

Supplementary Material

1. Results of Chemical Mineral Electron Microprobe Analyses

Table S1. Sample EAFS1 prior to leaching.

	Wuestite phases prior to leaching										Spinel phases prior to leaching					Mellilite phases prior to leaching					Olivine phases prior to leaching					Detection limit	
	Oxide [mass-%]										Oxide [mass-%]					Oxide [mass-%]					Oxide [mass-%]						
	an1	an2	an3	an4	an5	an6	an7	an8	an9	an10	an11	an12	an13	an14	an15	an1	an2	an3	an4	an5	an6	an7	an8	an9	an10		
SiO ₂	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	27.7	28.3	27.8	26.8	28.7	33.7	33.3	33.0	32.2	33.4		
Al ₂ O ₃	0.235	0.298	0.229	0.328	0.256	0.208	0.267	0.252	0.156	0.245	21.1	19.9	27.3	22.8	23.6	23.9	24.7	24.5	25.8	23.0	0.0630	0.0690	0.0850	0.132	0.0880		
Cr ₂ O ₃	1.21	1.13	1.40	1.07	0.814	1.01	1.11	1.06	0.449	0.554	38.8	42.9	34.6	37.8	38.3	0.0790	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		
V ₂ O ₃	bdl	bdl	0.0560	0.0860	0.0560	0.0670	0.146	bdl	0.0490	0.0760	0.191	0.170	0.289	0.111	0.130	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0460	bdl	0.0490		
FeO*	85.9	87.1	85.9	85.9	85.1	86.1	85.5	87.2	87.8	87.2	25.2	22.6	21.5	25.0	24.2	5.65	5.27	5.51	5.03	5.60	20.0	20.0	20.0	19.3	20.6		
MnO	9.05	8.22	8.74	9.31	8.88	8.55	8.87	8.88	8.91	8.89	4.00	3.89	4.32	3.92	3.82	0.755	0.713	0.729	0.572	0.674	5.87	5.90	5.91	5.92	5.90		
MgO	5.59	5.58	6.76	5.77	5.94	5.31	5.92	5.40	4.95	4.65	10.8	10.6	11.8	10.8	11.6	2.56	2.48	2.43	1.94	3.15	5.56	5.33	5.09	4.89	5.61		
CaO	0.171	0.276	0.302	0.283	0.384	0.308	0.330	0.324	0.782	0.596	0.443	0.398	0.747	0.445	0.377	39.1	39.3	39.1	39.5	39.2	36.3	36.6	37.3	36.2	36.7		
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.804	0.792	0.843	0.555	0.762	bdl	bdl	bdl	bdl	bdl	0.269	bdl	bdl	0.188	bdl		
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0720	0.0860	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		
Total	102.2	102.8	103.5	102.7	101.5	101.7	102.1	103.2	103.1	102.4	101.0	100.9	101.0	101.2	102.6	99.7	100.7	100.1	99.7	100.3	101.9	101.2	101.5	98.8	102.4		
	Element [mass-%]										Element [mass-%]					Element [mass-%]					Element [mass-%]					mass-%	
Si	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	12.9	13.2	13.0	12.5	13.4	15.8	15.6	15.4	15.0	15.6	0.0262	
Al	0.124	0.158	0.121	0.174	0.135	0.110	0.141	0.133	0.0826	0.130	11.2	10.5	14.4	12.1	12.5	12.6	13.1	13.0	13.7	12.2	0.0333	0.0365	0.0450	0.0699	0.0466	0.0121	
Cr	0.826	0.770	0.955	0.731	0.557	0.693	0.756	0.723	0.307	0.379	26.6	29.3	23.7	25.9	26.2	0.0541	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0362	
V	bdl	bdl	0.0381	0.0585	0.0381	0.0455	0.0992	bdl	0.0333	0.0517	0.130	0.116	0.196	0.0755	0.0884	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0313	bdl	0.0333	0.0295	
Fe	66.8	67.7	66.8	66.7	66.1	66.9	66.4	67.8	68.2	67.8	19.6	17.6	16.7	19.4	18.8	4.39	4.09	4.28	3.91	4.36	15.6	15.5	15.5	15.0	16.0	0.0464	
Mn	7.01	6.37	6.77	7.21	6.88	6.62	6.87	6.88	6.90	6.88	3.10	3.01	3.34	3.04	2.96	0.585	0.552	0.565	0.443	0.522	4.54	4.57	4.57	4.58	4.57	0.0202	
Mg	3.37	3.36	4.08	3.48	3.58	3.20	3.57	3.26	2.98	2.80	6.53	6.41	7.13	6.52	6.98	1.55	1.49	1.47	1.17	1.90	3.35	3.21	3.07	2.95	3.38	0.0163	
Ca	0.122	0.197	0.216	0.202	0.274	0.220	0.236	0.232	0.559	0.426	0.317	0.284	0.534	0.318	0.269	27.9	28.1	27.9	28.2	28.0	26.0	26.2	26.7	25.9	26.3	0.0176	
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.804	0.792	0.843	0.555	0.762	bdl	bdl	bdl	bdl	bdl	0.269	bdl	bdl	0.188	bdl	0.167	
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0480	0.0573	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0375	
O (calculated)	23.9	24.1	24.5	24.1	23.9	23.7	24.0	24.1	24.0	23.8	32.9	32.9	34.2	33.4	33.9	39.6	40.2	39.9	39.7	40.0	36.3	36.1	36.1	35.0	36.5		
Total	102.2	102.8	103.5	102.7	101.5	101.7	102.1	103.2	103.1	102.4	101.0	100.9	101.0	101.2	102.6	99.7	100.7	100.1	99.7	100.3	101.9	101.2	101.5	98.8	102.4		
	Cations based on 1 O										Cations based on 4 O					Cations based on 7 O					Cations based on 4 O						
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	1.31	1.30	1.26	1.34	0.99	0.98	0.97	0.98	0.98		
Al	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.76	1.00	0.86	0.87	1.32	1.35	1.35	1.43	1.26	0.00	0.00	0.00	0.00	0.00		
Cr	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.10	0.85	0.95	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Fe	0.80	0.81	0.78	0.79	0.79	0.80	0.79	0.80	0.82	0.82	0.68	0.61	0.56	0.67	0.63	0.22	0.20	0.22	0.20	0.22	0.49	0.49	0.49	0.49	0.50		
Mn	0.09	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.11	0.11	0.11	0.11	0.10	0.03	0.03	0.03	0.02	0.03	0.15	0.15	0.15	0.15	0.15		
Mg	0.09	0.09	0.11	0.09	0.10	0.09	0.10	0.09	0.08	0.08	0.52	0.51	0.55	0.52	0.54	0.18	0.17	0.17	0.14	0.22	0.24	0.23	0.22	0.22	0.24		
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.01	1.97	1.95	1.96	1.99	1.96	1.14	1.16	1.18	1.18	1.15		
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Sum cations	0.99	0.98	0.98	0.98	0.99	0.98	0.98	0.98	0.99	0.99	3.14	3.11	3.11	3.12	3.12	5.03	5.01	5.02	5.03	5.03	3.02	3.02	3.03	3.03	3.03	3.02	

*all Fe as FeO.

Table S2. Sample EAFS1 after leaching.

	Wuestite phases after leaching											Spinel phases after leaching				Meliilite phases after leaching												Olivine phases after leaching					Detection
	Oxide [mass-%]											Oxide [mass-%]				Oxide [mass-%]												Oxide [mass-%]					limit
	an13	an14	an15	an16	an17	an18	an19	an20	an21	an22		an25	an29	an30	an31	an3	an4	an5	an6	an7	an8	an9	an10	an11	an12		an23	an24	an26	an27	an28		
SiO ₂	bdl	bdl	bdl	bdl	bdl	0.0830	bdl	bdl	bdl	bdl		0.107	bdl	0.0970	bdl	31.2	7.58	28.0	7.06	33.5	8.4	31.1	30.5	31.4	29.1		32.3	31.9	33.3	33.5	32.3		
Al ₂ O ₃	0.0540	0.108	0.135	0.0700	0.123	0.0950	0.103	0.0810	0.132	0.124		21.5	20.5	22.7	22.7	19.2	22.9	23.1	20.7	14.7	19.7	19.2	20.1	17.5	22.5		0.0420	0.0410	bdl	0.0420	0.0490		
Cr ₂ O ₃	1.50	0.879	1.19	0.791	0.597	1.41	1.42	1.09	0.958	0.992		27.8	39.3	38.2	36.3	0.080	0.097	bdl	0.0810	0.164	0.0830	0.127	0.0830	0.170	0.132		bdl	0.0530	0.124	0.121	bdl		
V ₂ O ₅	0.100	bdl	0.106	0.106	0.186	0.272	bdl	0.243	0.117	bdl	0.147	0.189	0.191	0.262	0.185	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		bdl	bdl	bdl	bdl	bdl		
FeO*	84.3	84.1	84.3	86.9	87.8	83.9	83.7	83.7	84.8	86.0		33.2	25.5	24.3	26.2	5.57	4.99	5.37	11.35	5.84	5.35	5.53	5.02	5.59	4.79		21.1	20.7	20.1	19.6	20.2		
MnO	8.68	8.86	8.79	8.57	8.23	8.81	8.82	8.76	8.75	8.82		4.46	3.82	3.63	3.71	0.849	0.726	0.759	1.37	0.920	0.755	0.765	0.681	0.849	0.608		5.40	5.30	4.96	5.16	5.06		
MgO	6.50	5.93	6.11	5.46	4.68	7.02	6.90	6.15	5.83	5.63		11.9	10.3	10.8	10.5	3.69	3.01	2.22	2.93	4.91	3.95	3.85	3.57	4.19	2.91		4.91	5.33	7.48	7.00	5.49		
CaO	0.235	0.360	0.269	0.323	0.456	0.185	0.289	0.288	0.316	0.300		0.675	0.457	0.223	0.390	39.3	40.0	40.0	36.0	39.2	39.1	39.6	39.4	39.2	39.7		36.3	35.8	36.0	36.2	36.8		
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		0.356	0.680	1.14	1.12	bdl	bdl	0.341	bdl	bdl	bdl	bdl	0.201	bdl	bdl		bdl	0.559	bdl	bdl	bdl		
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0870	0.0930	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		bdl	bdl	bdl	bdl	bdl		
Total	101.4	100.4	101.0	102.3	102.3	101.5	101.6	100.2	101.1	102.2		100.1	100.5	100.8	100.6	100.0	79.4	99.7	79.6	99.2	77.4	100.2	99.5	99.0	99.9		100.0	99.7	102.0	101.8	100.0		
	Element [mass-%]											Element [mass-%]				Element [mass-%]												Element [mass-%]					mass-%
Si	bdl	bdl	bdl	bdl	0.0388	bdl	bdl	bdl	bdl	bdl		0.050	bdl	0.045	bdl	14.6	3.54	13.1	3.30	15.6	3.93	14.5	14.2	14.7	13.6		15.1	14.9	15.6	15.7	15.1	0.0356	
Al	0.0286	0.0572	0.0714	0.0370	0.0651	0.0503	0.0545	0.0429	0.0699	0.0656		11.4	10.8	12.0	12.0	10.2	12.1	12.2	10.9	7.76	10.4	10.2	10.6	9.27	11.9		0.0222	0.0217	bdl	0.0222	0.0259	0.0140	
Cr	1.03	0.601	0.813	0.541	0.408	0.966	0.969	0.743	0.655	0.679		19.0	26.9	26.1	24.8	0.0547	0.0664	bdl	0.0554	0.112	0.0568	0.0869	0.0568	0.116	0.0903		bdl	0.0363	0.0848	0.0828	bdl	0.0286	
V	0.0680	bdl	0.0721	0.126	0.185	bdl	0.165	0.0795	bdl	0.100		0.128	0.130	0.178	0.126	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		bdl	bdl	bdl	bdl	bdl	0.0530	
Fe	65.5	65.4	65.6	67.5	68.3	65.2	65.1	65.1	65.9	66.9		25.8	19.8	18.9	20.4	4.33	3.88	4.17	8.82	4.54	4.16	4.30	3.90	4.35	3.72		16.4	16.1	15.7	15.3	15.7	0.0439	
Mn	6.72	6.86	6.81	6.64	6.38	6.83	6.83	6.79	6.77	6.83		3.45	2.96	2.81	2.88	0.607	0.562	0.588	1.06	0.713	0.585	0.592	0.527	0.658	0.471		4.18	4.10	3.84	4.00	3.92	0.0289	
Mg	3.92	3.58	3.69	3.29	2.82	4.24	4.16	3.71	3.52	3.40		7.20	6.19	6.50	6.32	2.22	1.81	1.34	1.77	2.96	2.38	2.32	2.15	2.52	1.76		2.96	3.22	4.51	4.22	3.31	0.0121	
Ca	0.168	0.257	0.192	0.231	0.326	0.132	0.207	0.206	0.226	0.214		0.482	0.327	0.159	0.279	28.1	28.6	28.6	25.7	28.0	27.9	28.3	28.2	28.0	28.4		25.9	25.6	25.7	25.9	26.3	0.0118	
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		0.356	0.680	1.14	1.12	bdl	bdl	0.341	bdl	bdl	bdl	bdl	0.201	bdl	bdl		bdl	0.559	bdl	bdl	bdl	0.176	
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0580	0.0620	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		bdl	bdl	bdl	bdl	bdl	0.0552	
O (calculated)	23.9	23.6	23.7	23.9	23.8	24.0	24.0	23.6	23.7	23.9		32.2	32.6	32.9	32.7	39.7	28.8	39.3	27.8	39.4	27.9	39.9	39.6	39.3	39.9		35.4	34.9	36.6	36.6	35.5		
Total	101.4	100.4	101.0	102.3	102.3	101.5	101.6	100.2	101.1	102.2		100.1	100.5	100.8	100.6	100.0	79.4	99.7	79.6	99.2	77.4	100.2	99.5	99.0	99.9		100.0	99.5	102.0	101.8	100.0		
	Cations based on 1 O											Cations based on 4 O				Cations based on 7 O												Cations based on 4 O					
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	1.46	0.49	1.33	0.47	1.58	0.56	1.45	1.44	1.49	1.36		0.97	0.97	0.97	0.98	0.97		
Al	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.83	0.77	0.84	0.85	1.06	1.75	1.29	1.64	0.82	1.55	1.06	1.11	0.98	1.24		0.00	0.00	0.00	0.00	0.00		
Cr	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.72	1.00	0.95	0.91	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00		0.00	0.00	0.00	0.00	0.00		
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Fe	0.79	0.79	0.79	0.81	0.82	0.78	0.78	0.79	0.80	0.80		0.91	0.69	0.64	0.70	0.22	0.27	0.21	0.64	0.23	0.30	0.22	0.20	0.22	0.19		0.53	0.53	0.49	0.48	0.51		
Mn	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08		0.12	0.10	0.10	0.10	0.03	0.04	0.03	0.08	0.04	0.04	0.03	0.03	0.03	0.02		0.14	0.14	0.12	0.13	0.13		
Mg	0.11	0.10	0.10	0.09	0.08	0.12	0.11	0.10	0.10	0.09		0.58	0.49	0.51	0.50	0.26	0.29	0.16	0.29	0.35	0.39	0.27	0.25	0.30	0.20		0.22	0.24	0.32	0.30	0.25		
Ca	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		0.02	0.02	0.01	0.01	1.98	2.78	2.03	2.59	1.98	2.80	1.98	1.99	1.99	1.99		1.17	1.17	1.12	1.13	1.18		
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Sum cations	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	1.00	0.99		3.20	3.07	3.04	3.06	5.01	5.63	5.05	5.71	5.01	5.66	5.02	5.02	5.02	5.02		3.03	3.05	3.03	3.02	3.03		

*all Fe as FeO.

