367	4.322	-1.876	0.925	1654	178	247
Bismarck-New Britain	2.444	-11.172	22.718	0.794	273	155	241
Cascades	2.119	-7.914	38.687	0.648	712	171	262
Central American	1.423	-0.392	0.199	0.632	430	139	200
Izu-Bonin	0.875	7.380	-16.671	0.731	499	145	198
Kurile	1.431	0.440	8.376	0.863	336	156	220
Mariana	1.327	2.593	-5.636	0.664	638	153	217
New-Hebrides	1.158	-0.558	16.511	0.721	574	127	177
New-Zealand	2.293	-6.887	12.369	0.831	661	173	260
Ryukyu	2.839	-13.877	29.049	0.894	210	174	271
Scotia	1.930	-8.758	18.628	0.573	552	124	191
Sunda	1.895	-8.694	18.438	0.855	627	121	187
Tonga	0.692	5.878	-10.825	0.726	802	117	159
Yiyang pillow basalts	2.427	-11.088	74.876	0.910	11	207	291

*a, b, and c are the constant coefficients in the regression function of $Ni = a \times (MgO)^2 + b \times (MgO) + c$;

† Number of samples used in regression;

§ Ni_{10} and Ni_{12} are normalized Ni concentrations at MgO = 10% and 12%, respectively;

Typical arc basalts from datasets: http://georoc.mpch-mainz.gwdg.de/georoc/Entry.html, with acceptance of samples having LOI (loss of ignition) <3%, with SiO_2 ranging from 45% to 56%, MgO ranging from 5 to 17%, and K_2O/P_2O_5>1.

Table DR4 Petrographic features of the Yiyang basalts

Sample No.	Location		petrographic feature		
	Latitude (°N)	Longitude (°E)	texture	phenocrysts	Groundmass
05SC72-1	28˚35.50′	112˚20.90′	Fine-grained	sparse	Pl+Hb+Ep
05SC72-2	28˚35.50′	112˚20.90′	spinifexs	Ol+Py (~11%)	needle Py/Ol+glass
05SC72-3	28˚35.50′	112˚20.90′	spinifexs	Ol+Py (8-9%)	needle Py/Ol+glass
05SC72-4	28˚35.50′	112˚20.90′	spinifexs	Ol+Py (~12%)	needle Py/Ol+glass
05SC72-5	28˚35.50′	112˚20.90′	Spinifexs, slight deformation	Ol+Py (~6%)	needle Py/Ol+glass
05SC72-6	28˚35.50′	112˚20.90′	Spinifexs, slight deformation	Ol+Py (~12%)	needle Py/Ol+glass
05SC72-8	28˚35.50′	112˚20.90′	Spinifexs, slight deformation	Ol+Py (~8%)	needle Py/Ol+glass
05SC74-2	28˚33.59′	112˚20.25′	Vitrophyric and spinifexs	Ol+Py (~12%)	needle Py/Ol+glass
05SC74-4	28˚33.59′	112˚20.25′	Vitrophyric and spinifexs	Ol+Py (~10%)	needle Py/Ol+glass
05SC74-5	28˚33.59′	112˚20.25′	Vitrophyric and spinifexs	Ol+Py (~6%)	needle Py/Ol+glass
05SC74-6	28˚33.59′	112˚20.25′	Vitrophyric and spinifexs	Ol+Py (~7%)	needle Py/Ol+glass
05SC74-7	28˚33.59′	112˚20.25′	Vitrophyric and spinifexs	Ol+Py (~8%)	needle Py/Ol+glass
05YY-2	28˚35.50′	112˚20.91′	Fine-grained	sparse	Pl+Hb+Ep

Abbreviations: Ol, olivine; Py, Pyroxene; Pl, plagioclase; Hb, hornblende (tremolite). All samples are strongly replaced by tremolite, serpentite, talc and epidote. The modes of phenocrysts (olivine and pyroxene) were estimated using the method of Huang et al. (2007).

