

The Link Between Soil Geochemistry in South West England and Human Exposure to Soil Arsenic

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Supplementary Information

Example Relationship between an ISC and Its Geochemical Source

For example a high proportion of the S.Mg.Na ISC (Figure S1) is over the granite intrusions (cf. Figure 1 in the paper). It is made up of high concentrations of S and halides (Figure S2) and has a high Spearman correlation with loss on ignition at 450 °C values > 15% (0.70). This suggest that this ISC is derived from the high organic matter soils (peat) in the area [80] similar to a peat ISC found from a geochemical survey data in Ireland [81].

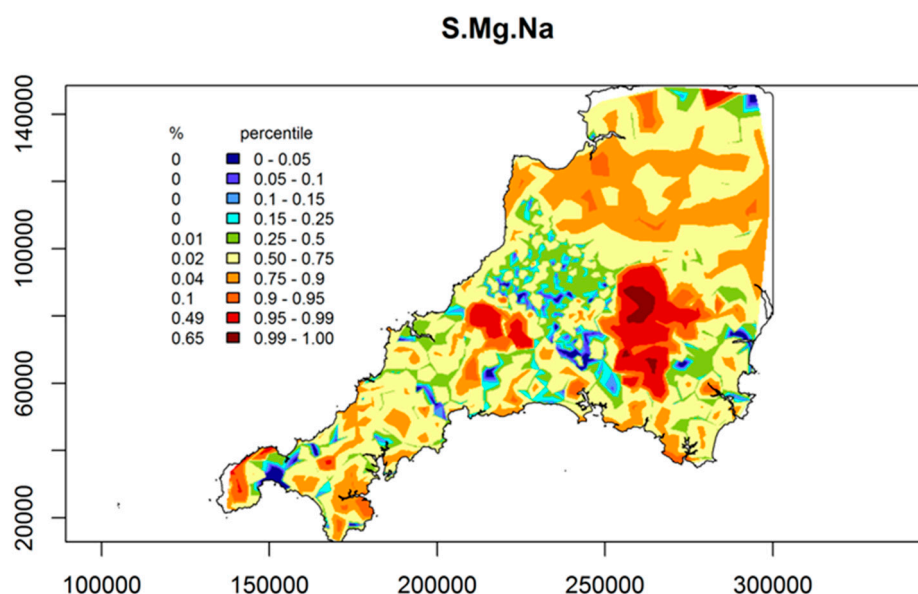


Figure S1. Interpolated Spatial distribution of the S.Mg.Na ISC.

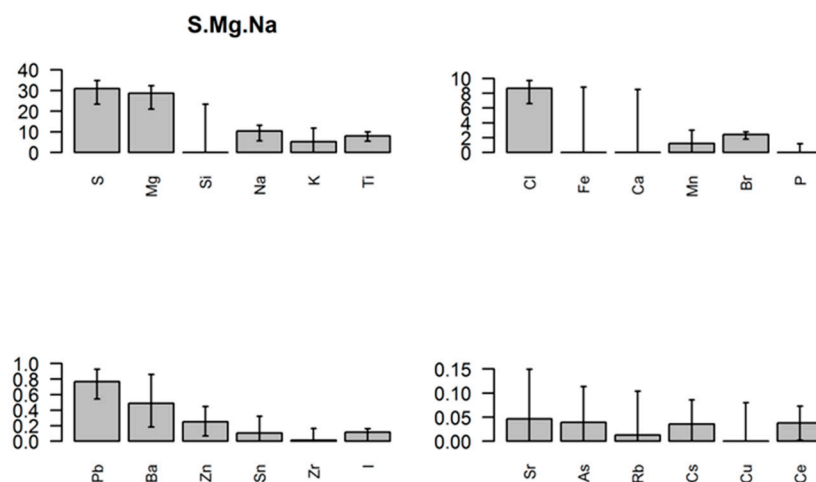


Figure S2. Chemical composition of the S.Mg.Na ISC (% units).