Table S3. Sample EAFS2_1 prior to leaching.

	Wuestite phases prior to leaching									Spinel phases prior to leaching					Olivine phases prior to leaching										Detection limit
	Oxide [mass-%]									Oxide [mass-%]					Oxide [mass-%]										
	an1	an2	an3	an4	an5	an7	an8	an9	an10	an11	an12	an13	an14	an15	an1	an2	an3	an4	an5	an6	an7	an8	an9	an10	
SiO ₂	bdl	bdl	bdl	bdl	bdl	0.227	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	34.6	33.5	33.5	33.7	33.7	34.9	33.8	34.3	32.6	33.5	
Al ₂ O ₃	0.964	0.304	0.278	0.354	0.227	0.295	0.458	0.961	0.229	7.96	6.37	8.84	6.48	7.23	0.183	0.108	0.159	0.0740	0.157	0.157	0.0740	0.102	1.353	0.165	
Cr ₂ O ₃	2.79	2.44	2.17	2.03	1.23	2.16	2.63	2.61	2.16	58.6	61.7	55.2	62.6	60.1	bdl	bdl	bdl	bdl	bdl	0.0750	bdl	0.0690	bdl	bdl	
V ₂ O ₃	0.0710	bdl	bdl	bdl	bdl	bdl	0.0830	0.0710	bdl	0.205	0.131	0.113	0.0680	0.218	bdl	0.0970	0.0610	0.107	0.136	0.0810	0.100	0.0690	bdl	0.155	
FeO*	65.2	66.5	67.4	67.2	68.6	67.0	65.7	65.7	67.8	14.2	14.4	15.8	13.3	14.2	2.22	0.636	1.04	0.600	1.24	2.23	0.789	2.13	2.55	0.902	
MnO	20.0	18.6	19.8	19.5	19.9	19.4	19.4	20.1	18.9	7.94	7.90	8.38	7.83	7.87	1.64	0.607	0.918	0.403	1.31	1.54	0.526	1.59	1.62	0.775	
MgO	15.2	15.1	15.3	14.8	15.7	12.4	16.8	15.5	16.0	11.3	10.9	13.0	11.1	11.2	4.46	0.105	0.932	0.0580	1.03	4.47	0.110	4.59	2.85	0.752	
CaO	0.652	1.12	0.789	0.820	0.828	0.949	0.714	0.769	0.893	0.886	1.30	1.49	1.08	0.768	57.3	63.9	61.6	63.1	61.6	57.0	63.6	57.2	56.1	62.1	
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	1.29	1.40	1.28	1.29	0.725	bdl	bdl	0.299	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
Total	105.0	104.1	105.8	104.8	106.7	102.5	105.7	105.8	106.0	101.8	103.5	103.6	103.2	102.1	100.4	99.0	98.3	98.1	99.3	100.5	99.0	100.0	97.2	98.3	
	Element [mass-%]									Element [mass-%]					Element [mass-%]										mass-%
Si	bdl	bdl	bdl	bdl	bdl	0.106	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	16.2	15.7	15.6	15.8	15.8	16.3	15.8	16.0	15.2	15.7	0.0256
Al	0.510	0.161	0.147	0.187	0.120	0.156	0.242	0.509	0.121	4.21	3.37	4.68	3.43	3.82	0.0969	0.0572	0.0842	0.0392	0.0831	0.0831	0.0392	0.0540	0.716	0.0873	0.0147
Cr	1.91	1.67	1.48	1.39	0.838	1.48	1.80	1.78	1.48	40.1	42.2	37.8	42.8	41.1	bdl	bdl	bdl	bdl	bdl	0.0513	bdl	0.0472	bdl	bdl	0.0372
V	0.0483	bdl	bdl	bdl	bdl	bdl	0.0564	0.0483	bdl	0.139	0.0890	0.0768	0.0462	0.148	bdl	0.0659	0.0415	0.0727	0.0924	0.0551	0.0680	0.0469	bdl	0.105	0.0325
Fe	50.7	51.7	52.4	52.2	53.4	52.1	51.1	51.0	52.7	11.0	11.2	12.3	10.4	11.1	1.72	0.494	0.805	0.466	0.962	1.73	0.613	1.65	1.98	0.701	0.0491
Mn	15.5	14.4	15.3	15.1	15.4	15.0	15.0	15.6	14.7	6.15	6.12	6.49	6.07	6.10	1.27	0.470	0.711	0.312	1.02	1.19	0.407	1.23	1.25	0.600	0.0220
Mg	9.19	9.08	9.21	8.90	9.49	7.47	10.1	9.37	9.66	6.79	6.56	7.81	6.68	6.76	2.69	0.0633	0.562	0.0350	0.622	2.69	0.066	2.77	1.72	0.453	0.0217
Ca	0.466	0.799	0.564	0.586	0.592	0.678	0.510	0.550	0.638	0.633	0.927	1.06	0.769	0.549	40.9	45.7	44.0	45.1	44.1	40.7	45.4	40.8	40.1	44.4	0.0205
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	1.29	1.40	1.28	1.29	0.725	bdl	bdl	0.299	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.172
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0490
O (calculated)	26.7	26.2	26.6	26.2	26.8	25.4	26.9	26.9	26.8	31.5	31.6	32.1	31.8	31.8	37.5	36.5	36.2	36.3	36.7	37.5	36.6	37.3	36.0	36.4	
Total	105.0	104.1	105.8	104.8	106.7	102.5	105.7	105.8	106.0	101.8	103.5	103.6	103.2	102.1	100.4	99.0	98.3	98.1	99.3	100.5	99.0	100.0	97.2	98.3	
	Cations based on 1 O									Cations based on 4 O					Cations based on 4 O										
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.98	0.99	0.99	0.98	0.99	0.98	0.98	0.96	0.98	
Al	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.32	0.25	0.35	0.26	0.29	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.05	0.01	
Cr	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	1.57	1.64	1.45	1.66	1.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fe	0.54	0.56	0.56	0.57	0.57	0.59	0.54	0.54	0.56	0.40	0.41	0.44	0.37	0.40	0.05	0.02	0.03	0.01	0.03	0.05	0.02	0.05	0.06	0.02	
Mn	0.17	0.16	0.17	0.17	0.17	0.17	0.16	0.17	0.16	0.23	0.23	0.24	0.22	0.22	0.04	0.02	0.02	0.01	0.03	0.04	0.01	0.04	0.04	0.02	
Mg	0.23	0.23	0.23	0.22	0.23	0.19	0.25	0.23	0.24	0.57	0.55	0.64	0.55	0.56	0.19	0.00	0.04	0.00	0.04	0.19	0.00	0.20	0.13	0.03	
Ca	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.05	0.05	0.04	0.03	1.74	2.00	1.94	1.99	1.92	1.73	1.98	1.75	1.78	1.95	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.99	3.12	3.12	3.17	3.11	3.10	3.01	3.02	3.02	3.01	3.02	3.01	3.01	3.02	3.02	3.01	

*all Fe as FeO.

Table S4. Sample EAFS2_1 after leaching.

	Wuestite phases after leaching														Spinel phases after leaching												Detection limit
	Oxide [mass-%]														Oxide [mass-%]												
	C1_an14	C1_an15	C1_an16	C1_an17	C1_an18	C2_an18	C2_an19	C2_an21	C2_an22	C2_an23	C2_an24	C2_an25	C2_an26	C2_an27	C1_an1	C1_an2	C1_an3	C1_an4	C1_an5	C1_an6	C2_an1	C2_an3	C2_an5	C2_an6	C2_an7	C2_an8	
SiO ₂	0.0740	bdl	bdl	bdl	bdl	0.125	bdl	0.0840	bdl	bdl	bdl	0.0670	bdl	bdl	0.120	bdl	bdl	bdl	0.0810	0.0680	bdl	bdl	bdl	bdl	bdl	bdl	
Al ₂ O ₃	0.2960	0.3760	0.4090	0.2110	0.5400	0.1080	0.1290	0.1150	0.1160	0.0950	0.0890	0.0950	0.0840	0.0990	7.13	12.05	7.55	14.11	7.32	5.02	8.35	5.58	7.36	7.84	7.28	7.10	
Cr ₂ O ₃	1.11	1.67	2.61	3.22	2.66	1.75	2.40	1.47	2.36	2.07	2.42	0.8880	2.55	2.21	60.0	54.2	59.8	52.7	60.1	62.6	59.1	63.5	59.8	59.1	59.4	60.9	
V ₂ O ₃	0.0680	bdl	bdl	bdl	bdl	bdl	bdl	0.0630	bdl	0.0680	0.0520	0.0610	bdl	0.0460	0.0690	0.131	0.135	0.100	0.122	0.0480	0.147	0.0710	0.124	0.0940	0.0710	0.109	
FeO*	67.7	67.6	67.4	66.7	66.0	67.9	66.5	69.2	68.1	68.3	67.0	70.6	69.1	67.9	14.3	19.0	14.9	13.0	14.9	14.3	14.3	14.1	14.3	15.6	15.0	14.2	
MnO	19.2	19.1	18.3	18.8	19.2	19.1	19.4	19.5	18.5	20.3	18.4	19.9	18.6	19.1	7.87	5.91	7.61	7.02	7.79	7.83	7.56	7.64	7.67	7.61	7.62	7.45	
MgO	12.7	12.1	13.7	13.5	13.6	13.4	12.9	11.0	13.2	13.0	12.8	10.7	13.4	13.0	10.5	8.8	10.7	12.4	10.4	10.5	10.9	10.4	11.0	9.9	10.9	10.9	
CaO	0.657	0.612	0.569	0.514	0.514	0.517	0.376	0.485	0.495	0.357	0.453	0.577	0.461	0.449	0.472	0.481	0.596	0.540	0.551	0.621	0.464	0.636	0.532	0.467	0.431	0.553	
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	1.65	1.34	1.80	1.43	1.06	1.81	1.44	1.26	1.69	1.86	1.57	1.81	
MoO ₃	bdl	bdl	0.103	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.150	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
Total	101.8	101.6	103.1	103.0	102.6	102.9	101.7	101.9	102.8	104.4	101.2	103.0	104.3	102.9	101.4	101.3	102.3	100.7	101.9	102.1	101.7	102.7	101.8	101.7	101.7	102.2	
	Element [mass-%]														Element [mass-%]												mass-%
Si	0.0346	bdl	bdl	bdl	bdl	0.0584	bdl	0.0393	bdl	bdl	bdl	0.0313	bdl	bdl	0.056	bdl	bdl	bdl	0.038	0.032	bdl	bdl	bdl	bdl	bdl	bdl	0.0262
Al	0.157	0.199	0.216	0.112	0.286	0.0572	0.0683	0.0609	0.0614	0.0503	0.0471	0.0503	0.0445	0.0524	3.78	6.38	3.99	7.47	3.88	2.66	4.42	2.95	3.90	4.15	3.85	3.76	0.0114
Cr	0.759	1.14	1.78	2.20	1.82	1.20	1.64	1.01	1.61	1.42	1.66	0.608	1.75	1.51	41.0	37.0	40.9	36.1	41.1	42.8	40.4	43.4	40.9	40.4	40.7	41.7	0.0285
V	0.0462	bdl	bdl	bdl	bdl	bdl	bdl	0.0428	bdl	0.0462	0.0353	0.0415	bdl	0.0313	0.0469	0.0890	0.0918	0.0680	0.0829	0.0326	0.100	0.0483	0.0843	0.0639	0.0483	0.0741	0.0272
Fe	52.6	52.6	52.4	51.8	51.3	52.8	51.7	53.8	53.0	53.1	52.1	54.9	53.7	52.8	11.1	14.7	11.6	10.1	11.6	11.1	11.1	11.0	11.1	12.2	11.7	11.0	0.0404
Mn	14.9	14.8	14.1	14.5	14.9	14.8	15.0	15.1	14.3	15.7	14.3	15.4	14.4	14.8	6.09	4.57	5.90	5.44	6.03	6.07	5.86	5.92	5.94	5.90	5.90	5.77	0.0285
Mg	7.63	7.33	8.28	8.16	8.22	8.06	7.77	6.62	7.95	7.85	7.71	6.43	8.11	7.86	6.32	5.32	6.44	7.48	6.28	6.33	6.60	6.27	6.62	5.97	6.56	6.55	0.0135
Ca	0.470	0.437	0.407	0.367	0.367	0.369	0.269	0.347	0.354	0.255	0.324	0.412	0.329	0.321	0.337	0.344	0.426	0.386	0.394	0.444	0.332	0.455	0.380	0.334	0.308	0.395	0.0118
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	1.65	1.34	1.80	1.43	1.06	1.81	1.44	1.26	1.69	1.86	1.57	1.81	0.167
Mo	bdl	bdl	0.069	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.100	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0465
O (calculated)	25.2	25.1	25.8	25.7	25.6	25.6	25.2	24.8	25.5	25.7	25.1	25.0	25.9	25.5	30.9	31.5	31.2	32.3	31.4	30.7	31.4	31.3	31.1	30.9	31.1	31.2	
Total	101.8	101.6	103.1	103.0	102.6	102.9	101.7	101.9	102.8	104.4	101.2	103.0	104.3	102.9	101.4	101.3	102.3	100.7	101.9	102.1	101.7	102.7	101.8	101.7	101.7	102.2	
	Cations based on 1 O														Cations based on 4 O												
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Al	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.46	0.29	0.53	0.28	0.20	0.32	0.22	0.28	0.30	0.28	0.27	
Cr	0.01	0.01	0.02	0.03	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.01	0.02	0.02	1.56	1.40	1.54	1.32	1.57	1.63	1.53	1.65	1.55	1.53	1.54	1.57	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fe	0.60	0.60	0.58	0.58	0.57	0.59	0.59	0.62	0.59	0.59	0.59	0.63	0.59	0.59	0.39	0.52	0.41	0.34	0.41	0.40	0.39	0.39	0.39	0.43	0.41	0.39	
Mn	0.17	0.17	0.16	0.16	0.17	0.17	0.17	0.18	0.16	0.18	0.17	0.18	0.16	0.17	0.22	0.16	0.21	0.19	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.21	
Mg	0.20	0.19	0.21	0.21	0.21	0.21	0.20	0.18	0.21	0.20	0.20	0.17	0.21	0.20	0.51	0.43	0.52	0.59	0.51	0.52	0.53	0.51	0.54	0.48	0.53	0.53	
Ca	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	2.99	3.00	2.99	3.00	3.02	2.99	3.00	3.00	2.99	2.98	3.00	2.98	

*all Fe as FeO.

Table S5. Sample EAFS2_2 prior to leaching.