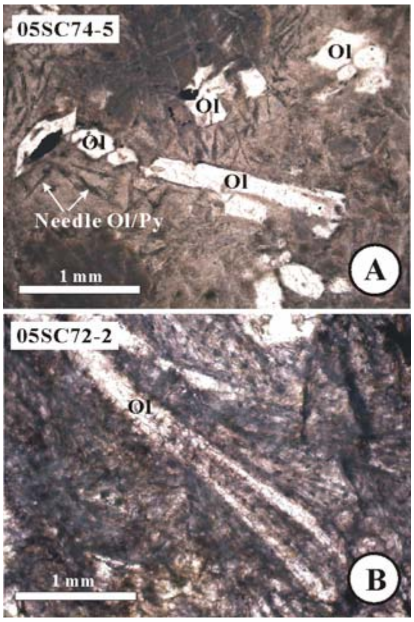

Fig. DR1 Photomicrographs showing spinifexs texture of the Yiyang komatiitic basalts. All olivine and pyroxene phenocrysts have been replaced by tremolite, serpentite, talc and epidote, but they still preserve skeletal, feathery dendritic and acicular crystals shapes. This suggests that the rocks crystallized at supercooling condition, consistent with their pillow structure. The elongate skeletal crystals are up to 5 mm long. The groundmass consists of needle crystals of probably olivine and pyroxene and glass that are replaced mainly by tremolite.

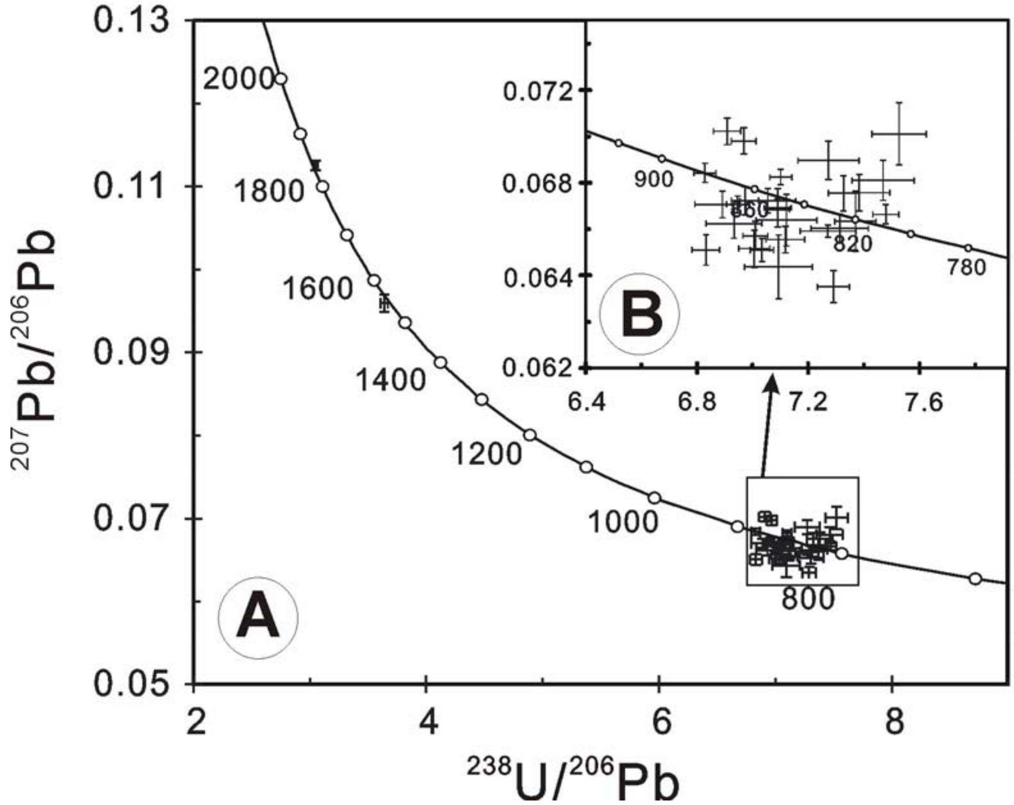

Fig. DR2 U-Pb concordia plot for zircons from sample 05YY-2.