Composition of the ISCs

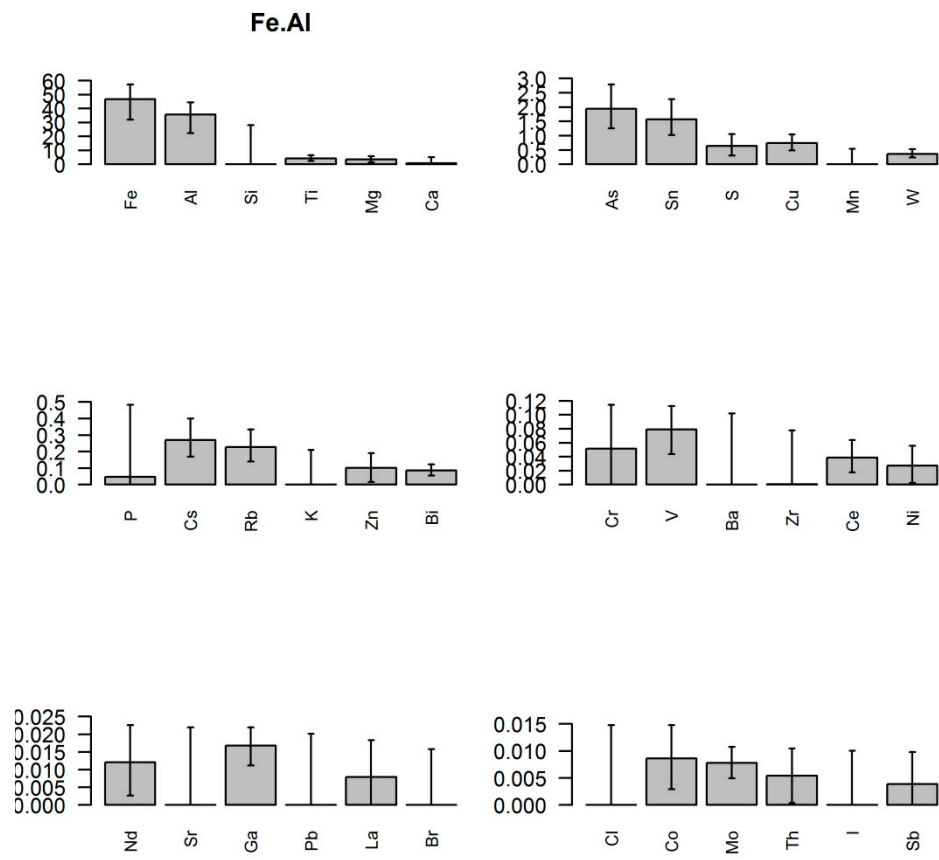


Figure S3. Composition of the Fe.Al ISC in units of %.