	Wuestite phases prior to leaching										Mellilite phases prior to leaching							Olivine phases prior to leaching						Detection
	Oxide [mass-%]										Oxide [mass-%]							Oxide [mass-%]						limit
	an1	an2	an3	an4	an5	an6	an7	an8	an9	an10	an2	an3	an4	an5	an6	an7		an8	an9	an10	an11	an12	an13	
SiO ₂	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	25.6	24.9	25.9	24.8	26.2	25.9		34.0	34.4	34.8	35.1	34.4	33.8	
Al ₂ O ₃	0.221	0.234	0.178	0.295	0.334	0.272	0.176	0.182	0.144	0.238	29.0	31.4	29.8	31.4	29.6	29.0		0.0900	0.0810	0.0880	0.125	0.0850	0.0750	
Cr ₂ O ₃	1.23	1.47	1.35	1.49	1.75	1.39	1.62	1.41	1.00	1.39	bdl	bdl	bdl	bdl	bdl	bdl		bdl	bdl	bdl	bdl	bdl	bdl	
V ₂ O ₃	0.0670	0.174	0.121	0.0900	0.138	0.186	0.0790	0.0710	0.146	0.202	bdl	0.0450	bdl	bdl	bdl	bdl		bdl	bdl	bdl	bdl	bdl	bdl	
FeO*	69.7	68.9	72.0	67.3	67.6	69.2	68.8	71.2	69.2	69.3	3.60	2.70	2.34	2.68	2.56	3.05		3.07	3.26	3.18	3.14	3.18	3.08	
MnO	18.9	18.7	18.4	19.4	19.3	18.6	18.5	18.6	19.3	18.8	0.894	0.650	0.684	0.649	0.656	0.805		2.15	2.08	2.15	2.05	2.19	2.14	
MgO	8.44	7.98	6.53	8.44	8.17	8.25	8.99	7.80	7.48	7.76	1.98	1.46	1.87	1.43	1.89	1.99		3.95	3.76	3.93	3.97	3.77	3.98	
CaO	0.307	0.335	0.386	0.441	0.377	0.413	0.343	0.419	0.657	0.621	39.3	39.6	39.5	39.6	39.8	39.5		55.3	55.0	55.6	55.3	54.0	54.9	
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.416	bdl	0.257	bdl	bdl	bdl		bdl	bdl	0.502	0.252	bdl	bdl	
MoO ₃	bdl	bdl	bdl	bdl	bdl	0.0770	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		bdl	0.078	bdl	bdl	bdl	bdl	
Total	99.0	97.9	99.0	97.6	98.3	98.6	99.7	97.9	98.3		100.9	100.8	100.4	100.7	100.9	100.3		98.6	98.6	100.0	99.9	97.7	98.1	
	Element [mass-%]										Element [mass-%]							Element [mass-%]						mass-%
Si	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	12.0	11.7	12.1	11.6	12.3	12.1		15.9	16.1	16.2	16.4	16.1	15.8	0.0290
Al	0.117	0.124	0.0942	0.156	0.177	0.144	0.0931	0.0963	0.0762	0.126	15.3	16.6	15.8	16.6	15.7	15.3		0.0476	0.0429	0.0466	0.0662	0.0450	0.0397	0.0140
Cr	0.844	1.00	0.923	1.02	1.19	0.948	1.11	0.962	0.686	0.952	bdl	bdl	bdl	bdl	bdl	bdl		bdl	bdl	bdl	bdl	bdl	bdl	0.0327
V	0.0455	0.118	0.0823	0.0612	0.0938	0.126	0.0537	0.0483	0.0992	0.137	bdl	0.0306	bdl	bdl	bdl	bdl		bdl	bdl	bdl	bdl	bdl	bdl	0.0271
Fe	54.2	53.6	55.9	52.3	52.6	53.8	53.5	55.3	53.8	53.9	2.79	2.10	1.82	2.08	1.99	2.37		2.39	2.53	2.47	2.44	2.47	2.39	0.0402
Mn	14.6	14.5	14.3	15.1	14.9	14.4	14.3	14.4	14.9	14.5	0.692	0.503	0.530	0.503	0.508	0.623		1.67	1.61	1.66	1.58	1.70	1.66	0.0192
Mg	5.09	4.81	3.94	5.09	4.93	4.97	5.42	4.70	4.51	4.68	1.19	0.882	1.13	0.860	1.14	1.20		2.38	2.27	2.37	2.40	2.27	2.40	0.0126
Ca	0.219	0.239	0.276	0.315	0.269	0.295	0.245	0.299	0.470	0.444	28.1	28.3	28.2	28.3	28.5	28.2		39.5	39.3	39.7	39.5	38.6	39.2	0.0119
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.416	bdl	0.257	bdl	bdl	bdl		bdl	bdl	0.502	0.252	bdl	bdl	
Mo	bdl	bdl	bdl	bdl	bdl	0.0513	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl		bdl	0.0520	bdl	bdl	bdl	bdl	0.0376
O (calculated)	23.8	23.5	23.4	23.5	23.6	23.6	23.7	23.8	23.4	23.5	40.1	40.7	40.4	40.5	40.7	40.4		36.7	36.8	37.0	37.2	36.5	36.4	
Total	99.0	97.9	99.0	97.6	97.8	98.3	98.6	99.7	97.9	98.3	100.9	100.8	100.4	100.7	100.9	100.3		98.6	98.6	100.0	99.9	97.7	98.1	
	Cations based on 1 O										Cations based on 7 O							Cations based on 4 O						
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.19	1.14	1.20	1.14	1.20	1.19		0.99	1.00	1.00	1.01	1.01	0.99	
Al	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.59	1.69	1.62	1.70	1.60	1.58		0.00	0.00	0.00	0.00	0.00	0.00	
Cr	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	
Fe	0.65	0.65	0.68	0.64	0.64	0.65	0.65	0.67	0.66	0.66	0.14	0.10	0.09	0.10	0.10	0.12		0.07	0.08	0.08	0.08	0.08	0.08	
Mn	0.18	0.18	0.18	0.19	0.18	0.18	0.18	0.18	0.19	0.18	0.04	0.03	0.03	0.03	0.03	0.03		0.05	0.05	0.05	0.05	0.05	0.05	
Mg	0.14	0.13	0.11	0.14	0.14	0.14	0.15	0.13	0.13	0.13	0.14	0.10	0.13	0.10	0.13	0.14		0.17	0.16	0.17	0.17	0.16	0.17	
Ca	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	1.96	1.94	1.95	1.95	1.96	1.96		1.72	1.71	1.72	1.70	1.69	1.72	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	5.05	5.01	5.01	5.02	5.01	5.02		3.01	3.00	3.02	3.00	3.00	3.01	

*all Fe as FeO.

Table S6. Sample EAFS2_2 after leaching.

	Wuestite phases after leaching								Spinel phases after leaching						Melilite phases after leaching				Detection
	Oxide [mass-%]								Oxide [mass-%]						Oxide [mass-%]				limit
	an2	an18	an19	an20	an21	an22	an23	an24	an9	an12	an13	an14	an15	an16	an1	an4	an5	an8	
SiO ₂	bdl	bdl	bdl	bdl	0.067	bdl	bdl	bdl	bdl	bdl	bdl	0.0610	bdl	0.118	7.15	6.80	7.33	7.47	
Al ₂ O ₃	0.0500	0.0830	0.0740	0.0960	0.0880	0.0840	0.0760	0.0880	9.86	6.91	6.54	5.69	5.49	11.2	26.8	27.4	27.7	27.2	
Cr ₂ O ₃	1.75	2.13	0.970	1.29	1.42	1.08	1.02	1.54	52.7	57.5	58.7	58.1	60.1	51.9	0.0760	0.0930	0.0590	0.0670	
V ₂ O ₃	0.0840	0.0690	0.0910	0.0820	0.117	0.107	0.136	0.0780	0.137	0.0920	0.0900	0.136	0.0640	0.206	bdl	bdl	bdl	bdl	
FeO*	70.9	70.2	70.3	71.7	74.5	71.8	73.6	70.1	19.0	18.3	16.8	17.5	16.4	17.9	2.81	6.98	2.94	2.41	
MnO	19.2	19.6	19.7	20.1	17.2	20.2	20.4	19.9	8.23	8.31	8.10	7.93	8.71	8.42	0.748	2.10	0.670	0.683	
MgO	10.3	11.1	11.2	10.9	8.35	9.70	9.69	10.8	8.87	8.71	9.09	9.51	8.50	8.92	1.73	1.89	1.52	1.61	
CaO	0.527	0.390	0.619	0.567	0.382	0.519	0.463	0.545	0.508	0.457	0.463	0.521	0.423	0.489	41.5	37.7	41.4	41.3	
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	1.63	1.54	1.47	1.44	1.70	1.31	bdl	bdl	bdl	0.275	
MoO ₃	0.117	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0900	bdl	bdl	
Total	103.0	103.6	103.0	104.8	102.1	103.5	105.4	103.2	100.3	101.2	100.7	100.3	100.7	99.9	80.9	83.0	81.6	80.9	
	Element [mass-%]								Element [mass-%]						Element [mass-%]				mass-%
Si	bdl	bdl	bdl	bdl	0.0313	bdl	bdl	bdl	bdl	bdl	bdl	0.0285	bdl	0.0552	3.34	3.18	3.43	3.49	0.0283
Al	0.0265	0.0439	0.0392	0.0508	0.0466	0.0445	0.0402	0.0466	5.22	3.66	3.46	3.01	2.91	5.94	14.2	14.5	14.6	14.4	0.0134
Cr	1.19	1.46	0.664	0.884	0.970	0.738	0.698	1.06	36.1	39.3	40.2	39.8	41.1	35.5	0.0520	0.0636	0.0404	0.0458	0.0290
V	0.0571	0.0469	0.0619	0.0557	0.0795	0.0727	0.0924	0.0530	0.0931	0.0625	0.0612	0.0924	0.0435	0.140	bdl	bdl	bdl	bdl	0.0251
Fe	55.1	54.5	54.6	55.7	57.9	55.8	57.2	54.5	14.8	14.2	13.1	13.6	12.8	13.9	2.18	5.42	2.28	1.88	0.0437
Mn	14.9	15.1	15.3	15.5	13.3	15.7	15.8	15.4	6.37	6.44	6.27	6.14	6.75	6.52	0.579	1.62	0.519	0.529	0.0292
Mg	6.22	6.72	6.76	6.59	5.03	5.85	5.84	6.53	5.35	5.25	5.48	5.73	5.13	5.38	1.04	1.14	0.914	0.972	0.0123
Ca	0.377	0.279	0.442	0.405	0.273	0.371	0.331	0.390	0.363	0.327	0.331	0.372	0.302	0.349	29.6	26.9	29.6	29.5	0.0116
F	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	1.63	1.54	1.47	1.44	1.70	1.31	bdl	bdl	bdl	0.275	0.169
Mo	0.078	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0600	bdl	bdl	0.0541
O (calculated)	25.0	25.3	25.1	25.5	24.5	24.9	25.4	25.1	30.4	30.3	30.4	30.1	30.0	30.8	29.7	30.1	30.1	29.8	
Total	103.0	103.6	103.0	104.8	102.1	103.5	105.4	103.2	100.3	101.2	100.7	100.3	100.7	99.9	80.9	83.0	81.6	80.9	
	Cations based on 1 O								Cations based on 4 O						Cations based on 7 O				
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.42	0.45	0.47	
Al	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.27	0.26	0.23	0.22	0.44	1.98	2.00	2.02	2.00	
Cr	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	1.40	1.53	1.56	1.56	1.61	1.37	0.00	0.00	0.00	0.00	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	
Fe	0.63	0.62	0.62	0.63	0.68	0.64	0.65	0.62	0.53	0.52	0.47	0.50	0.46	0.50	0.15	0.36	0.15	0.13	
Mn	0.17	0.17	0.18	0.18	0.16	0.18	0.18	0.18	0.23	0.24	0.23	0.23	0.25	0.24	0.04	0.11	0.04	0.04	
Mg	0.16	0.18	0.18	0.17	0.14	0.15	0.15	0.17	0.44	0.44	0.46	0.48	0.43	0.44	0.16	0.17	0.14	0.15	
Ca	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	2.79	2.50	2.75	2.77	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	0.99	0.99	0.99	0.99	0.99	1.00	0.99	0.99	3.02	3.01	3.01	3.02	2.99	3.02	5.57	5.57	5.55	5.56	

*all Fe as FeO.

Table S7. Sample EAFS2_A (oxides) prior to leaching.

