

Tracking halogens through the subduction cycle

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Data Repository – Additional figures and data tables

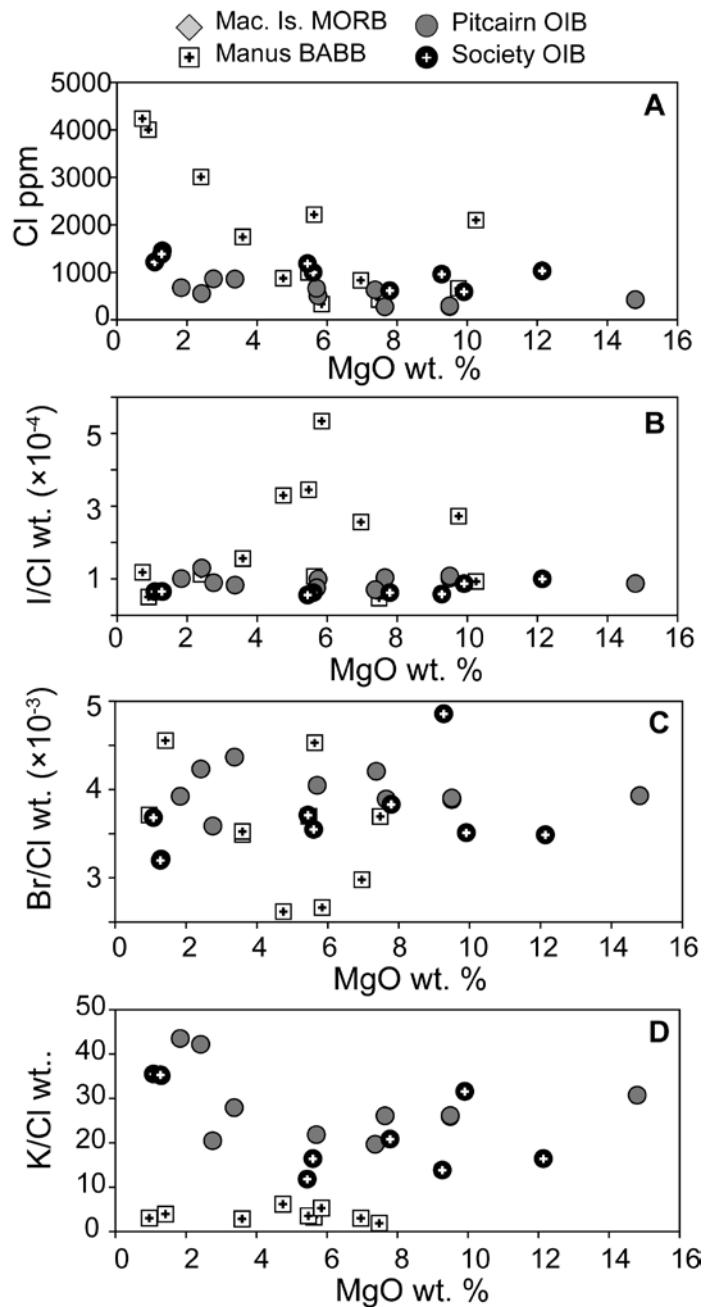


Fig DR1. Cl concentration, I/Cl, Br/Cl and K/Cl ratios versus MgO in the BABB and OIB melts analysed. The halogen ratios are not correlated with MgO providing evidence they have not been altered by partial melting or fractional crystallisation (Kendrick et al., 2012). Note that the major element compositions reported for Society samples, represent whole rock analyses (Devey et al., 1990). The majority of Pitcairn data are for glasses (Honda and Woodhead, 2005), but major elements determined by Woodhead and Devey (1993) may include cumulous phases explaining the high MgO value for sample 49DS1.

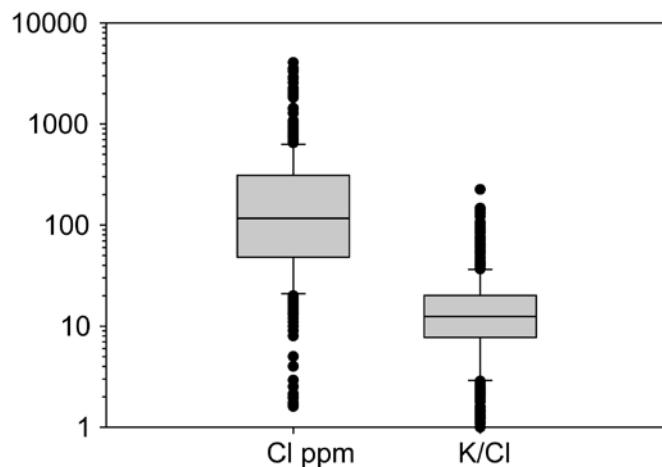


Fig DR2. Box and whisker plot for MORB Cl concentrations and K/Cl ratios.