Al.K.Si.Fe

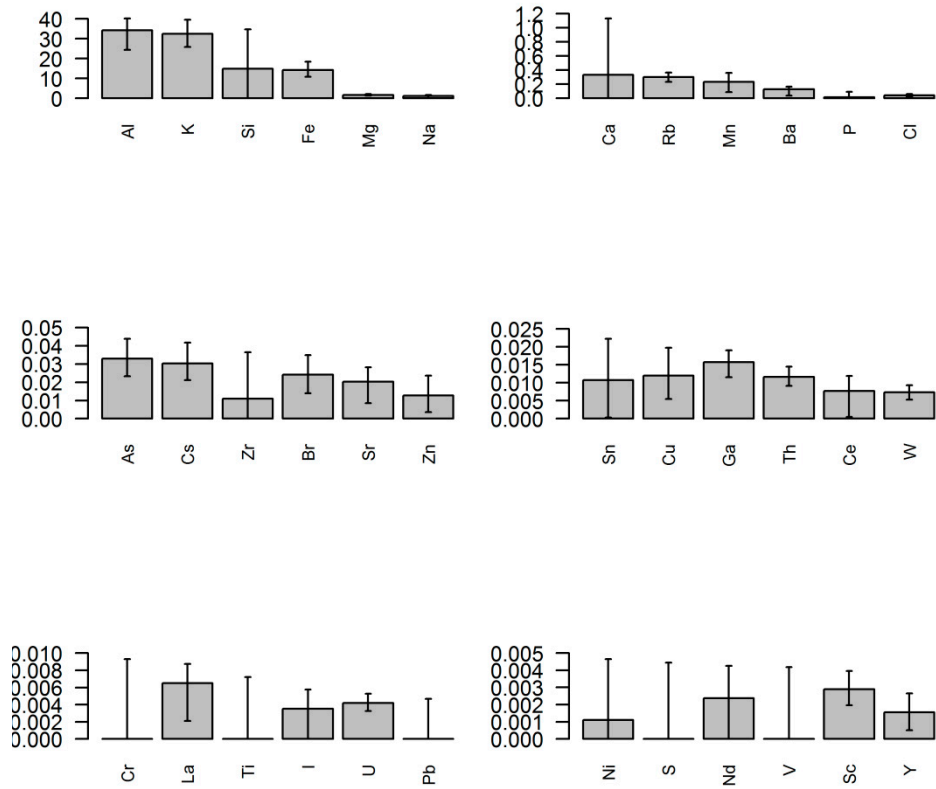


Figure S4. Composition of the Al.K.Si.Fe ISC in units of %.

Si.Fe.1

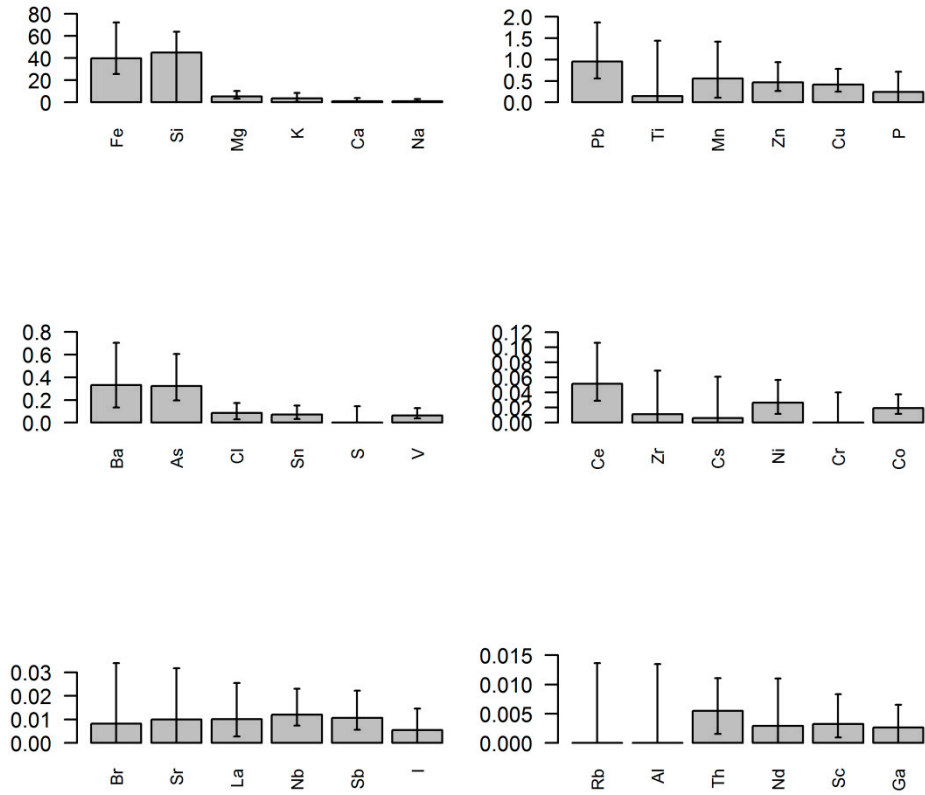


Figure S5. Composition of the Si.Fe.1 ISC in units of %.