	Wuestite phases prior to leaching												Spinel phases prior to leaching												Detection limit
	Oxide [mass-%]												Oxide [mass-%]												
	C1 an1	C1 an2	C1 an3	C1 an4	C1 an5	C2 an7	C2 an8	C2 an9	C2 an10	C2 an11	C2 an12	C1 an6	C1 an7	C1 an8	C1 an9	C1 an10	C1 an11	C1 an12	C2 an1	C2 an2	C2 an3	C2 an4	C2 an5	C2 an6	
SiO ₂	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.400	bdl	0.202	1.15	0.120	bdl	0.189	bdl	0.0830	bdl	bdl	0.0640	bdl	
Al ₂ O ₃	0.238	0.275	0.350	0.333	0.288	1.91	2.88	6.72	2.43	3.69	1.65	15.0	12.4	12.9	13.2	13.9	12.3	11.4	12.2	16.2	12.5	3.69	3.94	3.85	
Cr ₂ O ₃	0.956	1.17	0.770	0.821	0.860	3.55	7.23	6.84	5.88	9.43	4.14	46.2	49.5	46.3	41.4	48.2	49.7	49.6	49.3	45.4	50.6	61.7	60.0	60.8	
V ₂ O ₃	0.0610	0.0830	0.0820	0.0360	0.0900	0.162	0.139	0.139	0.0850	0.168	0.116	0.192	0.0660	0.0580	0.169	0.0880	0.0560	0.0690	0.0590	0.113	0.107	0.165	0.105	0.127	
FeO*	82.2	83.0	86.1	82.1	81.2	74.0	70.1	67.6	71.0	65.2	73.2	19.7	22.7	20.9	24.1	21.2	21.7	22.9	23.1	22.3	22.0	17.5	19.6	18.1	
MnO	8.31	7.91	7.49	8.15	7.86	10.8	10.8	9.48	11.5	11.2	11.5	5.55	4.30	4.10	4.39	4.18	4.25	4.31	4.31	4.25	4.32	5.42	5.70	5.55	
MgO	4.71	4.49	1.43	4.09	4.81	4.71	4.92	4.14	6.72	5.85	6.02	5.63	5.24	5.63	5.24	5.57	5.84	5.44	5.16	5.97	5.44	6.92	6.34	6.67	
CaO	0.613	0.650	0.655	0.534	0.387	0.730	0.729	0.792	0.543	0.551	0.648	1.15	0.471	0.587	1.30	0.586	0.567	1.29	0.480	0.470	0.504	0.902	0.901	1.32	
F	bdl	bdl	bdl	bdl	bdl	bdl	0.178	bdl	bdl	0.218	bdl	1.05	1.02	0.571	0.429	1.34	1.39	0.722	0.964	1.40	1.15	1.39	1.62	1.11	
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
Total	97.2	97.6	97.0	96.1	95.5	96.0	96.9	95.8	98.3	96.3	97.4	94.4	95.2	91.0	91.2	94.6	95.3	95.6	95.2	95.6	96.1	97.1	97.7	97.1	
	Element [mass-%]												Element [mass-%]												mass-%
Si	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.187	bdl	0.0944	0.535	0.0561	bdl	0.0883	bdl	0.0388	bdl	bdl	0.0299	bdl	0.0291
Al	0.126	0.146	0.185	0.176	0.152	1.01	1.52	3.55	1.28	1.95	0.872	7.94	6.54	6.83	7.00	7.37	6.51	6.05	6.45	8.60	6.60	1.95	2.09	2.04	0.0122
Cr	0.654	0.799	0.527	0.562	0.588	2.43	4.94	4.68	4.02	6.45	2.83	31.6	33.9	31.7	28.3	33.0	34.0	33.9	33.8	31.1	34.6	42.2	41.0	41.6	0.0294
V	0.0415	0.0564	0.0557	0.0245	0.0612	0.110	0.0945	0.0945	0.0578	0.114	0.0789	0.131	0.0449	0.0394	0.115	0.0598	0.0381	0.0469	0.0401	0.0768	0.0727	0.112	0.0714	0.0863	0.0227
Fe	63.9	64.5	66.9	63.8	63.1	57.5	54.5	52.5	55.2	50.7	56.9	15.3	17.6	16.3	18.8	16.5	16.9	17.8	17.9	17.3	17.1	13.6	15.3	14.1	0.0358
Mn	6.44	6.13	5.80	6.31	6.09	8.37	8.33	7.34	8.94	8.68	8.89	4.30	3.33	3.17	3.40	3.23	3.29	3.34	3.34	3.29	3.35	4.19	4.42	4.30	0.0177
Mg	2.84	2.71	0.86	2.46	2.90	2.84	2.97	2.49	4.05	3.53	3.63	3.39	3.16	3.39	3.16	3.36	3.52	3.28	3.11	3.60	3.28	4.17	3.82	4.02	0.0545
Ca	0.438	0.465	0.468	0.382	0.277	0.522	0.521	0.566	0.388	0.394	0.463	0.818	0.337	0.420	0.932	0.419	0.405	0.920	0.343	0.336	0.360	0.645	0.644	0.944	0.0186
F	bdl	bdl	bdl	bdl	bdl	bdl	0.178	bdl	bdl	0.218	bdl	1.05	1.02	0.571	0.429	1.34	1.39	0.72	0.96	1.40	1.15	1.39	1.62	1.11	0.169
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0368
O (calculated)	22.6	22.8	22.1	22.3	22.3	23.1	23.8	24.5	24.2	24.2	23.6	29.7	29.3	28.6	28.6	29.3	29.2	29.4	29.2	29.9	29.6	28.8	28.6	28.9	
Total	97.2	97.6	97.0	96.1	95.5	96.0	96.9	95.8	98.3	96.3	97.4	94.4	95.2	91.0	91.2	94.6	95.3	95.6	95.2	95.6	96.1	97.1	97.7	97.1	
	Cations based on 1 O												Cations based on 4 O												
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.09	0.03	0.05	0.02	0.63	0.53	0.57	0.58	0.60	0.53	0.49	0.52	0.68	0.53	0.16	0.17	0.17	
Cr	0.01	0.01	0.01	0.01	0.01	0.03	0.06	0.06	0.05	0.08	0.04	1.31	1.42	1.36	1.22	1.38	1.43	1.42	1.42	1.28	1.44	1.80	1.76	1.77	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fe	0.81	0.81	0.87	0.82	0.81	0.71	0.66	0.61	0.65	0.60	0.69	0.59	0.69	0.65	0.75	0.64	0.66	0.69	0.70	0.66	0.66	0.54	0.61	0.56	
Mn	0.08	0.08	0.08	0.08	0.08	0.11	0.10	0.09	0.11	0.10	0.11	0.17	0.13	0.13	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.17	0.18	0.17	
Mg	0.08	0.08	0.03	0.07	0.09	0.08	0.08	0.07	0.11	0.10	0.10	0.30	0.28	0.31	0.29	0.30	0.32	0.29	0.28	0.32	0.29	0.38	0.35	0.37	
Ca	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.02	0.02	0.05	0.02	0.02	0.05	0.02	0.02	0.02	0.04	0.04	0.05	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	1.00	0.99	0.99	0.99	0.99	0.97	0.95	0.93	0.96	0.94	0.97	3.07	3.08	3.06	3.08	3.08	3.10	3.08	3.08	3.09	3.08	3.10	3.12	3.09	

*all Fe as FeO.

Table S8. Sample EAFS2_A (calcium silicates) prior to leaching.

	Melilite phases prior to leaching										Olivine phases 1 prior to leaching													Olivine phases 2 prior to leaching			Detection limit	
	Oxide (mass-%)										Oxide (mass-%)													Oxide (mass-%)				
	C1_an1	C1_an2	C1_an3	C1_an4	C1_an5	C2_an6	C2_an7	C2_an8	C2_an9	C2_an10	C1_an6	C1_an7	C1_an8	C1_an9	C1_an10	C1_an11	C1_an12	C1_an13	C2_an1	C2_an2	C2_an3	C2_an4	C2_an5	C2_an11	C2_an12	C2_an13		
SiO ₂	32.3	32.1	28.8	29.8	32.1	30.5	29.5	29.0	29.5	29.9	33.0	33.3	33.9	32.9	33.2	33.3	34.2	34.8	34.5	34.4	33.6	34.0	34.4	34.0	34.2	34.0		
Al ₂ O ₃	17.9	18.6	22.7	22.4	18.6	21.4	23.2	24.0	22.6	22.1	0.0780	0.0670	0.0800	0.0520	0.0680	0.0620	0.0800	0.122	0.0900	0.0880	0.0780	0.0930	0.107	0.108	0.081	1.11		
Cr ₂ O ₃	0.0570	bdl	bdl	bdl	bdl	0.0490	bdl	0.0490	0.111	bdl	0.172	bdl	bdl	bdl	0.0730	0.227	bdl	bdl	bdl	bdl	0.105	0.0670	bdl	bdl	0.073	0.059		
V ₂ O ₃	bdl	bdl	bdl	bdl	0.052	bdl	bdl	bdl	bdl	bdl	0.0420	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0500	bdl	0.059	bdl		
FeO*	4.93	4.72	4.13	4.02	5.25	5.06	4.56	4.60	5.66	4.66	23.0	21.3	20.2	20.7	22.1	20.3	19.2	18.3	18.0	19.4	20.4	18.9	18.2	2.83	1.22	3.98		
MnO	0.833	0.711	0.635	0.609	0.896	0.821	0.682	0.714	0.956	0.735	6.55	5.96	5.44	5.62	5.85	5.59	4.95	4.95	5.55	5.65	6.36	5.92	5.42	1.01	0.337	1.41		
MgO	4.11	4.02	3.21	3.21	4.30	3.36	3.30	2.74	2.12	2.98	4.69	6.22	7.57	7.24	5.84	7.12	8.65	9.36	7.80	7.68	6.41	7.59	8.01	2.34	0.388	3.84		
CaO	35.8	36.1	36.7	37.5	37.3	37.1	37.6	37.4	36.4	36.5	31.2	31.7	32.6	32.9	32.2	32.3	32.2	33.2	34.0	33.5	33.1	34.0	33.9	55.7	59.8	52.6		
F	bdl	bdl	bdl	bdl	0.191	0.310	0.191	bdl	0.215	bdl	bdl	0.198	0.243	bdl	bdl	bdl	bdl	0.178	bdl	bdl	bdl	bdl	bdl	bdl	0.512	bdl		
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0560	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0660	bdl	bdl	bdl	bdl	0.0620	bdl	0.057	bdl		
Total	96.0	96.2	96.1	97.6	98.6	98.6	99.1	98.4	97.4	97.2	98.8	98.8	100.0	99.4	99.4	98.9	99.3	101.0	99.9	100.9	100.0	100.6	100.3	96.0	96.8	97.0		
	Element (mass-%)										Element (mass-%)													Element (mass-%)			mass-%	
Si	15.1	15.0	13.5	13.9	15.0	14.3	13.8	13.6	13.8	14.0	15.4	15.6	15.8	15.4	15.5	15.6	16.0	16.3	16.1	16.1	15.7	15.9	16.1	15.9	16.0	15.9	0.0291	
Al	9.50	9.83	12.0	11.9	9.86	11.3	12.3	12.7	11.9	11.7	0.0413	0.0355	0.0423	0.0275	0.0360	0.0328	0.0423	0.0646	0.0476	0.0466	0.0413	0.0492	0.0566	0.0572	0.0429	0.589	0.0122	
Cr	0.0390	bdl	bdl	bdl	bdl	0.0335	bdl	0.0335	0.0759	bdl	0.118	bdl	bdl	bdl	0.0499	0.155	bdl	bdl	bdl	bdl	0.0718	0.0458	bdl	bdl	0.0499	0.0404	0.0294	
V	bdl	bdl	bdl	bdl	0.0353	bdl	bdl	bdl	bdl	bdl	0.0285	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.034	bdl	0.0401	bdl	0.0227
Fe	3.83	3.67	3.21	3.12	4.08	3.93	3.54	3.57	4.40	3.62	17.9	16.5	15.7	16.1	17.2	15.8	14.9	14.3	14.0	15.1	15.8	14.7	14.2	2.20	0.946	3.09	0.0358	
Mn	0.645	0.551	0.492	0.472	0.694	0.636	0.528	0.553	0.740	0.569	5.07	4.61	4.21	4.35	4.53	4.33	3.83	3.83	4.30	4.37	4.92	4.58	4.20	0.783	0.261	1.09	0.0177	
Mg	2.48	2.42	1.93	1.94	2.60	2.03	1.99	1.58	1.28	1.79	2.83	3.75	4.56	4.37	3.52	4.30	5.22	5.65	4.71	4.63	3.86	4.58	4.83	1.41	0.234	2.32	0.0545	
Ca	25.6	25.8	26.2	26.8	26.6	26.5	26.9	26.7	26.0	26.1	22.3	22.7	23.3	23.5	23.0	23.1	23.0	23.7	24.3	24.0	23.7	24.3	24.3	39.8	42.8	37.6	0.0186	
F	bdl	bdl	bdl	bdl	0.191	0.310	0.191	bdl	bdl	0.215	bdl	0.198	0.243	bdl	bdl	bdl	bdl	0.178	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.512	bdl	0.169
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.037	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0440	bdl	bdl	bdl	bdl	bdl	0.0413	bdl	0.0380	bdl	0.0368
O (calculated)	38.8	38.9	38.8	39.4	39.5	39.4	39.8	39.7	39.0	39.1	35.0	35.3	36.0	35.7	35.5	35.7	36.3	36.9	36.5	36.5	35.9	36.4	36.6	35.9	35.7	36.4		
Total	96.0	96.2	96.1	97.6	98.6	98.6	99.1	98.4	97.4	97.2	98.8	98.8	100.0	99.4	99.4	98.9	99.3	101.0	99.9	100.9	100.0	100.6	100.3	96.0	96.8	97.0		
	Cations based on 7 O										Cations based on 4 O													Cations based on 4 O				
Si	1.55	1.54	1.38	1.41	1.51	1.44	1.38	1.36	1.41	1.43	1.00	1.01	1.00	0.98	1.00	0.99	1.00	1.00	1.01	1.00	1.00	0.99	1.00	1.01	1.02	1.00		
Al	1.02	1.05	1.28	1.25	1.04	1.19	1.28	1.33	1.27	1.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fe	0.20	0.19	0.17	0.16	0.21	0.20	0.18	0.18	0.23	0.19	0.58	0.54	0.50	0.52	0.55	0.51	0.47	0.44	0.44	0.47	0.50	0.46	0.44	0.07	0.03	0.10		
Mn	0.03	0.03	0.03	0.02	0.04	0.03	0.03	0.03	0.04	0.03	0.17	0.15	0.14	0.14	0.15	0.14	0.12	0.12	0.14	0.14	0.16	0.15	0.13	0.03	0.01	0.03		
Mg	0.29	0.29	0.23	0.23	0.30	0.24	0.23	0.18	0.15	0.21	0.21	0.28	0.33	0.32	0.26	0.32	0.38	0.40	0.34	0.33	0.28	0.33	0.35	0.10	0.02	0.17		
Ca	1.84	1.85	1.89	1.90	1.88	1.88	1.89	1.88	1.86	1.87	1.02	1.03	1.03	1.05	1.03	1.03	1.01	1.03	1.06	1.05	1.05	1.07	1.06	1.77	1.91	1.65		
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Sum cations	4.94	4.94	4.98	4.97	4.98	4.98	4.99	4.97	4.96	4.97	3.00	3.00	3.01	3.02	3.00	3.00	2.99	3.00	2.99	3.00	3.00	3.00	2.99	2.99	3.00	2.98		

*all Fe as FeO.

Table S9. Sample EAFS2_A (oxides) after leaching.