The boxes encompass 50 % of the 566 reported analyses compiled by Kendrick et al. (2012); see Michael and Cornell, 1998 and Kamenetsky et al., 2000; Kamenetsky and Maas, 2002; le Roux et al., 2006; Saal et al., 2002; Sims et al., 2002; 2003). The whiskers extend to the 10th and 90th percentile and outliers are plotted. MORB have a median K/Cl of 12.5 ± 1.0 (Kendrick et al., 2012), with ~50% of the selected analyses having K/Cl of between ~8 and ~20.

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Table DR1. Summary of major element and isotope geochemistry

sample	MgO wt %	SiO ₂ wt %	⁸⁶ Sr/ ⁸⁷ Sr	¹⁴⁴ Nd/ ¹⁴³ Nd	²⁰⁶ Pb/ ²⁰⁴ Pb	²⁰⁷ Pb/ ²⁰⁴ Pb	²⁰⁸ Pb/ ²⁰⁴ Pb
<i>Manus Basin Back Arc Basin Basalts (BABB)</i>							
<i>Sinton et al. (2003)</i>							
16-14	5.63	54.1	0.703611	0.513046	18.744	15.541	38.383
14-9	5.47	52.9			18.796	15.544	38.405
18-4	6.96	52.5	0.703438	0.513021	18.751	15.530	38.358
19-12	5.84	52.8	0.703204	0.513084	18.780	15.527	38.366
24-9	3.59	57.7	0.703248	0.513066			
24-9	3.59	57.7	0.703248	0.513066			
28-1	7.48	50.4	0.703389	0.513034	18.437	15.509	38.175
36-4	4.75	54.7			18.740	15.531	38.317
<i>Kamenetsky et al. (2001)</i>							
MD36	2.4	59.2	0.703562	0.513054	18.767	15.539	38.368
MD41	0.9	67.4					
MD28	0.73	68.6	0.703690	0.513040	18.771	15.533	38.365
MD43	10.25	52.8	0.703659	0.513023	18.781	15.542	38.386
MD38	9.75	50.5	0.703573	0.513008	18.818	15.544	38.439
<i>Pitcairn seamount glasses (EM1 - OIB)</i>							
<i>Honda and Woodhead (2005)</i>							
52DS-1	1.84	53.2	0.705193	0.512478	17.454	15.461	38.993
51DS-4	2.76	54.2	0.703932	0.512811	18.191	15.515	38.898
51DS-9	7.65	50.0	0.704427	0.512696	17.950	15.499	38.807
49DS-1	14.8	46.7	0.705010	0.512501	17.619	15.473	38.859
48DS-6	5.74	49.0	0.704251	0.512629	17.853	15.484	38.611
45DS-1	3.37	53.5	0.704920	0.51253	17.743	15.487	38.966
46DS-2	7.37	48.4	0.704228	0.512692	18.037	15.502	38.939
57DS-8	2.42	54.5	0.705281	0.512462	17.508	15.470	38.878
51DS-2	9.5	50.0	0.704431	0.512661	17.944	15.496	38.805
51DS-2	9.5	50.0	0.704431	0.512661	17.944	15.496	38.805
33GTV2	5.7	49.6	0.704107	0.512708	18.124	15.513	38.936
<i>Society seamount glasses (EM2 - OIB)</i>							
<i>Devey et al. (1990)</i>							
3-1	9.27	45.4	0.704622	0.51276			
81-3	1.08	59.7	0.704504	0.512888	18.993	15.563	38.681
DR4-1							
DR2-1	12.14	44.1			19.098	15.587	38.876
4-2	1.3	58.1	0.706017	0.512582	19.212	15.643	39.107
9-1	9.91	47.2	0.705506	0.512707	19.117	15.624	38.983
P3-4	5.6	43.1	0.704276	0.512847	19.057	15.561	38.751
4-3	1.28	57.6	0.706018	0.512612			
29/1	5.44	42.7	0.703709	0.512932	19.222	15.540	38.744
P1-1	7.79	45.3	0.704655	0.512757	19.095	15.567	38.949