Si.A1.1

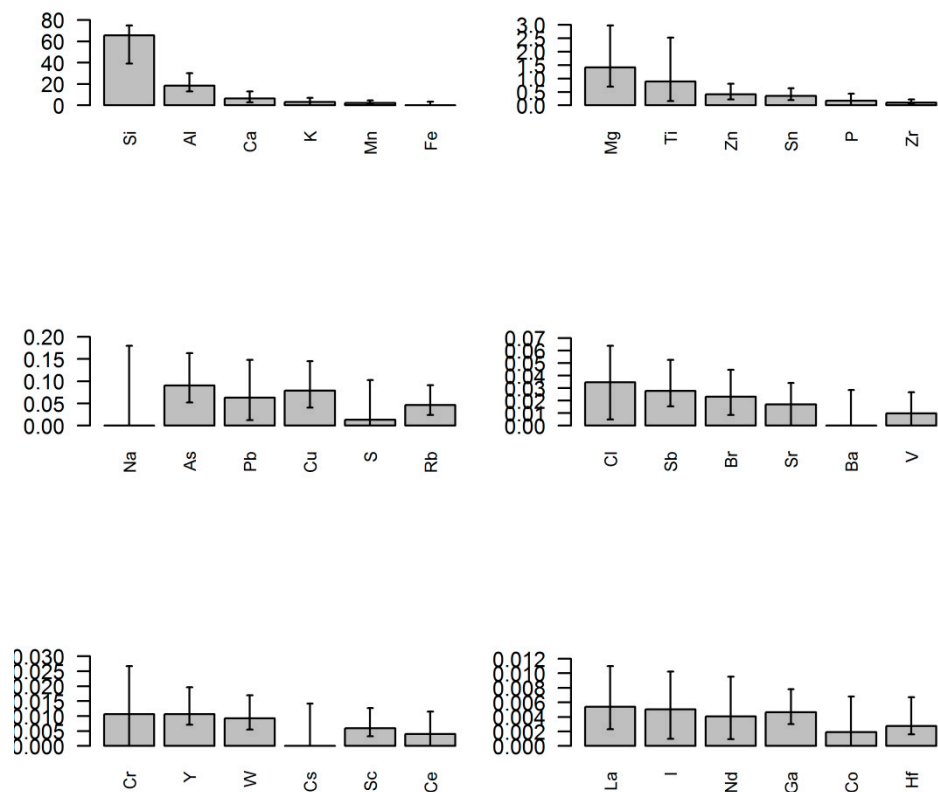


Figure S6. Composition of the Si.A1.1 ISC in units of %.

Soils XRF QA

Throughout the lifetime of the G-BASE project, strict quality control procedures have been in place at all stages from sample collection to analytical data reporting. Analytical data have been closely monitored to ensure continuity during numerous field campaigns and between different analytical methods. All data have been conditioned with respect to certified reference materials in order to provide both accurate and precise element concentrations with a high degree of confidence.

Four certified reference materials were analysed repeatedly throughout the batches of field samples. Analysis was carried out between April and June 2013. The CRMs analysed are as below.

GSD-7	Bulk stream sediment	National Research Centre for CRMs, China
GSS-1	Bulk soil	National Research Centre for CRMs, China
LKSD-1	Bulk lake sediment	CANMET, Canada
LKSD-4	Bulk lake sediment	CANMET, Canada

The results of the reference material analysis are given in Table S1 with the lower limits of detection given in Table S2

Table S1. results of the analysis of the XRFs reference materials.