	Wuestite phases after leaching												Spinel phases after leaching												Detection limit	
	Oxide [mass-%]												Oxide [mass-%]													
	C2 an1	C2 an2	C2 an3	C2 an4	C2 an5	C3 an20	C3 an21	C3 an22	C3 an24	C3 an25	C3 an26	C2 an6	C2 an7	C2 an8	C2 an9	C2 an10	C2 an21	C2 an22	C3 an1	C3 an2	C3 an3	C3 an5	C3 an6	C3 an7		
SiO ₂	bdl	bdl	bdl	bdl	bdl	bdl	0.233	bdl	bdl	0.255	bdl	bdl	bdl	bdl	bdl	0.108	bdl	bdl	bdl	bdl	0.262	bdl	0.296			
Al ₂ O ₃	0.403	1.14	1.01	0.473	0.882	0.232	1.16	1.49	1.02	0.406	0.124	6.63	5.82	6.38	21.0	15.6	15.3	15.2	1.50	1.80	1.61	1.67	5.26	1.53		
Cr ₂ O ₃	5.13	10.5	7.10	5.48	3.57	2.94	6.44	7.28	5.98	1.25	0.496	45.9	47.3	46.3	40.8	44.3	47.7	50.9	65.2	63.1	64.7	59.7	61.9	58.0		
V ₂ O ₃	0.130	0.258	0.272	0.147	0.257	0.248	0.365	0.354	0.268	bdl	0.216	0.345	0.168	0.339	0.680	0.299	0.243	0.199	0.134	0.239	0.118	0.201	0.301	0.265		
FeO*	79.9	70.1	76.3	78.3	79.1	79.7	70.9	72.1	73.7	87.0	87.0	30.2	30.4	29.3	28.9	29.0	25.2	22.8	16.5	18.9	17.4	18.9	18.1	18.8		
MnO	8.25	7.87	8.37	8.19	9.11	11.2	10.4	11.0	10.8	8.28	8.84	2.98	3.05	3.05	3.38	5.44	4.29	4.41	5.24	5.54	5.63	5.03	5.47	5.04		
MgO	7.90	7.26	5.92	7.85	5.16	8.06	7.29	7.72	7.23	2.98	3.27	5.10	4.92	5.05	5.25	5.58	7.58	7.83	9.68	9.36	9.39	8.77	9.79	8.74		
CaO	0.347	0.375	0.480	0.408	0.697	0.329	0.386	0.324	0.321	1.22	0.671	0.482	0.626	0.518	0.555	0.634	0.525	0.491	0.441	0.505	0.447	0.512	0.439	0.559		
F	bdl	bdl	0.202	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.801	1.16	0.847	0.458	1.40	1.46	1.49	2.25	1.67	1.90	2.20	1.69	1.78		
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.169	bdl	0.080	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
Total	102.2	97.7	99.7	100.9	98.8	102.3	94.2	99.6	100.7	97.2	100.5	92.3	93.0	91.5	100.8	101.6	101.8	102.6	100.0	100.5	100.3	96.3	102.3	94.2		
	Element [mass-%]												Element [mass-%]												mass-%	
Si	bdl	bdl	bdl	bdl	bdl	bdl	0.109	bdl	bdl	0.119	bdl	bdl	bdl	bdl	bdl	0.0505	bdl	bdl	bdl	bdl	0.122	bdl	0.138	0.0362		
Al	0.213	0.601	0.536	0.250	0.467	0.123	0.614	0.790	0.541	0.215	0.0656	3.51	3.08	3.38	11.1	8.25	8.09	8.03	0.796	0.954	0.851	0.885	2.78	0.812	0.0142	
Cr	3.51	7.21	4.86	3.75	2.44	2.01	4.40	4.98	4.09	0.853	0.339	31.4	32.4	31.7	27.9	30.3	32.6	34.8	44.6	43.1	44.2	40.8	42.4	39.7	0.0286	
V	0.088	0.175	0.185	0.100	0.175	0.169	0.248	0.241	0.182	bdl	0.147	0.235	0.114	0.230	0.462	0.203	0.165	0.135	0.091	0.162	0.080	0.137	0.205	0.180	0.0522	
Fe	62.1	54.5	59.3	60.9	61.5	61.9	55.1	56.1	57.3	67.6	67.7	23.5	23.6	22.8	22.5	22.5	19.6	17.7	12.8	14.7	13.5	14.7	14.0	14.6	0.0433	
Mn	6.39	6.09	6.48	6.34	7.06	8.68	8.06	8.51	8.40	6.41	6.85	2.31	2.36	2.36	2.61	4.22	3.32	3.41	4.06	4.29	4.36	3.89	4.24	3.90	0.0288	
Mg	4.76	4.38	3.57	4.73	3.11	4.86	4.40	4.66	4.36	1.80	1.97	3.08	2.96	3.04	3.17	3.37	4.57	4.72	5.84	5.64	5.66	5.29	5.91	5.27	0.0120	
Ca	0.248	0.268	0.343	0.292	0.498	0.235	0.276	0.232	0.229	0.873	0.480	0.344	0.447	0.370	0.397	0.453	0.375	0.351	0.315	0.361	0.319	0.366	0.314	0.400	0.0116	
F	bdl	bdl	0.202	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.801	1.16	0.847	0.458	1.40	1.46	1.49	2.25	1.67	1.90	2.20	1.69	1.78	0.179	
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.113	bdl	0.0533	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0589	
O (calculated)	24.8	24.3	24.1	24.5	23.6	24.2	20.9	24.0	25.5	19.3	22.9	27.0	26.8	26.8	32.2	30.9	31.5	32.0	29.2	29.5	29.4	27.9	30.7	27.5		
Total	102.2	97.7	99.7	100.9	98.8	102.3	94.2	99.6	100.7	97.2	100.5	92.3	93.0	91.5	100.8	101.6	101.8	102.6	100.0	100.5	100.3	96.3	102.3	94.2		
	Cations based on 1 O												Cations based on 4 O													
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01			
Al	0.01	0.01	0.01	0.01	0.01	0.00	0.02	0.02	0.01	0.01	0.00	0.30	0.26	0.29	0.81	0.61	0.59	0.57	0.06	0.07	0.07	0.07	0.21	0.07		
Cr	0.04	0.09	0.06	0.05	0.03	0.03	0.06	0.06	0.05	0.01	0.00	1.40	1.43	1.42	1.05	1.16	1.23	1.29	1.76	1.72	1.76	1.69	1.62	1.69		
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01		
Fe	0.72	0.64	0.70	0.71	0.75	0.73	0.75	0.67	0.64	1.01	0.84	0.97	0.97	0.95	0.79	0.80	0.69	0.61	0.47	0.55	0.50	0.57	0.50	0.58		
Mn	0.08	0.07	0.08	0.08	0.09	0.10	0.11	0.10	0.10	0.10	0.09	0.10	0.10	0.10	0.09	0.15	0.12	0.12	0.15	0.16	0.16	0.15	0.15	0.16		
Mg	0.13	0.12	0.10	0.13	0.09	0.13	0.14	0.13	0.11	0.06	0.06	0.29	0.28	0.29	0.26	0.28	0.37	0.37	0.49	0.48	0.48	0.47	0.48	0.48		
Ca	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.02	0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	0.98	0.95	0.96	0.97	0.98	1.00	1.10	0.99	0.92	1.21	1.00	3.09	3.08	3.09	3.04	3.04	3.01	2.99	2.96	3.01	2.98	2.98	2.99	3.01		

*all Fe as FeO.

Table S10. Sample EAFS2_A (calcium silicates) after leaching.

	Melilite phases after leaching										Olivine phases 1 after leaching											Detection
	Oxide [mass-%]										Oxide [mass-%]											limit
	C2 an16	C2 an17	C2 an18	C2 an19	C2 an20	C3 an15	C3 an16	C3 an17	C3 an18	C3 an19	C2 an11	C2 an12	C2 an13	C2 an14	C2 an15	C3 an8	C3 an10	C3 an11	C3 an12	C3 an13	C3 an14	
SiO ₂	30.8	30.7	29.4	29.5	29.5	29.3	25.8	8.8	8.1	28.7	10.3	10.3	33.0	33.1	33.0	33.2	33.0	33.2	33.1	33.5	32.2	
Al ₂ O ₃	19.7	20.9	20.1	20.6	21.4	21.3	21.6	21.3	20.2	23.0	0.117	0.0520	0.136	0.0560	0.0380	bdl	bdl	0.0480	0.0370	bdl	0.0320	
Cr ₂ O ₃	0.063	bdl	bdl	bdl	bdl	0.227	0.124	0.0550	bdl	bdl	0.111	0.0560	bdl	0.0730	0.187	bdl	0.0750	bdl	0.0860	0.438	0.130	
V ₂ O ₃	0.130	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.077	bdl	bdl	0.083	
FeO*	6.36	6.39	5.99	6.06	5.87	5.39	10.9	5.45	7.03	5.20	18.9	22.6	22.3	26.2	29.7	20.9	24.2	18.8	18.8	22.3	19.9	
MnO	0.754	0.958	0.783	0.784	0.818	0.848	1.49	0.823	1.47	0.748	4.95	4.58	5.23	6.08	6.42	6.20	6.93	5.51	5.75	6.43	5.56	
MgO	2.78	2.51	3.11	2.46	2.47	2.85	2.95	3.13	2.79	2.41	8.01	9.36	7.82	5.41	3.76	5.78	5.29	7.12	6.61	5.95	7.17	
CaO	39.2	38.7	39.0	38.6	38.9	40.1	36.3	39.4	39.2	39.7	33.0	29.0	32.6	31.3	30.6	35.3	33.3	36.3	36.3	33.3	34.3	
F	bdl	bdl	bdl	bdl	0.264	bdl	0.273	0.206	0.225	bdl	bdl	0.283	bdl	bdl	bdl	bdl	bdl	0.212	0.270	bdl	bdl	
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
Total	99.8	100.3	98.5	98.1	99.3	100.2	99.5	79.1	79.1	99.8	75.4	76.2	101.1	102.3	103.8	101.5	102.9	101.3	101.0	102.0	99.4	
	Element [mass-%]										Element [mass-%]										mass-%	
Si	14.4	14.4	13.8	13.8	13.8	13.7	12.0	4.1	3.8	13.4	4.81	4.82	15.4	15.5	15.4	15.5	15.4	15.5	15.5	15.6	15.0	0.0362
Al	10.4	11.1	10.6	10.9	11.3	11.3	11.4	11.3	10.7	12.2	0.0619	0.0275	0.0720	0.0296	0.0201	bdl	bdl	0.0254	0.0196	bdl	0.0169	0.0142
Cr	0.0431	bdl	bdl	bdl	bdl	0.155	0.0848	0.0376	bdl	bdl	0.0759	0.0383	bdl	0.0499	0.128	bdl	0.0513	bdl	0.0588	0.300	0.0889	0.0286
V	0.0884	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0523	bdl	bdl	0.0564	0.0522
Fe	4.94	4.96	4.65	4.71	4.56	4.19	8.51	4.24	5.47	4.04	14.7	17.6	17.3	20.3	23.1	16.3	18.8	14.6	14.6	17.4	15.4	0.0433
Mn	0.584	0.742	0.606	0.607	0.634	0.657	1.15	0.637	1.14	0.579	3.83	3.54	4.05	4.71	4.98	4.80	5.37	4.26	4.45	4.98	4.31	0.0288
Mg	1.67	1.51	1.88	1.48	1.49	1.72	1.78	1.89	1.68	1.45	4.83	5.65	4.71	3.26	2.26	3.49	3.19	4.30	3.99	3.59	4.32	0.0120
Ca	28.0	27.7	27.9	27.6	27.8	28.6	26.0	28.1	28.0	28.4	23.6	20.7	23.3	22.4	21.8	25.2	23.8	26.0	25.9	23.8	24.5	0.0116
F	bdl	bdl	bdl	bdl	0.264	bdl	0.273	0.206	0.225	bdl	bdl	0.283	bdl	bdl	bdl	bdl	bdl	0.212	0.270	bdl	bdl	0.179
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0589
O (calculated)	39.6	39.9	39.0	38.9	39.3	39.6	38.1	28.5	27.9	39.7	23.5	23.5	36.2	36.0	35.9	36.2	36.2	36.3	36.1	36.3	35.5	
Total	99.8	100.3	98.5	98.1	99.1	100.1	99.4	79.0	79.0	99.8	75.4	76.2	101.1	102.3	103.8	101.5	102.9	101.3	101.0	102.0	99.4	
	Cations based on 7 O										Cations based on 4 O											
Si	1.45	1.43	1.41	1.41	1.40	1.38	1.26	0.57	0.54	1.35	0.47	0.47	0.97	0.98	0.98	0.98	0.97	0.98	0.98	1.08	0.97	
Al	1.09	1.15	1.13	1.17	1.20	1.18	1.24	1.64	1.59	1.27	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cr	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fe	0.25	0.25	0.24	0.24	0.23	0.21	0.45	0.30	0.39	0.20	0.72	0.86	0.55	0.65	0.74	0.52	0.60	0.46	0.46	0.57	0.50	
Mn	0.03	0.04	0.03	0.03	0.03	0.03	0.06	0.05	0.08	0.03	0.19	0.18	0.13	0.15	0.16	0.15	0.17	0.14	0.14	0.17	0.14	
Mg	0.19	0.17	0.22	0.18	0.18	0.20	0.22	0.31	0.28	0.17	0.54	0.63	0.34	0.24	0.17	0.25	0.23	0.31	0.29	0.31	0.32	
Ca	1.98	1.94	2.00	1.98	1.98	2.02	1.90	2.76	2.80	2.00	1.60	1.41	1.03	0.99	0.97	1.11	1.05	1.14	1.15	1.22	1.10	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	5.00	4.99	5.03	5.01	5.02	5.03	5.14	5.63	5.69	5.02	3.53	3.55	3.03	3.02	3.02	3.02	3.03	3.03	3.03	3.35	3.04	

*all Fe as FeO.

Table S11. Sample EAFS2_B (oxides) prior to leaching.

	Spinel phases prior to leaching														Detection
	oxide [mass-%]														limit
	C1_an1	C1_an2	C1_an3	C1_an4	C1_an5	C1_an6	C1_an7	C2_an1	C2_an2	C2_an3	C2_an4	C2_an5	C2_an6	C2_an7	
SiO ₂	bdl	bdl	bdl	bdl	0.604	bdl	bdl	2.58	bdl	0.216	bdl	0.358	0.361	0.114	
Al ₂ O ₃	21.4	15.6	18.5	16.7	22.9	25.2	16.1	22.0	15.0	14.6	23.5	28.7	16.8	22.5	
Cr ₂ O ₃	40.2	46.4	43.2	48.0	39.5	36.7	49.7	37.1	49.5	45.7	38.3	29.9	38.4	40.5	
V ₂ O ₃	0.194	0.094	0.141	0.131	0.161	0.258	0.177	0.281	0.103	0.213	0.217	0.200	0.168	0.161	
FeO*	17.6	19.5	18.1	16.4	17.4	17.6	14.0	16.9	17.9	14.3	16.6	19.4	16.9	17.1	
MnO	5.52	5.57	5.91	5.93	5.48	5.47	5.86	5.64	5.59	5.84	6.78	5.41	5.26	5.13	
MgO	7.22	6.25	7.41	6.96	7.15	7.17	7.54	7.64	6.43	7.87	7.17	7.17	8.13	7.16	
CaO	0.469	0.629	0.698	0.461	0.831	0.498	0.553	1.88	0.420	0.264	0.357	0.517	0.618	0.518	
F	1.19	1.07	0.523	0.874	1.36	0.980	1.23	1.16	1.20	0.882	0.978	0.750	1.027	0.930	
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	0.0570	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
Total	93.3	94.7	94.3	95.2	94.8	93.5	94.7	94.7	95.6	89.6	93.6	92.1	87.2	93.8	
	Element [mass-%]														mass-%
Si	bdl	bdl	bdl	bdl	0.282	bdl	bdl	1.21	bdl	0.101	bdl	0.167	0.169	0.0533	0.0302
Al	11.3	8.3	9.8	8.9	12.1	13.3	8.5	11.6	7.9	7.7	12.5	15.2	8.9	11.9	0.0118
Cr	27.5	31.7	29.6	32.9	27.0	25.1	34.0	25.4	33.8	31.3	26.2	20.4	26.2	27.7	0.0296
V	0.132	0.0639	0.0958	0.0890	0.109	0.175	0.120	0.191	0.0700	0.145	0.148	0.136	0.114	0.109	0.0227
Fe	13.7	15.2	14.0	12.7	13.5	13.7	10.8	13.1	13.9	11.1	12.9	15.1	13.1	13.3	0.0357
Mn	4.28	4.32	4.58	4.60	4.25	4.23	4.54	4.36	4.33	4.52	5.25	4.19	4.07	3.98	0.0175
Mg	4.35	3.77	4.47	4.20	4.31	4.32	4.54	4.61	3.88	4.75	4.32	4.32	4.90	4.32	0.0548
Ca	0.335	0.450	0.499	0.329	0.594	0.356	0.395	1.34	0.300	0.189	0.255	0.369	0.442	0.370	0.0183
F	1.19	1.07	0.523	0.874	1.36	0.980	1.23	1.16	1.20	0.882	0.978	0.750	1.03	0.930	0.164
Mo	bdl	bdl	bdl	bdl	bdl	bdl	0.038	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0359
O (calculated)	30.5	29.9	30.7	30.6	31.2	31.3	30.4	31.6	30.1	28.8	31.0	31.4	28.2	31.1	
Total	93.3	94.7	94.3	95.2	94.8	93.5	94.7	94.7	95.6	89.6	93.6	92.1	87.2	93.8	
	Cations based on 4 O														
Si	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.09	0.00	0.01	0.00	0.01	0.01	0.00	
Al	0.88	0.66	0.75	0.69	0.92	1.01	0.66	0.87	0.62	0.64	0.95	1.15	0.75	0.91	
Cr	1.11	1.31	1.19	1.32	1.07	0.99	1.38	0.99	1.38	1.33	1.04	0.80	1.15	1.10	
V	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.00	
Fe	0.51	0.58	0.52	0.48	0.49	0.50	0.41	0.48	0.53	0.44	0.48	0.55	0.53	0.49	
Mn	0.16	0.17	0.17	0.17	0.16	0.16	0.17	0.16	0.17	0.18	0.20	0.16	0.17	0.15	
Mg	0.38	0.33	0.38	0.36	0.36	0.36	0.39	0.38	0.34	0.43	0.37	0.36	0.46	0.37	
Ca	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.07	0.02	0.01	0.01	0.02	0.03	0.02	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	3.07	3.07	3.05	3.04	3.06	3.05	3.04	3.04	3.06	3.05	3.05	3.05	3.10	3.04	

*all Fe as FeO.