Table DR2. Halogen analyses (this study)

sample	size mg	Cl	Br	I	K	Analytical uncertainties 2σ						
		ppm	ppb	ppb	wt %	Br/Cl	±	I/Cl	±	K/Cl	±	
		Total fusion data					Total fusion data					
Manus Basin Back Arc Basin Basalts (BABB)												
16-14	20.8	2214	10028	237	0.74	4.5E-03	1.5E-04	1.1E-04	7.5E-06	3.27	0.2	
14-9	24.5	998	3688	344	0.36	3.7E-03	1.1E-04	3.5E-04	1.9E-05	3.55	0.3	
18-4	18.1	831	2476	213	0.25	3.0E-03	8.8E-05	2.6E-04	1.1E-05	3.01	0.2	
19-12	29.6	329	876	175	0.18	2.7E-03	9.3E-05	5.3E-04	3.3E-05	5.29	0.4	
24-9	26.9	1753	6118	272	0.52	3.5E-03	1.2E-04	1.6E-04	9.0E-06	2.88	0.2	
24-9	23.4	1742	6139	272	0.51	3.5E-03	1.2E-04	1.6E-04	9.8E-06	2.88	0.2	
28-1	20.5	423	1564	20	0.08	3.7E-03	1.3E-04	4.8E-05	2.7E-06	1.90	0.1	
36-4	12.6	874	2288	288	0.55	2.6E-03	9.3E-05	3.3E-04	2.0E-05	6.18	0.5	
MD36	23.6	3008	11162	339	0.91	3.7E-03	1.2E-04	1.1E-04	3.7E-06	3.04	0.2	
MD41	27.8	4006	17639	202	1.46	4.4E-03	7.9E-05	5.0E-05	5.7E-06	3.64	0.2	
MD28	27.4	4238	19308	500	1.68	4.6E-03	7.1E-05	1.2E-04	3.4E-06	3.97	0.2	
MD43	34.0	2101	4580	195	0.72	2.2E-03	1.2E-04	9.3E-05	5.0E-06	3.43	0.4	
MD38	25.6	664	1791	181	0.18	2.7E-03	8.9E-05	2.7E-04	1.8E-05	2.77	0.1	
Pitcairn seamount glasses (EM1 - OIB)												
52DS-1	43.3	673	2638	68	3.0	3.9E-03	1.0E-04	1.0E-04	4.3E-06	43.5	2.2	
51DS-4	24.9	859	3079	77	1.8	3.6E-03	1.2E-04	8.9E-05	5.5E-06	20.5	1.0	
51DS-9	38.9	269	1046	28	0.7	3.9E-03	8.6E-05	1.0E-04	4.8E-06	26.1	1.3	
49DS-1	33.6	421	1654	37	1.3	3.9E-03	1.3E-04	8.7E-05	5.1E-06	30.7	1.6	
48DS-6	24.8	503	2138	50	1.4	4.3E-03	1.5E-04	1.0E-04	6.1E-06	27.2	1.4	
45DS-1	28.9	855	3733	71	2.4	4.4E-03	1.5E-04	8.3E-05	4.4E-06	27.9	1.4	
46DS-2	24.0	627	2637	44	1.3	4.2E-03	1.5E-04	7.0E-05	4.5E-06	19.6	1.0	
57DS-8	30.9	549	2324	71	2.4	4.2E-03	1.4E-04	1.3E-04	7.1E-06	42.2	2.2	
51DS-2	29.1	275	1067	28	0.7	3.9E-03	1.4E-04	1.0E-04	4.3E-06	25.9	1.3	
51DS-2	19.2	289	1129	31	0.8	3.9E-03	1.4E-04	1.1E-04	3.8E-06	26.1	1.4	
33GTV2	22.1	659	2665	50	1.5	4.0E-03	1.2E-04	7.5E-05	4.1E-06	21.8	1.1	
Society seamount glasses (EM2 - OIB)												
3-1	44.0	957	4647	55	1.4	4.9E-03	1.7E-04	5.8E-05	3.1E-06	13.9	0.7	
81-3	32.8	1214	4471	79	4.4	3.7E-03	1.2E-04	6.5E-05	3.4E-06	35.5	1.8	
DR4-1	35.3	1335	4499	94	4.8	3.4E-03	7.0E-05	7.0E-05	2.5E-06	35.5	1.8	
DR2-1	2.1	1027	3581	103	1.7	3.5E-03	8.2E-05	1.0E-04	3.8E-06	16.4	0.8	
4-2	21.1	1449	4652	94	5.2	3.2E-03	1.1E-04	6.5E-05	3.2E-06	35.1	1.8	
9-1	22.8	588	2063	51	1.9	3.5E-03	1.1E-04	8.7E-05	4.5E-06	31.6	1.6	
P3-4	16.3	996	3535	62	1.7	3.5E-03	1.2E-04	6.2E-05	3.5E-06	16.4	0.8	
4-3	20.0	1382	4418	90	5.0	3.2E-03	1.0E-04	6.5E-05	2.7E-06	35.3	1.8	
29/1	17.9	1182	4382	66	1.4	3.7E-03	1.3E-04	5.6E-05	3.3E-06	11.8	0.6	
P1-1	0.7	611	2339	38	1.3	3.8E-03	1.1E-04	6.2E-05	3.1E-06	20.8	1.1	