CRM ID	Na2O	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	S	Cl	Sc
GSD-7	1.3	4.9	16.4	74.4	0.23	3.72	1.65	0.723	0.099	6.59	NDL	NDL	16.5
GSD-7	1.3	4.7	15.9	75.4	0.23	3.64	1.59	0.71	0.092	6.37	NDL	NDL	13.2
GSD-7	1.3	4.6	15.8	73.1	0.22	3.66	1.63	0.699	0.093	6.4	NDL	NDL	12.1
GSD-7	1.3	4.6	15.8	73.5	0.22	3.66	1.63	0.703	0.092	6.4	NDL	NDL	13.3
GSD-7	1.3	5	16.4	74.8	0.23	3.73	1.66	0.726	0.093	6.61	NDL	NDL	13.3
CRM ID	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Rb	Sr
GSD-7	92.6	131.8	22.5	56.3	39	245.4	16.8	1	82.6	0.3	0.4	146.5	223.8
GSD-7	92.5	120.7	21.5	56.1	34.4	238.9	16.5	1.4	81.6	0.4	0.2	141.7	216.6
GSD-7	89.3	117.8	21.5	55.2	34.8	241	15.7	0.8	82.5	0.2	0.5	142	218.9
GSD-7	89.3	118.8	21.7	55	34.3	243.6	15.7	1.2	81.6	0.1	0.2	143.1	217.3
GSD-7	92.3	134	22.9	57.7	40.5	247.5	17.5	1	83.2	0.2	-0.3	146.4	223
CRM ID	Y	Zr	Nb	Mo	Nd	Sm	Yb	Hf	Ta	W	Tl	Pb	Bi
GSD-7	25	155.3	15.1	1.8	33.4	1.4	0.2	4.1	0.6	6.5	0.6	359.4	1.3
GSD-7	24	152.6	14.2	1.6	31.4	5	2.2	4.5	1.2	6.3	0.9	351.2	1.5
GSD-7	24.1	151.1	14.8	1.7	33.5	2.3	2.2	3.2	0.3	6.7	0.7	351.4	0.3
GSD-7	24	151.6	15.1	1.5	36.4	6.1	3.1	3.8	1.1	6.9	1.1	352.1	1.2
GSD-7	25.9	155.6	15.5	1.8	36.6	3.7	0.8	3.6	0.7	5.9	0.5	361.7	1.4
CRM ID	Th	U	Ag	Cd	In	Sn	Sb	Te	I	Cs	Ba	La	Ce
GSD-7	12.9	3.1	1.2	0.8	0.1	4.5	2.8	NDL	0.6	5	747	46	82
GSD-7	12.4	2.3	1.3	1.3	NDL	5.2	2.7	NDL	0.6	5	750	46	84
GSD-7	12.5	3.2	1.1	1.3	0.1	4.5	2.8	NDL	1.2	5	748	45	84
GSD-7	12.4	3	1.1	0.9	NDL	4.9	2.9	NDL	0.4	5	748	45	84
GSD-7	12.3	2.9	1.1	0.9	NDL	4.3	2.9	0.3	0.8	4	751	46	84

CRM ID	Na2O	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	S	Cl	Sc
GSS-1	1.4	2.4	15.8	64.8	0.21	2.6	1.77	0.788	0.242	5.27	NDL	NDL	8.9
GSS-1	1.4	2.4	15.5	63.9	0.21	2.58	1.75	0.782	0.237	5.25	NDL	NDL	11.1
GSS-1	1.4	2.4	15.5	62.3	0.2	2.61	1.79	0.779	0.243	5.29	NDL	NDL	8.8
GSS-1	1.4	2.4	15.6	62.7	0.2	2.61	1.79	0.777	0.246	5.29	NDL	NDL	10.1
GSS-1	1.4	2.4	15.9	65	0.21	2.61	1.78	0.794	0.245	5.3	NDL	NDL	12
CRM ID	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Rb	Sr
GSS-1	80.2	60	16.1	22.4	19.4	666.8	17.2	0.3	34.9	0	2	138.3	156.6
GSS-1	80.4	114	14.8	22.5	20.1	671.3	17.2	0.7	36.2	0.1	2.1	137.8	154.7
GSS-1	73.9	114.8	14.2	20.9	19.7	675.9	17.5	0.1	35.4	-0.1	2.2	138.9	156.1
GSS-1	80.6	114.1	15.4	21.6	19.9	675.5	17.8	0.6	36.6	0.2	2.6	139.6	155.6
GSS-1	84.2	63.4	14.6	20.6	20.3	672.9	17.7	0.6	34.6	-0.1	1.7	140.7	158.1
CRM ID	Y	Zr	Nb	Mo	Nd	Sm	Yb	Hf	Ta	W	Tl	Pb	Bi
GSS-1	25.5	247.5	14.7	1.6	27	4.3	2.7	6	1.5	3.1	1.2	96.1	0.8
GSS-1	23.4	248.7	14.5	1.8	23.8	1.3	1.6	6.1	1	4.7	1.5	97	0.8
GSS-1	25.3	249.2	15	1.6	28.3	5.2	2.2	6.7	1.1	6.2	0.5	97.7	0.9
GSS-1	25.3	250.3	15.1	1.6	28.7	5.7	1.9	6.7	1.3	6.5	1.1	96.1	1.5
GSS-1	24.3	249.6	15	1.8	27.6	2.1	0.3	5.5	0.8	4.1	0.7	96.1	0.4
CRM ID	Th	U	Ag	Cd	In	Sn	Sb	Te	I	Cs	Ba	La	Ce
GSS-1	11.3	2.9	0.3	4.2	0.2	6	1	NDL	1.9	8	565	32	65
GSS-1	11.8	2.9	0.4	4.4	0.3	6.1	0.9	NDL	1.6	8	565	32	64
GSS-1	11.3	3.6	0.3	4.3	NDL	5.9	1.2	NDL	1.4	9	566	33	65
GSS-1	11.7	3.8	0.2	3.9	NDL	5.7	0.8	0.1	2.3	8	565	32	65
GSS-1	12	3.2	0.1	4.2	0.2	5.6	1.1	0.2	1.6	8	566	32	65