Table S12. Sample EAFS2_B (calcium silicates) prior to leaching.

	Melilite phases prior to leaching										Olivine phases prior to leaching										Detection limit
	Oxide [mass-%]										Oxide [mass-%]										
	C1_an1	C1_an2	C1_an3	C1_an4	C1_an5	C2_an1	C2_an2	C2_an3	C2_an4	C2_an5	C1_an6	C1_an7	C1_an8	C1_an9	C1_an10	C2_an6	C2_an7	C2_an8	C2_an9	C2_an10	
SiO ₂	32.1	31.3	30.2	31.2	32.4	32.0	32.0	31.7	30.7	32.2	33.2	33.8	33.2	32.9	33.2	32.9	32.9	32.3	33.2	32.2	
Al ₂ O ₃	19.2	20.3	21.2	20.0	18.1	18.6	18.7	21.0	20.9	18.1	0.0940	0.0890	0.0550	0.0840	0.160	0.158	0.233	0.135	0.258	0.0980	
Cr ₂ O ₃	0.0820	bdl	bdl	0.0440	0.0990	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.102	bdl	0.0870	bdl	0.221	bdl	0.183	
V ₂ O ₃	bdl	bdl	bdl	0.0480	bdl	0.0440	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0360	bdl	bdl	bdl	bdl	
FeO*	3.91	3.74	3.77	4.49	4.43	3.92	3.92	3.66	3.53	4.02	24.9	24.2	27.3	27.0	22.3	24.7	24.3	24.2	22.5	28.2	
MnO	0.968	1.064	0.965	1.05	1.15	1.01	0.977	0.919	0.910	1.02	9.95	10.1	10.3	9.75	9.03	11.7	10.8	9.85	9.42	10.3	
MgO	4.24	4.22	3.80	3.98	4.70	4.98	4.79	3.91	3.93	4.61	5.62	5.72	3.55	4.37	7.43	5.34	6.01	5.26	6.26	3.18	
CaO	36.6	37.2	37.6	37.5	37.0	36.8	37.1	37.6	37.5	37.2	27.6	27.9	26.9	27.1	28.0	25.9	26.7	27.9	28.0	26.4	
F	bdl	bdl	bdl	bdl	0.192	bdl	0.433	0.169	bdl	bdl	bdl	bdl	bdl	bdl	0.263	bdl	bdl	bdl	bdl	bdl	
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
Total	97.2	97.9	97.6	98.3	98.0	97.3	97.8	98.9	97.6	97.3	101.3	101.9	101.4	101.3	100.3	101.0	101.1	99.9	99.6	100.7	
	Element [mass-%]										Element [mass-%]										mass-%
Si	15.0	14.6	14.1	14.6	15.1	14.9	14.9	14.8	14.4	15.1	15.5	15.8	15.5	15.4	15.5	15.4	15.4	15.1	15.5	15.0	0.0302
Al	10.2	10.7	11.2	10.6	9.6	9.8	9.9	11.1	11.1	9.6	0.0497	0.0471	0.0291	0.0445	0.0847	0.0836	0.123	0.0714	0.137	0.0519	0.0118
Cr	0.0561	bdl	bdl	0.030	0.0677	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0698	bdl	0.0595	bdl	0.151	bdl	0.125	0.0296
V	bdl	bdl	bdl	0.033	bdl	0.0299	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0245	bdl	bdl	bdl	bdl	0.0227
Fe	3.04	2.91	2.93	3.49	3.45	3.05	3.04	2.84	2.74	3.12	19.4	18.8	21.2	21.0	17.3	19.2	18.9	18.8	17.5	22.0	0.0357
Mn	0.750	0.824	0.747	0.811	0.888	0.779	0.757	0.712	0.705	0.787	7.70	7.85	7.94	7.55	6.99	9.08	8.34	7.62	7.29	7.96	0.0175
Mg	2.56	2.54	2.29	2.40	2.83	3.00	2.89	2.35	2.37	2.78	3.39	3.45	2.14	2.63	4.48	3.22	3.63	3.17	3.78	1.92	0.0548
Ca	26.2	26.6	26.8	26.8	26.5	26.3	26.5	26.8	26.8	26.6	19.7	20.0	19.3	19.3	20.0	18.5	19.1	19.9	20.0	18.9	0.0183
F	bdl	bdl	bdl	bdl	0.192	bdl	0.433	0.169	bdl	bdl	bdl	bdl	bdl	bdl	0.263	bdl	bdl	bdl	bdl	bdl	0.164
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0359
O (calculated)	39.4	39.5	39.4	39.6	39.4	39.4	39.2	40.0	39.5	39.2	35.6	36.0	35.2	35.3	35.6	35.2	35.5	34.9	35.4	34.6	
Total	97.2	97.9	97.6	98.3	98.0	97.3	97.8	98.9	97.6	97.3	101.3	101.9	101.4	101.3	100.3	101.0	101.1	99.9	99.6	100.7	
	Cations based on 7 O										Cations based on 4 O										
Si	1.52	1.47	1.43	1.47	1.53	1.51	1.52	1.48	1.45	1.53	0.99	1.00	1.01	0.99	0.99	1.00	0.99	0.98	1.00	0.99	
Al	1.07	1.13	1.18	1.11	1.01	1.04	1.05	1.15	1.17	1.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.00	
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fe	0.15	0.15	0.15	0.18	0.18	0.16	0.16	0.14	0.14	0.16	0.62	0.60	0.69	0.68	0.56	0.63	0.61	0.62	0.57	0.73	
Mn	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.25	0.25	0.26	0.25	0.23	0.30	0.27	0.25	0.24	0.27	
Mg	0.30	0.30	0.27	0.28	0.33	0.35	0.34	0.27	0.28	0.33	0.25	0.25	0.16	0.20	0.33	0.24	0.27	0.24	0.28	0.15	
Ca	1.86	1.88	1.90	1.89	1.88	1.87	1.89	1.87	1.90	1.89	0.88	0.89	0.87	0.88	0.90	0.84	0.86	0.91	0.90	0.87	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	4.95	4.97	4.98	4.97	4.98	4.97	4.99	4.96	4.97	4.97	3.01	3.00	3.00	3.00	3.02	3.01	3.01	3.02	3.00	3.01	

*all Fe as FeO.

Table S13. Sample EAFS2_B (spinel and melilites) after leaching.

	Spinel phases after leaching										Melilite phases after leaching																				Detection limit
	Oxide [mass-%]										Oxide [mass-%]																				
	C2_an1	C2_an5	C2_an8	C3_an1	C3_an2	C3_an3	C3_an4	C3_an10	C3_an20	C2_an3	C2_an13	C2_an14	C2_an15	C2_an22	C2_an23	C2_an24	C2_an25	C2_an26	S1_an6	S1_an7	S1_an8	S1_an9	S1_an10	C3_an6	C3_an7	C3_an11					
SiO ₂	bdl	0.308	0.0770	bdl	bdl	bdl	bdl	0.105	bdl	32.7	30.3	28.6	31.7	33.8	31.8	30.5	33.2	9.74	36.4	36.5	35.7	35.5	37.5	39.3	36.8	38.5					
Al ₂ O ₃	17.2	22.1	21.2	15.0	19.3	27.5	29.6	19.6	19.9	13.5	5.39	6.08	16.0	14.4	15.4	16.8	13.8	13.2	8.72	10.0	9.84	8.65	9.11	7.87	5.94	9.37					
Cr ₂ O ₃	46.6	36.7	40.4	49.2	43.8	33.3	31.8	43.8	44.6	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.123	bdl	bdl	0.041	bdl	bdl	bdl	0.089					
V ₂ O ₅	0.113	0.244	0.260	0.224	0.298	0.378	0.603	0.220	0.203	bdl	bdl	0.0560	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0410	bdl	bdl	bdl						
FeO*	17.8	20.7	19.4	18.6	20.6	19.2	18.9	18.1	18.3	5.22	6.45	4.72	5.19	5.09	5.38	5.14	4.99	5.83	9.16	8.25	9.77	9.08	11.82	15.57	6.36	15.86					
MnO	6.07	5.33	5.59	4.51	4.57	6.85	5.43	5.39	5.53	1.51	1.75	1.19	1.41	1.44	1.31	1.31	1.47	1.68	1.81	1.73	1.84	2.31	2.39	4.45	3.03	3.67					
MgO	10.3	8.99	9.61	9.77	9.64	9.67	10.3	10.3	10.1	4.91	3.06	3.77	4.41	4.67	4.41	3.97	4.81	4.68	3.72	4.09	3.16	5.28	3.33	6.18	6.34	5.90					
CaO	0.554	0.393	0.753	0.240	0.232	0.339	0.225	0.578	0.524	40.2	39.4	40.1	40.5	40.5	40.6	41.0	40.9	40.0	38.2	38.8	38.1	37.6	32.3	24.3	39.5	23.9					
F	1.07	0.943	0.489	1.14	0.795	0.921	0.581	0.975	1.12	bdl	0.314	bdl	bdl	0.186	0.309	bdl	bdl	bdl	0.244	bdl	0.182	bdl	0.255	bdl	bdl	bdl					
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl					
Total	99.3	95.3	97.5	98.2	98.9	97.9	97.3	98.8	100.0	98.1	86.7	84.5	99.3	99.9	99.1	98.8	99.2	75.2	98.3	99.4	98.5	98.6	96.7	97.7	98.1	97.4					
	Element [mass-%]										Element [mass-%]																				mass-%
Si	bdl	0.144	0.0360	bdl	bdl	bdl	bdl	0.0491	bdl	15.3	14.2	13.4	14.8	15.8	14.9	14.2	15.5	4.55	17.0	17.0	16.7	16.6	17.6	18.4	17.2	18.0	0.0304				
Al	9.1248	11.7	11.2	7.9440	10.2	14.5	15.7	10.4	10.5	7.14	2.85	3.22	8.46	7.60	8.14	8.88	7.31	7.01	4.62	5.31	5.21	4.58	4.82	4.17	3.14	4.96	0.0135				
Cr	31.9	25.1	27.7	33.7	30.0	22.8	21.8	30.0	30.5	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0842	bdl	bdl	0.0281	bdl	bdl	bdl	0.0609	0.0272				
V	0.0768	0.166	0.177	0.152	0.203	0.257	0.410	0.150	0.138	bdl	bdl	0.0381	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0279	bdl	bdl	bdl	bdl	0.0248				
Fe	13.9	16.1	15.1	14.5	16.0	14.9	14.7	14.1	14.2	4.05	5.02	3.67	4.03	3.95	4.18	3.99	3.87	4.53	7.12	6.41	7.60	7.06	9.19	12.1	4.94	12.3	0.0388				
Mn	4.70	4.12	4.33	3.49	3.54	5.30	4.20	4.17	4.29	1.17	1.35	0.925	1.09	1.11	1.02	1.01	1.14	1.30	1.40	1.34	1.43	1.79	1.85	3.45	2.35	2.84	0.0282				
Mg	6.21	5.42	5.79	5.89	5.81	5.83	6.19	6.20	6.08	2.96	1.84	2.24	2.66	2.81	2.66	2.39	2.90	2.82	2.24	2.47	1.91	3.18	2.01	3.73	3.82	3.56	0.0125				
Ca	0.396	0.281	0.538	0.172	0.166	0.242	0.161	0.413	0.374	28.7	28.2	28.6	28.9	28.9	29.0	29.3	29.2	28.6	27.3	27.7	27.2	26.9	23.1	17.3	28.2	17.1	0.0117				
F	1.07	0.943	0.489	1.14	0.795	0.921	0.581	0.975	1.12	bdl	0.314	bdl	bdl	0.186	0.309	bdl	bdl	bdl	bdl	0.244	bdl	0.182	bdl	0.255	bdl	bdl	bdl	0.166			
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0628				
O (calculated)	32.0	31.3	32.2	31.3	32.2	33.0	33.6	32.3	32.6	38.7	32.9	32.3	39.1	39.5	38.9	38.8	39.1	26.4	38.3	39.0	38.3	38.4	37.9	38.4	38.2	38.5					
Total	99.3	95.3	97.5	98.2	98.9	97.9	97.3	98.8	100.0	98.1	86.7	84.5	99.3	99.9	99.1	98.8	99.2	75.2	98.3	99.4	98.5	98.6	96.7	97.7	98.1	97.4					
	Cations based on 4 O										Cations based on 7 O																				
Si	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.57	1.72	1.65	1.51	1.59	1.53	1.46	1.58	0.69	1.77	1.74	1.74	1.73	1.85	1.90	1.79	1.87					
Al	0.66	0.84	0.81	0.58	0.74	1.02	1.09	0.74	0.75	0.77	0.36	0.41	0.90	0.80	0.87	0.95	0.78	1.10	0.50	0.56	0.56	0.49	0.53	0.45	0.34	0.54					
Cr	1.19	0.94	1.03	1.28	1.12	0.83	0.79	1.11	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
V	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Fe	0.48	0.56	0.52	0.51	0.56	0.51	0.50	0.49	0.49	0.21	0.31	0.23	0.21	0.20	0.22	0.21	0.20	0.34	0.37	0.33	0.40	0.37	0.49	0.63	0.26	0.64					
Mn	0.17	0.15	0.15	0.13	0.13	0.18	0.14	0.15	0.15	0.06	0.08	0.06	0.06	0.06	0.05	0.05	0.06	0.10	0.07	0.07	0.08	0.09	0.10	0.18	0.13	0.15					
Mg	0.50	0.43	0.46	0.48	0.47	0.45	0.48	0.49	0.48	0.35	0.26	0.32	0.31	0.33	0.31	0.28	0.34	0.49	0.27	0.29	0.23	0.38	0.24	0.45	0.46	0.43					
Ca	0.02	0.01	0.03	0.01	0.01	0.01	0.01	0.02	0.02	2.07	2.40	2.48	2.07	2.05	2.08	2.11	2.08	3.03	1.99	1.98	1.99	1.96	1.70	1.26	2.06	1.24					
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Sum cations	3.02	2.95	3.02	3.00	3.03	3.02	3.02	3.01	3.00	5.04	5.13	5.14	5.05	5.02	4.97	5.07	5.04	5.76	4.99	4.98	4.99	5.03	4.91	4.88	5.05	4.87					

*all Fe as FeO.