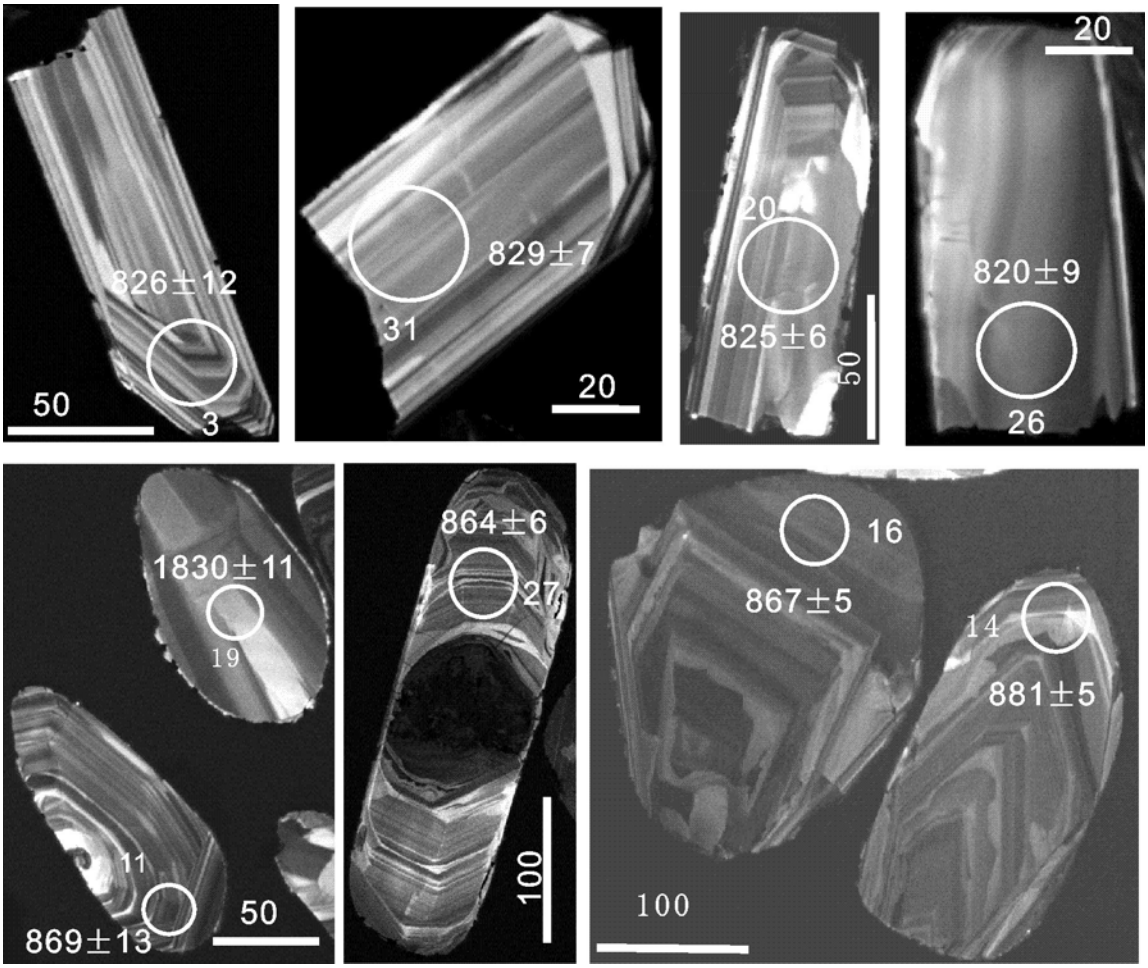

Fig. DR3 Cathodoluminescence (CL) images of reprentative zircons. Numbers labeled near the zircons are SHRIMP analysis spot numbers and ^{206}Pb/^{238}U ages. The upper row is from the Group 1 zircons, and the low row (spots 11, 27, 14 and 16) from Group 2 zircons.