Reported data are blank corrected.

Typcal blank based on a 10 mg sample					
		Cl	Br	I	K
		ppm	ppb	ppb	wt %
1600 C		0.26	1.41	0.05	bdl

Table DR3. Noble gas analyses (This and previous study)

sample	^{36}Ar	^{40}Ar	(Includes J era)	Analytical	2σ	$^{3}\text{He}/^{4}\text{He}$	$^{20}\text{Ne}/^{22}\text{Ne}$	$^{21}\text{Ne}/^{22}\text{Ne}$
	mol g ⁻¹	mol g ⁻¹	Ar-Ar age Ma ±	$^{40}\text{Ar}/^{36}\text{Ar}$	±	(R/Ra) ±	±	±
Total fusion data								
Manus Basin Back Arc Basin Basalts (BABB)								
16-14		1.6E-11	12 1					
14-9	5.8E-13	2.1E-10	60 10	362	13			
18-4		1.6E-11	36 1					
19-12		1.5E-11	47 2					
24-9	8.2E-15	2.8E-11	28 2	3382	2756			
24-9	9.3E-14	4.8E-11	22 2	511	37			
28-1		2.0E-11	136 6					
36-4		2.0E-11	20 1					
MD36	3.6E-13	1.2E-10	7 3	326	14			
MD41	4.5E-14	1.5E-11	1 1	331	86			
MD28		2.4E-11	8 1					
MD43	2.1E-12	6.6E-10	22 3	309	2			
MD38	1.4E-13	4.8E-11	19 12	339	33			
Pitcairn seamount glasses (EM1 - OIB)								
52DS-1	1.8E-12	5.7E-10	9.0 0.5	322	1	1.9 0.1	10.68 0.04	0.0307 0.0002
51DS-4		2.5E-11	7 2			3.60 0.05	9.94 0.06	0.0289 0.0002
51DS-9		3.7E-11	29 4			10.6 0.3	9.87 0.01	0.0294 0.0001
49DS-1	1.1E-13	1.4E-10	47 2	1293	156	9.3 0.1	10.39 0.03	0.0307 0.0001
48DS-6		3.0E-11	14 2					
45DS-1		1.7E-11	6 1			9.1 0.1	9.91 0.03	0.0294 0.0003
46DS-2		2.6E-12	14 4			9.1 0.2	9.81 0.02	0.0289 0.0001
57DS-8	9.2E-14	5.0E-11	5 1	538	81	6.9 0.1	9.96 0.03	0.0295 0.0002
51DS-2		1.6E-11	30 2			7.6 0.1	10.34 0.03	0.0314 0.0002
51DS-2		1.7E-11	28 4			7.6 0.1	10.34 0.03	0.0314 0.0002
33GTV2		9.3E-12	8 2					
Society seamount glasses (EM2 - OIB)								
3-1	8.9E-13	3.3E-10	27 2	368	6			
81-3	3.7E-13	1.2E-10	1.7 0.6	331	13			
DR4-1		1.0E-10	11.6 0.5					
DR2-1	1.0E-12	3.3E-10	8 39	319	121			
4-2	1.2E-13	6.2E-11	3 1	525	72			
9-1		1.0E-10	33 4					
P3-4		2.0E-11	13 2					
4-3	9.2E-14	5.1E-11	2.8 0.6	559	96			
29/1		2.0E-11	14 3					
P1-1	1.6E-12	5.0E-10	6 48	304	69			