Table S14. Sample EAFS2_B (olivines) after leaching.

	Olivine phases after leaching																Detection limit
	Oxide [mass-%]																
	C2_an5	C2_an6	C2_an7	C2_an8	C2_an9	C2_an10	C2_an11	C2_an12	S1_an1	S1_an2	S1_an3	S1_an4	C3_an12	C3_an14	C3_an16	C3_an19	
SiO ₂	31.5	31.5	31.1	30.7	30.8	30.2	30.7	30.6	31.3	32.6	33.5	33.1	30.1	30.4	30.9	31.2	
Al ₂ O ₃	0.0450	0.0760	0.0490	0.0740	bdl	bdl	bdl	0.0290	0.119	0.138	0.0460	0.0300	0.624	0.130	0.0350	0.413	
Cr ₂ O ₃	0.0620	0.0590	bdl	bdl	bdl	bdl	bdl	bdl	0.0680	bdl	0.0910	0.109	bdl	bdl	bdl	0.0400	
V ₂ O ₃	bdl	0.0380	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
FeO*	27.3	27.0	25.5	25.0	25.2	26.9	29.0	28.5	22.4	22.2	22.5	23.3	23.6	27.5	22.5	26.5	
MnO	11.6	11.0	11.4	11.2	11.0	11.7	12.2	12.518	7.90	7.77	7.61	7.62	11.7	15.3	19.4	11.4	
MgO	4.01	3.86	4.09	4.13	4.11	3.36	2.46	2.48	8.53	8.14	8.14	7.99	5.28	6.44	1.60	4.76	
CaO	26.2	27.4	28.3	27.9	28.3	26.7	25.6	25.9	29.4	29.5	29.9	29.3	26.9	19.5	26.3	25.3	
F	bdl	bdl	bdl	0.335	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
MoO ₃	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.111	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	
Total	100.8	101.0	100.5	99.1	99.4	99.0	100.1	100.2	99.9	100.4	101.8	101.5	98.3	99.3	100.8	99.6	
	Element [mass-%]																mass-%
Si	14.7	14.7	14.5	14.3	14.4	14.1	14.4	14.3	14.6	15.2	15.7	15.5	14.1	14.2	14.4	14.6	0.0304
Al	0.0238	0.0402	0.0259	0.0392	bdl	bdl	bdl	0.0153	0.0630	0.0730	0.0243	0.0159	0.330	0.0688	0.0185	0.219	0.0135
Cr	0.0424	0.0404	bdl	bdl	bdl	bdl	bdl	bdl	0.0465	bdl	0.0623	0.0746	bdl	bdl	bdl	0.0274	0.0272
V	bdl	0.0258	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0248
Fe	21.2	21.0	19.9	19.4	19.6	20.9	22.6	22.2	17.4	17.3	17.5	18.1	18.4	21.4	17.5	20.6	0.0388
Mn	9.02	8.50	8.81	8.64	8.52	9.09	9.48	9.69	6.12	6.02	5.90	5.90	9.04	11.8	15.0	8.82	0.0282
Mg	2.42	2.33	2.46	2.49	2.48	2.03	1.48	1.49	5.15	4.91	4.91	4.82	3.18	3.88	0.96	2.87	0.0125
Ca	18.7	19.6	20.2	19.9	20.2	19.1	18.3	18.5	21.0	21.1	21.4	20.9	19.2	13.9	18.8	18.1	0.0117
F	bdl	bdl	bdl	0.335	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.166
Mo	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0740	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.0628
O (calculated)	34.6	34.7	34.5	33.9	34.2	33.7	33.9	33.9	35.3	35.8	36.4	36.1	34.0	34.0	34.0	34.4	
Total	100.8	101.0	100.5	99.1	99.4	99.0	100.1	100.2	99.9	100.4	101.8	101.5	98.3	99.3	100.8	99.6	
	Cations based on 4 O																
Si	0.97	0.97	0.96	0.96	0.96	0.96	0.97	0.96	0.95	0.97	0.98	0.98	0.94	0.95	0.97	0.97	
Al	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fe	0.70	0.69	0.66	0.66	0.66	0.70	0.76	0.75	0.57	0.55	0.55	0.58	0.62	0.72	0.59	0.69	
Mn	0.30	0.29	0.30	0.30	0.29	0.31	0.33	0.33	0.20	0.20	0.19	0.19	0.31	0.41	0.51	0.30	
Mg	0.18	0.18	0.19	0.19	0.19	0.17	0.12	0.12	0.38	0.36	0.36	0.35	0.25	0.30	0.07	0.22	
Ca	0.86	0.90	0.94	0.94	0.94	0.90	0.86	0.87	0.95	0.94	0.94	0.92	0.90	0.65	0.88	0.84	
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum cations	3.03	3.03	3.05	3.05	3.04	3.04	3.03	3.04	3.06	3.03	3.02	3.02	3.04	3.04	3.03	3.03	

*all Fe as FeO.

2. Model Input LeachXSTM/Orchestra**Table S15.** Input for estimated parameters via trial and error and experimental data for HFO.

	EAFS1	EAFS2_1	EAFS2_2	EAFS2_A	EAFS2_B
CO ₃ ²⁻ (mg/kg)	2.4×10^5	8.5×10^4	1.5×10^5	1.5×10^5	2.0×10^5
HFO (mg/kg)	500	2×10^4	8×10^4	1×10^5	500
HFO experimental	3.10×10^4	2.34×10^4	n.a.	n.a.	n.a.
pe	9	9	9	9	9
pH	1	1	1	1	1

n.a.: not analyzed.

3. Model Components LeachXSTM/Orchestra**Table S16.** Implemented solid solutions.

Brownmillerite_s s	ettr_ss	Fe[OH] ₂ Mn[OH] ₂ _ss	Hydroxide_ss	Spinel_ss	Wustite_ Periclase_ss
Ca ₂ Fe ₂ O ₅	Cu(OH) ₄	Fe(OH) ₂	Cu(OH) ₂	<i>FeV₂O₄</i>	MgO
Ca ₂ V ₂ O ₇	CrO ₄	Mn(OH) ₂	Co(OH) ₂	<i>FeCr₂O₄</i>	FeO
	Fe_Ettringite		Ca(OH) ₂	<i>FeAl₂O₄</i>	Cr ₂ O ₃
	Ettringite		Zn(OH) ₂	MgAl ₂ O ₄	V ₂ O ₅
	Ba_Ettringite		Pb(OH) ₂	MgCr ₂ O ₄	V ₂ O ₄
	AsO ₄		Ni(OH) ₂	Mn ₃ O ₄	MnO
	Co(OH) ₄				
	Bentorite				
	Sr_Ettringite				
	Pb(OH) ₄				
	Zn(OH) ₄				
	VO ₃				
	MoO ₄				
	Mn(OH) ₄				
	PO ₄				
	Ni(OH) ₄				

Italic & bold: not selected for sample EAFS2_B.

Table S17. Selected minerals.

Name	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant
AA_2CaO_Al2O3_8H2O[s]		2 Al[OH]4-		2 Ca+2		-2 H+		5 H2O								
AA_2CaO_Al2O3_SiO2_8H2O[s]		2 Al[OH]4-		2 Ca+2		3 H2O		1 H2SiO4-2								
AA_2CaO_Fe2O3_8H2O[s]		2 Ca+2		2 Fe[OH]4-		-2 H+		5 H2O								
AA_2CaO_Fe2O3_SiO2_8H2O[s]		2 Ca+2		2 Fe[OH]4-		4.44E-16 H+		3 H2O		1 H2SiO4-2						
AA_3CaO_Fe2O3_6H2O[s]		3 Ca+2		2 Fe[OH]4-		-4 H+		4 H2O								
AA_Brucite		-2 H+		2 H2O		1 Mg+2										
AA_Calcite		1 CO3-2		1 Ca+2												
Al2[MoO4]3		2 Al[OH]4-		8 H+		-8 H2O		3 MoO4-2								
Atacamite		1 Cl-		2 Cu+2		-3 H+		3 H2O								
Ba2V2O7·2H2O		2 Ba+2		-6 H+		5 H2O		2 VO2+								
Ba3[VO4]2·4H2O		3 Ba+2		-8 H+		8 H2O		2 VO2+								
BaCrO4		1 Ba+2		1 CrO4-2												
BaMoO4		1 Ba+2		1 MoO4-2												
Ba[SCR]O4[77%SO4]		1 Ba+2		0.23 CrO4-2		0.77 SO4-2										
Ba[SCR]O4[96%SO4]		1 Ba+2		0.04 CrO4-2		0.96 SO4-2										
Brucite		-2 H+		2 H2O		1 Mg+2										
CC_Calcite		1 CO3-2		1 Ca+2												
Ca2Cu3[PO4]3Cl		2 Ca+2		1 Cl-		3 Cu+2		3 PO4-3								
Ca2Pb3[PO4]3Cl		2 Ca+2		1 Cl-		3 PO4-3		3 Pb+2								
Ca2V2O7		2 Ca+2		-6 H+		3 H2O		2 VO2+								
Ca2V2O7·2H2O		2 Ca+2		-6 H+		5 H2O		2 VO2+								
Ca2Zn3[PO4]3Cl		2 Ca+2		1 Cl-		3 PO4-3		3 Zn+2								
Ca3Al2O6		2 Al[OH]4-		3 Ca+2		-4 H+		-2 H2O								
Ca3Cu2[PO4]3Cl		3 Ca+2		1 Cl-		2 Cu+2		3 PO4-3								
Ca3Pb2[PO4]3Cl		3 Ca+2		1 Cl-		3 PO4-3		2 Pb+2								
Ca3Zn2[PO4]3Cl		3 Ca+2		1 Cl-		3 PO4-3		2 Zn+2								
Ca3[AsO4]2·2.25H2O		2 AsO4-3		3 Ca+2		2.25 H2O										
Ca3[AsO4]2·3H2O		2 AsO4-3		3 Ca+2		3 H2O										
Ca3[AsO4]2·4H2O		2 AsO4-3		3 Ca+2		4 H2O										
Ca3[AsO4]2·6H2O		2 AsO4-3		3 Ca+2		6 H2O										
Ca3[VO4]2		3 Ca+2		-8 H+		4 H2O		2 VO2+								
Ca3[VO4]2·4H2O		3 Ca+2		-8 H+		8 H2O		2 VO2+								
Ca4Cu[PO4]3Cl		4 Ca+2		1 Cl-		1 Cu+2		3 PO4-3								
Ca4Pb[PO4]3Cl		4 Ca+2		1 Cl-		3 PO4-3		1 Pb+2								
Ca4Zn[PO4]3Cl		4 Ca+2		1 Cl-		3 PO4-3		1 Zn+2								
Ca4[OH]2[AsO4]2·4H2O[c]		2 AsO4-3		4 Ca+2		-2 H+		6 H2O								
Ca5[OH][AsO4]3[c]		3 AsO4-3		5 Ca+2		-1 H+		1 H2O								
CaCrO4		1 Ca+2		1 CrO4-2												
CaCu4[PO4]3Cl		1 Ca+2		1 Cl-		4 Cu+2		3 PO4-3								
CaMoO4[c]		1 Ca+2		1 MoO4-2												
CaMoO4[s]		1 Ca+2		1 MoO4-2												
CaPb4[PO4]3Cl		1 Ca+2		1 Cl-		3 PO4-3		4 Pb+2								
CaV2O6		1 Ca+2		-4 H+		2 H2O		2 VO2+								

Name	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant
CaZn4[PO4]3Cl		1 Ca+2		1 Cl-		3 PO4-3		4 Zn+2								
Ca[OH]2.Co[OH]2		1 Ca+2		1 Co+2		-4 H+		4 H2O								
Ca[OH]2.Cu[OH]2		1 Ca+2		1 Cu+2		-4 H+		4 H2O								
Ca[OH]2.Ni[OH]2		1 Ca+2		-4 H+		4 H2O		1 Ni+2								
Ca[OH]2.Pb[OH]2		1 Ca+2		-4 H+		4 H2O		1 Pb+2								
Ca[OH]2.Zn[OH]2		1 Ca+2		-4 H+		4 H2O		1 Zn+2								
Ca[VO3]2		1 Ca+2		-4 H+		2 H2O		2 VO2+								
Calcite		1 CO3-2		1 Ca+2												
Chloroapatite		5 Ca+2		1 Cl-		3 PO4-3										
Co3[AsO4]2		2 AsO4-3		3 Co+2												
Co3[PO4]2		3 Co+2		2 PO4-3												
CoCO3[s]		1 CO3-2		1 Co+2												
CoCl2		2 Cl-		1 Co+2												
CoCl2:6H2O		2 Cl-		1 Co+2		6 H2O										
CoF2		1 Co+2		2 F-												
CoF3		1 Co+2		3 F-		-1 e-										
CoHPO4[s]		1 Co+2		1 H+		1 PO4-3										
CoMoO4		1 Co+2		1 MoO4-2												
CoO		1 Co+2		-2 H+		1 H2O										
CoSO4:6H2O		1 Co+2		6 H2O		1 SO4-2										
CoSO4[s]		1 Co+2		1 SO4-2												
CoS[alpha]		1 Co+2		8 H+		-4 H2O		1 SO4-2		8 e-						
CoS[beta]		1 Co+2		8 H+		-4 H2O		1 SO4-2		8 e-						
Co[OH]2[s]		1 Co+2		-2 H+		2 H2O										
Co[OH]3		1 Co+2		-3 H+		3 H2O		-1 e-								
Cotunnite		2 Cl-		1 Pb+2												
Cr-Ettringite		2 Al[OH]4-		6 Ca+2		3 CrO4-2		-4 H+		30 H2O						
CrCl2		2 Cl-		1 CrO4-2		8 H+		-4 H2O		4 e-						
CrCl3		3 Cl-		1 CrO4-2		8 H+		-4 H2O		3 e-						
CrF3		1 CrO4-2		3 F-		8 H+		-4 H2O		3 e-						
CrO3		1 CrO4-2		2 H+		-1 H2O										
Cr[OH]2		1 CrO4-2		6 H+		-2 H2O		4 e-								
Cr[OH]3[am]		1 CrO4-2		5 H+		-1 H2O		3 e-								
Cr[OH]3[s]		1 CrO4-2		5 H+		-1 H2O		3 e-								
Crmetal		1 CrO4-2		8 H+		-4 H2O		6 e-								
Cu5[PO4]3Cl		1 Cl-		5 Cu+2		3 PO4-3										
CuCrO4		1 CrO4-2		1 Cu+2												
CuMoO4		1 Cu+2		1 MoO4-2												
CuMoO4[c]		1 Cu+2		1 MoO4-2												
Cu[OH]2[s]		1 Cu+2		-2 H+		2 H2O										
Diaspore		1 Al[OH]4-		1 H+		-2 H2O										
Dolo-Ba		1 Ba+2		2 CO3-2		1 Ca+2										
Dolo-Mg		2 CO3-2		1 Ca+2		1 Mg+2										
Dolo-Sr		2 CO3-2		1 Ca+2		1 Sr+2										
Fayalite		2 Fe[OH]4-		6 H+		-8 H2O		1 H2SiO4-2		2 e-						
Fe		1 Fe[OH]4-		4 H+		-4 H2O		3 e-								
Fe2[MoO4]3[1]		2 Fe[OH]4-		8 H+		-8 H2O		3 MoO4-2								
Fe2[MoO4]3[2]		2 Fe[OH]4-		8 H+		-8 H2O		3 MoO4-2								
FeMoO4		1 Fe[OH]4-		4 H+		-4 H2O		1 MoO4-2		1 e-						
FeV2O4		1 Fe[OH]4-		4 H+		-4 H2O		2 VO2+		5 e-						
Fe[VO3]2		1 Fe[OH]4-		-2 H2O		2 VO2+		1 e-								
Fluorite		1 Ca+2		2 F-												
Friedel_salt_BG		2 Al[OH]4-		4 Ca+2		2 Cl-		-4 H+		4 H2O						
Friedel_salt_ML		2 Al[OH]4-		4 Ca+2		2 Cl-		-4 H+		4 H2O						
Gehlenite		2 Al[OH]4-		2 Ca+2		-8 H2O		1 H2SiO4-2								