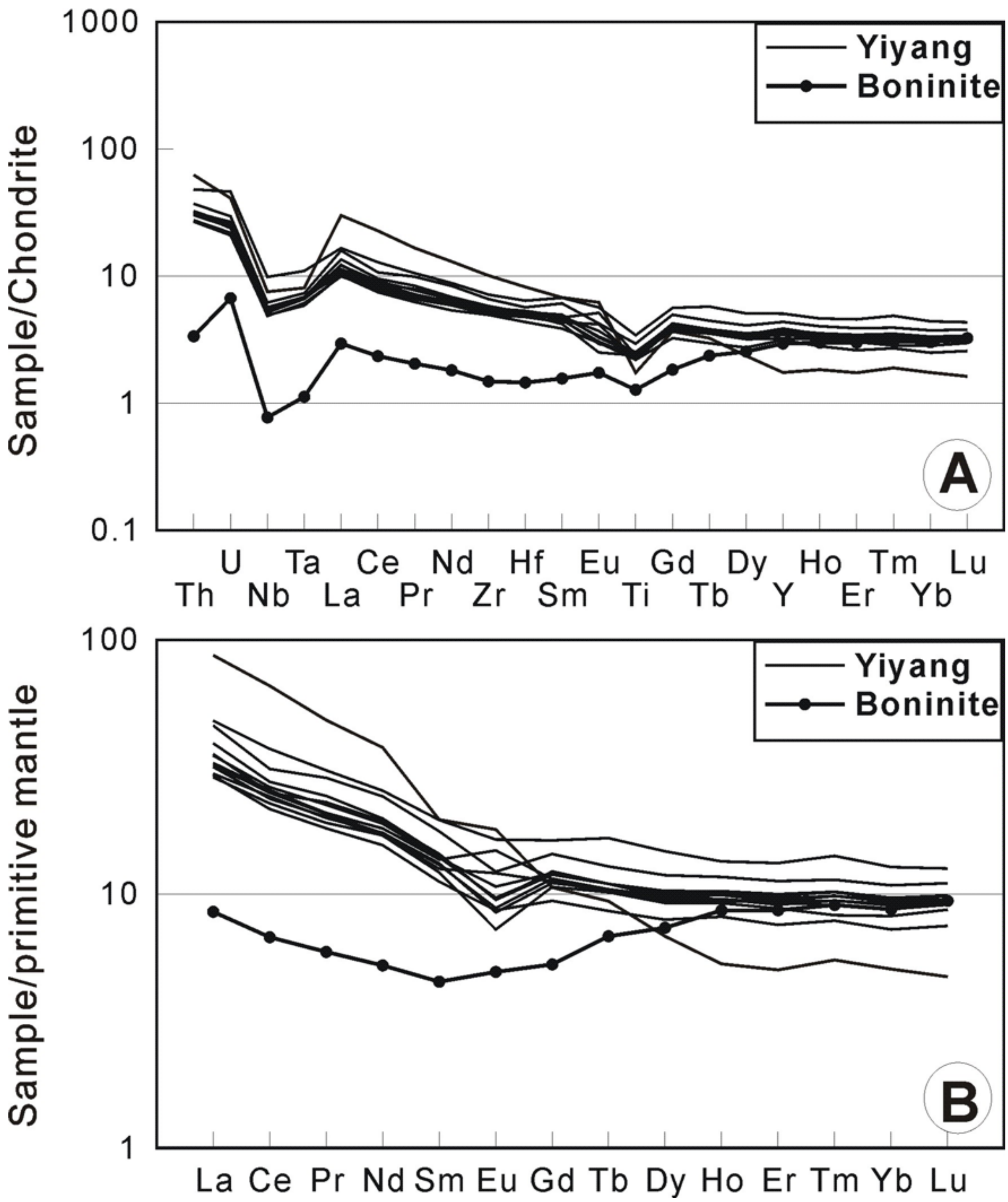

Fig. DR4 (A) Chondrite-normalized REE patterns and (B) Primitive mantle-normalized incompatible trace element spidergrams for the Yiyang komatiitic basalts. Normalizing values are from Sun and McDonough (1989). The boninite data is from the Neoarchaean Gadwal Greenstone belt (Manikyamba et al., 2005).