Age ranges reflect
presence of mantle
derived excess ^{40}Ar

Typical blank based on a 10 mg sample			
	^{36}Ar mol g ⁻¹	^{40}Ar mol g ⁻¹	
1600 C	1.4E-14	2.7E-12	

Table DR4. Trace element geochemistry

sample	Rb	Ba	Th	U	Nb	Ta	K	Cl	La	Ce	Pb	Sr	Nd	Sm	Zr	Hf	Eu	Ti	Gd	Dy	Y	Er	Yb	Lu
concentrations in ppm																								
Manus Basin Back Arc Basin Basalts (BABB)																								
16-14	11.2	174	0.3	0.3	0.8	0.03	7388	2214	4.8	11.0	2.7	441	7.6	2.1	45	1.3	0.7	3537	2.2	2.0	15	1.47	1.43	0.22
14-9	4.9	121	0.3	0.1	0.5	0.03	3616	998	2.9	6.9	1.9	448	5.3	1.6	31	0.9	0.6	4017	1.8	2.0	13	1.36	1.36	0.21
18-4	3.5	68			0.6		2549	831			2.0	183			29			3057			11			
19-12	3.3	33	0.2	0.3	0.7	0.1	1776	329	2.1	5.8	0.8	105	5.4	2.0	53	1.5	0.8	6055	3.0	3.8	26	2.64	2.59	0.40
24-9	7.5	155			4.0		5152	1753			3.0	251			100			5875			19			
24-9	7.5	155			4.0		5114	1742			3.0	251			100			5875			19			
28-1	1.6	19	0.1	0.1	1.1	0.1	819	423	2.0	6.4	0.6	101	6.4	2.4	55	1.6	0.9	6714	3.5	4.5	30	3.04	2.97	0.45
36-4	8.8	192	3.1	1.1	4.9	0.3	5510	874	16.5	31.8	3.5	456	13.9	2.7	95	2.2	0.9	5276	2.7	2.8	18	1.83	1.79	0.27
(Kamenetsky et al., 2001)																								
MD36	16.6	248	0.9	0.5	1.4		9136	3008	8.9	20.5	4.0	392	14.7	4.1	85	2.5	1.4	5575	4.6	4.9	26	3.22	3.11	0.47
MD41	25.0	337	1.4	0.8	1.9		14601	4006	11.6	25.9	5.2	263	17.6	4.7	133	3.9	1.5	3537	5.2	5.8	34	4.04	3.98	0.60
MD28	29.0	374	1.6	0.9	2.0		16828	4238	12.8	28.5	6.3	243	18.3	5.0	143	4.3	1.5	2998	5.4	6.1	32	4.08	4.17	0.65
MD43	12.5	151	0.5	0.3	0.5		7197	2101	4.4	9.1	2.6	434	6.5	1.7	32	0.9	0.6	2458	1.8	1.8	11	1.08	1.02	0.15
MD38	2.8	66	0.1	0.1	0.3		1837	664	1.6	3.6	1.4	251	3.2	1.1	18	0.5	0.4	2458	1.3	1.7	10	1.07	1.01	0.15
Pitcairn seamount glasses (EM1 - OIB)																								
(Honda and Woodhead, 2005)																								
52DS-1	58.6	853	10.3	2.0	80.0	4.7	29860	673	91.0	186.0	10.1	517	86.4	16.7	629	13.8	4.8	16846	13.9	10.9	55	5.26	4.21	0.59
51DS-4	36.6	436	6.1	1.5	51.0	3.1	17930	859	54.0	119.0	5.3	522	64.9	14.4	537	11.7	4.3	12889	12.9	10.4	55	5.08	4.09	0.59
51DS-9		190	2.3	0.6	22.0	1.4	7158	269	22.0	48.0	2.2	478	28.9	6.9	212	5.1	2.3	17626	6.6	5.4	29	2.60	2.02	0.29
49DS-1	20.8	300	3.7	0.8	31.0	2.2	13198	421	32.0	68.0	3.6	507	33.9	6.9	235	5.5	2.1	16786	6.1	4.7	25	2.25	1.79	0.26
48DS-6	21.8	574	3.7	0.9	35.0	2.2	13971	503	33.0	72.0	3.4	574	39.9	8.9	297	6.6	2.8	18765	8.0	6.1	31	2.80	2.10	0.30
45DS-1	46.6	576	8.9	1.9	59.9	3.7	24352	855	68.7	144.4	7.4	561	71.2	14.3	543	11.7	4.1	15407	12.2	9.1	47	4.23	3.28	0.47
46DS-2	21.8	291	3.8	0.9	36.0	2.3	12577	627	33.0	73.0	3.4	583	40.5	9.0	296	6.9	2.8	20084	8.1	6.2	31	2.82	2.16	0.30
57DS-8	42.4	600	8.0	1.7	59.0	3.7	23650	549	73.0	157.0	8.4	487	81.2	16.5	557	12.2	4.7	11690	14.0	10.7	55	5.10	3.98	0.57
51DS-2	12.6	186	2.3	0.6	22.0	1.4	7267	275	21.0	48.0	2.4	467	28.1	6.8	207	5.0	2.2	16846	6.5	5.2	28	2.53	2.00	0.28
51DS-2	12.6	186	2.3	0.6	22.0	1.4	7714	289	21.0	48.0	2.4	467	28.1	6.8	207	5.0	2.2	16846	6.5	5.2	28	2.53	2.00	0.28
33GTV2	26.5	347	4.4	1.1	41.0	2.6	14661	659	40.0	86.0	3.9	685	47.0	10.1	348	7.6	3.1	21342	8.8	6.6	33	2.94	2.20	0.31