CRM ID	Na2O	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	S	Cl	Sc
LKSD-1	1.3	1.7	4.9	27.7	0.15	1	12.45	0.431	0.092	4.01	9506	327	9.7
LKSD-1	1.2	1.7	4.8	27	0.14	0.98	12.18	0.421	0.09	3.95	9441	352	10.4
LKSD-1	1.2	1.7	4.8	26.8	0.14	1	12.36	0.419	0.094	3.97	9538	345	10.1
LKSD-1	1.2	1.7	4.9	27.1	0.14	1	12.41	0.418	0.094	3.98	9613	346	10.7
LKSD-1	1.3	1.8	5	28.3	0.15	1.02	12.57	0.433	0.09	4.04	9540	344	11.2
CRM ID	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Rb	Sr
LKSD-1	45.9	32.3	11.2	15.8	44.7	326.2	8.8	-0.2	34.2	1.1	10.4	21.3	257.2

LKSD-1	45.2	25.5	12.1	15.5	43.2	313.7	8.3	0.3	34	1.1	9.9	22.9	252
LKSD-1	46.4	27.1	12.7	14.5	38.9	320	9.1	0.1	35.8	1	10.3	22.7	256.7
LKSD-1	46.2	27.9	11.8	15.8	40.2	319.3	8.3	0.3	35.5	1	10.1	22.8	256
LKSD-1	45.5	30.4	12.1	16.3	41.6	328.2	9.1	0	33.9	1	10.3	23.2	258.3

CRM ID	Y	Zr	Nb	Mo	Nd	Sm	Yb	Hf	Ta	W	Tl	Pb	Bi
LKSD-1	19.8	130.9	4	9.6	14.2	2.3	1.2	2.4	-0.1	0.9	1.3	80.7	1.5
LKSD-1	20.2	124.9	3.8	9.9	16.1	3.1	0.9	3.3	-0.3	0.9	0.8	80.1	0.6
LKSD-1	21.6	126.7	4.3	9.9	19.8	1.6	0.7	2.5	0.4	2	0.3	81	1.3
LKSD-1	19.7	127.5	3.7	9.6	19.9	3.9	0.5	3.5	0.3	2.4	0.4	81.6	0.6
LKSD-1	20.5	130.7	3.9	9.8	18.7	2	1.6	4.1	0	0.9	0.8	80.7	0.9

CRM ID	Th	U	Ag	Cd	In	Sn	Sb	Te	I	Cs	Ba	La	Ce
LKSD-1	2.3	9.5	0.2	1	0.7	14.7	1.1	NDL	1.8	2	393	14	25
LKSD-1	2.5	9.2	0.4	1.2	0.4	14.4	0.6	NDL	2.2	2	395	14	26
LKSD-1	2	10.1	0.3	1	0.9	14.6	1.3	NDL	1.8	2	396	13	25
LKSD-1	1.9	9.5	0.6	1.1	NDL	14.1	1	0.4	1.4	1	394	15	26
LKSD-1	2.1	9.5	0.2	1.3	0.9	14.1	0.7	NDL	2	2	396	14	25