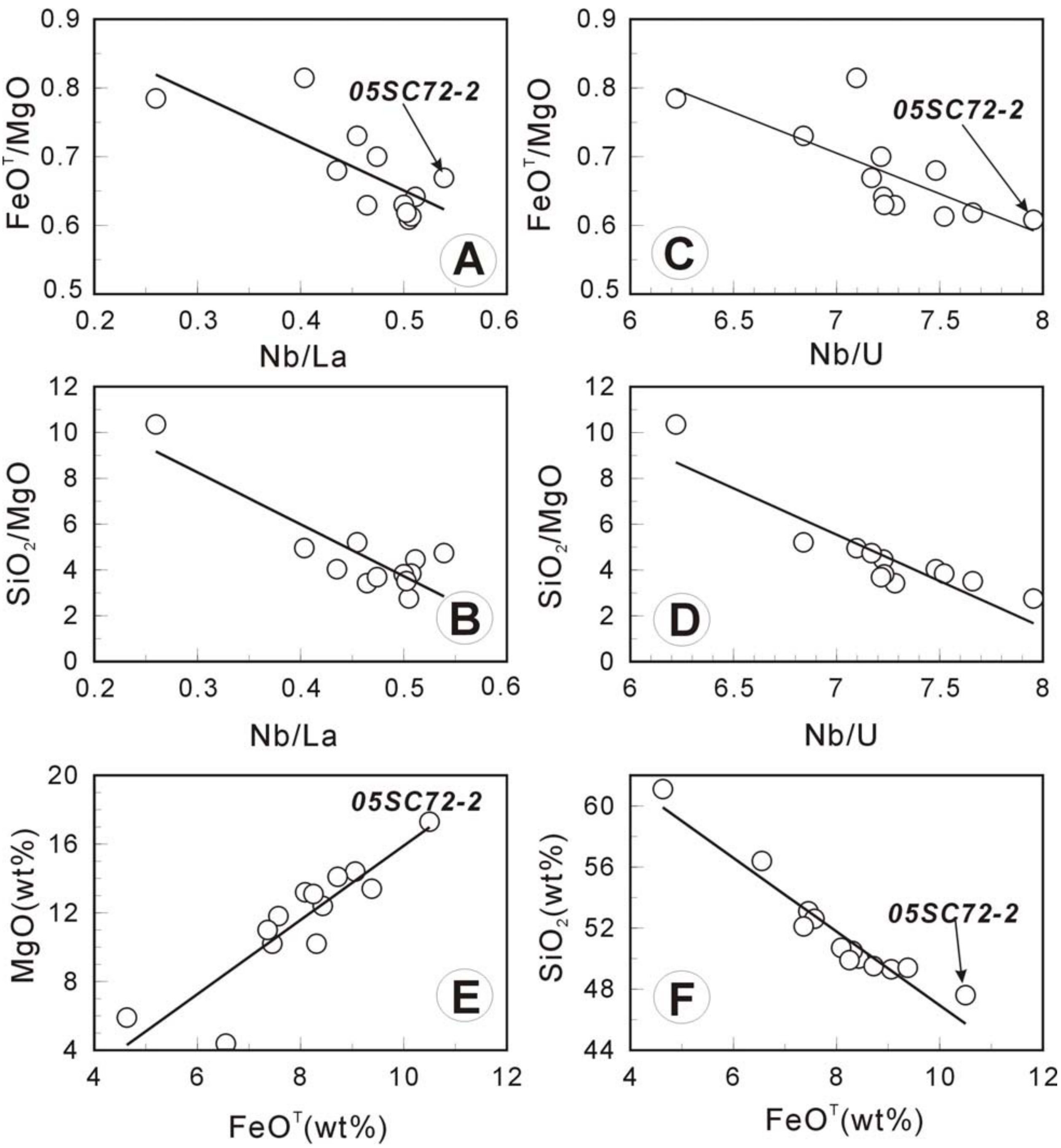

Fig. DR5 Plots of (A) FeO^T/MgO vs. Nb/La , (B) SiO_2/MgO vs. Nb/La (C) FeO^T/MgO vs. Nb/U, (D) SiO_2/MgO vs. Nb/U, (E) MgO vs. FeO^T , and (F) SiO_2 vs. FeO^T.