K and Cl data obtained by the noble gas method (this study)

Table DR4. continued

sample	Rb	Ba	Th	U	Nb	Ta	K	Cl	La	Ce	Pb	Sr	Nd	Sm	Zr	Hf	Eu	Ti	Gd	Dy	Y	Er	Yb	Lu
concentrations in ppm																								
Society seamount glasses (EM2 - OIB)																								
3-1	30	423	4.3	1.3	34.8	2.1	13531	957	35.4	81.1	3.5	705	45.5	9.9	282	6.7	3.1	21657	8.7	5.9	25	2.30	1.60	0.20
81-3	84	833	9.2	2.8	84.6	4.8	43967	1214	83.9	182.5	8.2	113	82.6	15	890	17.1	4.6	3592	11.2	8.4	40	4.00	3.40	0.50
DR4-1	144.9	268	21.7	6.7	144.7	7.8	48399	1335	119.2	256.1	16	107	112.8	20.8	1264	27.6	4.9	4622	15.4	11.8	55	5.50	4.80	0.70
DR2-1	34.8	410	5.8	1.7	44.9	2.7	17226	1027	43.7	97.9	3.9	745	51.1	10.8	308	7.2	3.2	21054	9.2	6.2	26	2.40	1.60	0.20
4-2	145.4	267	21.7	6.7	144.2	7.8	51890	1449	119.8	257.1	16.1	107	113.5	21	1265	27.7	4.9	4476	15.6	11.8	55	5.50	4.80	0.70
9-1	42.1	595	6.3	1.9	39.4	2.2	18938	588	43.3	96.3	5	763	50.3	10.3	328	7.6	3.2	19034	8.7	5.9	25	2.30	1.70	0.20
P3-4	47.2	489	7.4	2.1	58.9	3.5	16698	996	52.3	115.6	4.6	900	59.5	12.6	375	8.4	3.8	25058	10.9	7.7	33	3.20	2.30	0.30
4-3	139.2	258	21	6.5	141.9	7.7	49800	1382	116.5	250.3	15.5	103	109.9	20.3	1222	26.9	4.7	7080	15	11.5	53	5.30	4.60	0.60
29/1	48.7	515	6.1	1.8	70.6	4.2	14228	1182	58.2	129	4.3	1062	67	14.1	403	9.1	4.2	26713	12.2	8.9	40	3.90	2.90	0.40
P1-1	47.5	502	8.1	2.3	53.1	3.1	12985	611	52.1	114.2	5.2	816	58.2	12.1	382	8.8	3.6	23031	10.4	7.2	31	2.90	2.00	0.30

Trace element data of this study obtained at the University of Melbourne using the Agilent 7700 ICPMS