CRM ID	Na2O	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	S	Cl	Sc
LKSD-4	0.5	1	5.1	45.2	0.36	0.74	1.78	0.294	0.066	4.08	5452	96	4.7
LKSD-4	0.5	1	4.8	42.4	0.33	0.72	1.73	0.285	0.064	4.02	5352	94	6.2
LKSD-4	0.4	1	4.8	42	0.34	0.74	1.77	0.285	0.067	4.09	5517	102	7.9
LKSD-4	0.4	1	4.9	42.5	0.34	0.75	1.8	0.29	0.067	4.1	5539	106	8.3
LKSD-4	0.5	1.1	5.2	46.3	0.37	0.75	1.78	0.296	0.066	4.13	5438	113	5.4

CRM ID	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Rb	Sr
LKSD-4	42.2	29.5	11.5	33.2	27.1	186.8	7.8	-0.2	15.7	2.1	48.7	24	116.6
LKSD-4	39.8	28.6	10.6	32.1	28.5	183.5	7.5	0.1	15.7	2.2	48.8	24.4	115.1
LKSD-4	43.6	28.9	12	33.6	28.6	187.6	7	0.3	16.2	2.2	49.7	24.4	117.4
LKSD-4	44.8	29.3	11.7	34.1	28.3	186.8	7	0.5	17.1	2.3	49.6	24.1	118
LKSD-4	45.9	27.7	10.5	35	28.4	188.8	7.4	0	16.3	2.1	48.7	24.5	117.8

CRM ID	Y	Zr	Nb	Mo	Nd	Sm	Yb	Hf	Ta	W	Tl	Pb	Bi
LKSD-4	22	95.1	3.9	1.7	26.5	5	0.5	2.6	-0.4	1.3	0.8	93	-0.6
LKSD-4	20.8	94.6	3.5	1.7	23.8	3.8	1.8	2.4	0.6	1.7	1.2	92.3	0.2
LKSD-4	21.6	97.3	4.3	1.7	28.7	5.7	1.7	2.8	0	2.2	0.9	95.1	0.1
LKSD-4	22.2	97.5	4.2	1.6	27.8	5.1	3.6	2.2	0.6	2.4	0.6	93.9	0.6
LKSD-4	21.9	95.8	4.4	1.7	25.6	5.3	2.1	2.4	0.4	1.8	0.9	93.7	0.1

CRM ID	Th	U	Ag	Cd	In	Sn	Sb	Te	I	Cs	Ba	La	Ce
LKSD-4	4.3	29.9	NDL	1.7	0.1	4.9	1.5	0.1	10	2	270	22	39
LKSD-4	4.2	29.9	NDL	1.7	NDL	4.6	1.2	NDL	9.2	2	269	21	39
LKSD-4	4.8	30.6	NDL	1.7	0.4	4.5	1.4	NDL	9.9	2	269	22	39
LKSD-4	4.5	30.7	NDL	1.8	0.1	4.5	1.1	0.2	10.1	2	269	20	38
LKSD-4	5.7	29.7	0.1	2	0.3	4.3	1.3	NDL	10.2	2	268	20	39

Table S2 Lower Limits of Detection for XRF analysis

Analyte	LLD	Analyte	LLD	Analyte	LLD	Analyte	LLD
Na2O	0.3	V	3	Y	1	Th	0.7
MgO	0.3	Cr	3	Zr	1	U	0.5
Al2O3	0.2	Co	1.5	Nb	1	Ag	0.5
SiO2	0.1	Ni	1.3	Mo	0.2	Cd	0.5
P2O5	0.05	Cu	1.3	Nd	4	In	0.5
K2O	0.01	Zn	1.3	Sm	3	Sn	0.5
CaO	0.05	Ga	1	Yb	1.5	Sb	0.5
TiO2	0.01	Ge	0.5	Hf	1	Te	0.5
MnO	0.005	As	0.9	Ta	1	I	0.5
Fe2O3	0.01	Se	0.2	W	0.6	Cs	1
S	1000	Br	0.8	Tl	0.5	Ba	1
Cl	200	Rb	1	Pb	1.3	La	1
Sc	3	Sr	1	Bi	0.3	Ce	1

All units are in mg kg⁻¹.