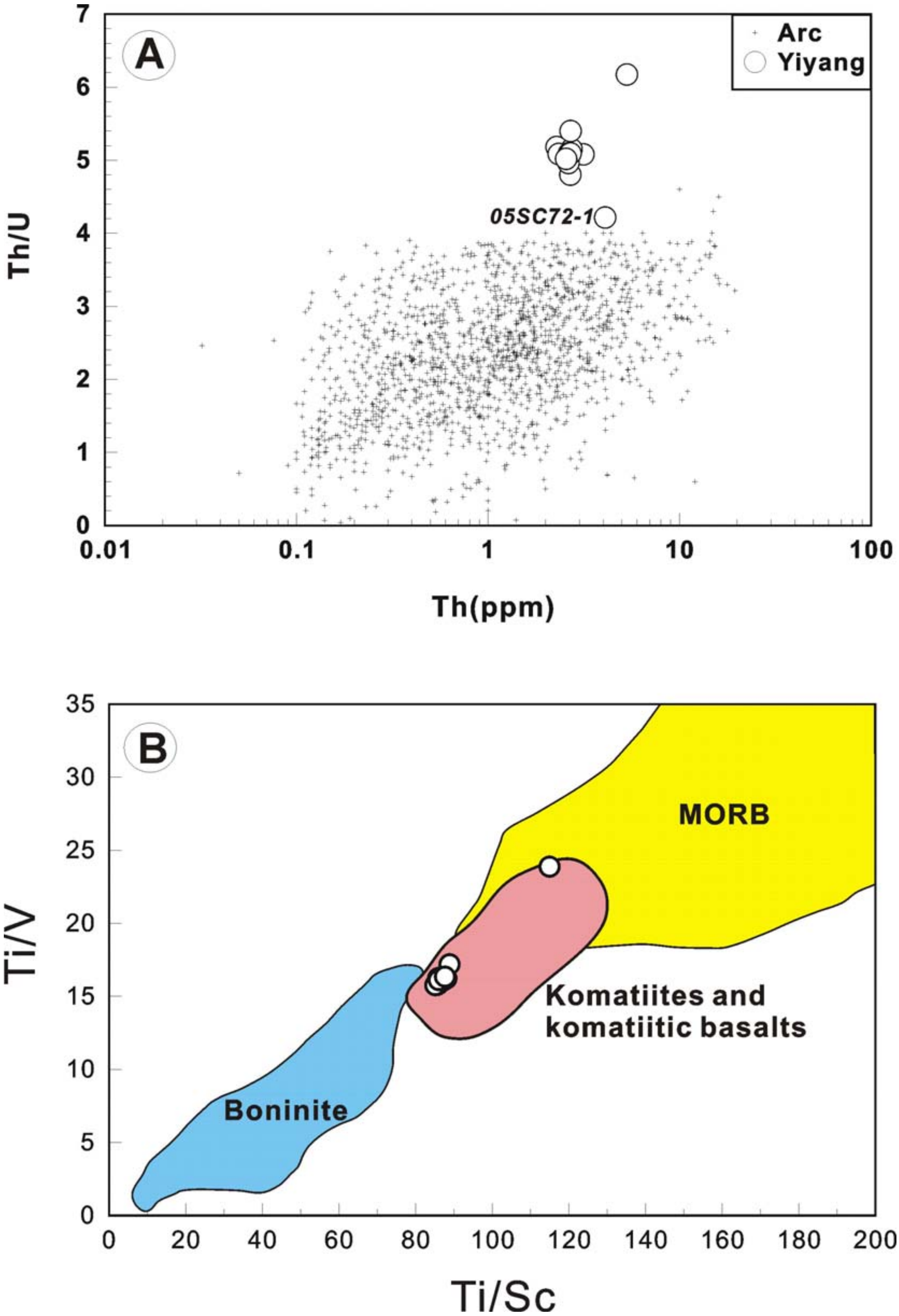

Fig. DR6 Chemical variation diagrams for the Yiyang komatiitic basalts in comparison with (A) arc basalts and (B) boninites, komatiites and MORB (Smithies et al., 2005). The arc basalts in (A) were from 17 individual arc datasets: http://georoc.mpch-mainz.gwdg.de/georoc with MgO>7%, SiO_2<52%, and LOI<3%.