Name	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant
H2MoO4[s]	2	H+	1	MoO4-2												
Halite	1	Cl-	1	Na+												
Huntite	4	CO3-2	1	Ca+2	3	Mg+2										
Illite	2.3	Al[OH]4-	8.2	H+	-6.2	H2O	3.5	H2SiO4-2	0.6	K+	0.25	Mg+2				
Illite[1]	2.3	Al[OH]4-	8.2	H+	-11.2	H2O	3.5	H2SiO4-2	0.6	K+	0.25	Mg+2				
Illite[2]	2.3	Al[OH]4-	8.2	H+	-11.2	H2O	3.5	H2SiO4-2	0.6	K+	0.25	Mg+2				
K2Cr2O7	2	CrO4-2	2	H+	-1	H2O	2	K+								
K2CrO4	1	CrO4-2	2	K+												
K2MoO4	2	K+	1	MoO4-2												
Kalsilite	1	Al[OH]4-	2	H+	-4	H2O	1	H2SiO4-2	1	K+						
Karelianite	2	H+	-1	H2O	2	VO2+	4	e-								
Larnite	2	Ca+2	-2	H+	1	H2SiO4-2										
Laurionite	1	Cl-	-1	H+	1	H2O	1	Pb+2								
Magnesite	1	CO3-2	1	Mg+2												
Matlockite	1	Cl-	1	F-	1	Pb+2										
Melanothallite	2	Cl-	1	Cu+2												
Mg2V2O7	-6	H+	3	H2O	2	Mg+2	2	VO2+								
MgCr2O4	2	CrO4-2	8	H+	-4	H2O	1	Mg+2	6	e-						
MgCrO4	1	CrO4-2	1	Mg+2												
MgMoO4[s]	1	Mg+2	1	MoO4-2												
MgV2O6	-4	H+	2	H2O	1	Mg+2	2	VO2+								
Mg[VO3]2	-4	H+	2	H2O	1	Mg+2	2	VO2+								
Mileslag_Bentorite	6	Ca+2	2	CrO4-2	4	H+	30	H2O	3	SO4-2	6	e-				
Mileslag_Brownmillerite	0.6	Al[OH]4-	2	Ca+2	0.013	CrO4-2	1.363	Fe[OH]4-	-1.972	H+	-2.94	H2O	0.018	VO2+	0.057	e-
Mileslag_Calcium-Aluminum-Monochromate-Pentadecahydrate	2	Al[OH]4-	4	Ca+2	1	CrO4-2	-4	H+	13	H2O						
Mileslag_Fluoromayenite	14	Al[OH]4-	12	Ca+2	2	F-	-8	H+	-24	H2O						
Mileslag_Mo-AFM	2	Al[OH]4-	4	Ca+2	-4	H+	18	H2O	1	MoO4-2						
MnCl2·4H2O	2	Cl-	4	H2O	1	Mn+2										
MnMoO4	1	Mn+2	1	MoO4-2												
MnV2O6	-4	H+	2	H2O	1	Mn+2	2	VO2+								
Mn[OH]3	-3	H+	3	H2O	1	Mn+2	-1	e-								
Mn[VO3]2	-4	H+	2	H2O	1	Mn+2	2	VO2+								
MoO3	2	H+	-1	H2O	1	MoO4-2										
MoS2	24	H+	-12	H2O	1	MoO4-2	2	SO4-2	18	e-						
Na2Cr2O7	2	CrO4-2	2	H+	-1	H2O	2	Na+								
Na2CrO4	1	CrO4-2	2	Na+												
Na2Mo2O7	2	H+	-1	H2O	2	MoO4-2	2	Na+								
Na2MoO4	1	MoO4-2	2	Na+												
Na2MoO4·2H2O	2	H2O	1	MoO4-2	2	Na+										
Na3VO4	-4	H+	2	H2O	3	Na+	1	VO2+								
Na4V2O7	-6	H+	3	H2O	4	Na+	2	VO2+								
NaVO3	-2	H+	1	H2O	1	Na+	1	VO2+								
Nantokite	1	Cl-	1	Cu+2	1	e-										
Nepheline	1	Al[OH]4-	2	H+	-4	H2O	1	H2SiO4-2	1	Na+						
Nesquehonite	1	CO3-2	3	H2O	1	Mg+2										
NiMoO4	1	MoO4-2	1	Ni+2												
Pb2V2O7	-6	H+	3	H2O	2	Pb+2	2	VO2+								
Pb2[OH]3Cl	1	Cl-	-3	H+	3	H2O	2	Pb+2								
Pb3[VO4]2	-8	H+	4	H2O	3	Pb+2	2	VO2+								
PbCrO4	1	CrO4-2	1	Pb+2												
PbMoO4	1	MoO4-2	1	Pb+2												
PbMoO4[c]	1	MoO4-2	1	Pb+2												
PbMoO4[cc]	1	MoO4-2	1	Pb+2												
Pb[OH]2[s]	-2	H+	2	H2O	1	Pb+2										

Name	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant	Coefficient	Reactant
Phosgenite		1 CO3-2		2 Cl-		2 Pb+2										
Pyrite		1 Fe[OH]4-		20 H+		-12 H2O		2 SO4-2		15 e-						
Pyromorphite		1 Cl-		3 PO4-3		5 Pb+2										
Rhodochrosite		1 CO3-2		1 Mn+2												
Shcherbinaite		-2 H+		1 H2O		2 VO2+										
SrCrO4		1 CrO4-2		1 Sr+2												
SrMoO4		1 MoO4-2		1 Sr+2												
V2O4		2 VO2+		2 e-												
V2O5		-2 H+		1 H2O		2 VO2+										
V3O5		2 H+		-1 H2O		3 VO2+		5 e-								
V4O7		2 H+		-1 H2O		4 VO2+		6 e-								
V6O13		-2 H+		1 H2O		6 VO2+		4 e-								
VCl2		2 Cl-		4 H+		-2 H2O		1 VO2+		3 e-						
VCl3		3 Cl-		4 H+		-2 H2O		1 VO2+		2 e-						
VF4		4 F-		4 H+		-2 H2O		1 VO2+		1 e-						
VO		2 H+		-1 H2O		1 VO2+		3 e-								
VO2Cl		1 Cl-		1 VO2+												
VOCl		1 Cl-		2 H+		-1 H2O		1 VO2+		2 e-						
VOCl2		2 Cl-		2 H+		-1 H2O		1 VO2+		1 e-						
VOSO4[s]		2 H+		-1 H2O		1 SO4-2		1 VO2+		1 e-						
VO[OH]2		1 H2O		1 VO2+		1 e-										
V[OH]3[s]		1 H+		1 H2O		1 VO2+		2 e-								
Varnite		2 Ca+2		-4 H+		2 H2O		1 VO2+		1 e-						
Vmetal		4 H+		-2 H2O		1 VO2+		5 e-								
Zn2[OH]3Cl		1 Cl-		-3 H+		3 H2O		2 Zn+2								
Zn5[OH]8Cl2		2 Cl-		-8 H+		8 H2O		5 Zn+2								
Zn5[PO4]3Cl		1 Cl-		3 PO4-3		5 Zn+2										
ZnCl2[s]		2 Cl-		1 Zn+2												
ZnMoO4		1 MoO4-2		1 Zn+2												
ZnO[active]		-2 H+		1 H2O		1 Zn+2										
Zn[OH]2[s]		-2 H+		2 H2O		1 Zn+2										
[VO]3[PO4]2		6 H+		-3 H2O		2 PO4-3		3 VO2+		3 e-						

Italic & bold: not selected for sample EAFS1.

4. pH Dependence Leaching Test (Experimental Data and Modeled Results) for Ca, Si, Fe, Al, Mg and Mn

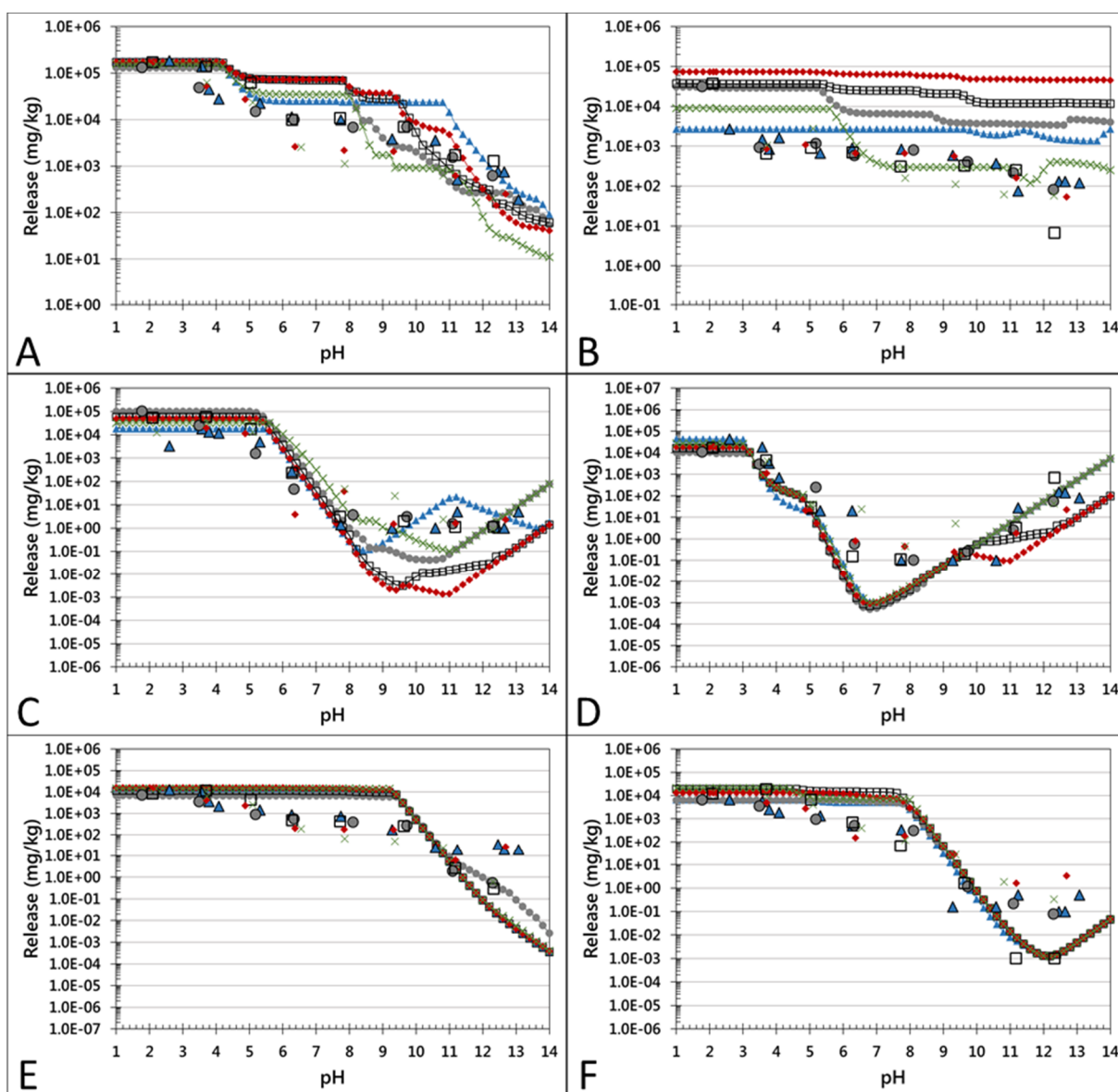


Figure S1. pH dependence leaching test (experimental data and modeled results) for Ca, Si, Fe, Al, Mg and Mn. **Symbols:** experimental data; corresponding **lines with symbols:** modeled results; for Ca (A), Si (B), Fe (C), Al (D), Mg (E) and Mn (F). **Samples:** EAFS1 (blue triangle and blue line with triangles), EAFS2_1 (grey circle and grey line with circles), EAFS2_2 (black square and black line with squares), EAFS2_A (red rhomb and red line with rhombs) and EAFS2_B (green cross and green line with crosses).

5. Calculated Leaching Controlling Phases and Mechanisms

Predominant species: roughly ordered from lower pH to higher pH. Background species: no specific order.

Table S18. Calculated leaching controlling phases and mechanisms for sample EAFS1.

Al	Ca	Fe	Si	Mg	Mn
predominant species/mechanisms					
Diaspore	AA_Calcite	Spinel_ss	FeOxide	FeOxide	FeOxide
Spinel_ss	AA_3CaO_Fe ₂ O ₃ _6H ₂ O[s]	AA_3CaO_Fe ₂ O ₃ _6H ₂ O[s]	Larnite	Spinel_ss	Rhodochrosite
ettr_ss	Hydroxide_ss		Nepheline	AA_Brucite	Spinel_ss
	FeOxide				
background species/mechanisms					
nepheline	ettr_ss	Wustite_Periclase_ss			ettr_ss
MiLeSlag_Fluoromayenite	Fluorite	Fe[VO ₃] ₂			
	Dolo-Ba				
	Larnite				
	Chloroapatite				
	CaxPb _{5-x} [PO ₄] ₃ Cl (4)				
	Ca[OH] ₂ .A[OH] ₂ (4)				
	Ca ₅ [OH][AsO ₄] ₃ [c]				
	MiLeSlag_Fluoromayenite				

X = 1-4 and A = Co, Ni, Cu, Zn.

Table S19. Calculated leaching controlling phases and mechanisms for sample EAFS2_1.

Al	Ca	Fe	Si	Mg	Mn
predominant species/mechanisms					
Diaspore	AA_Calcite	Fayalite	Kalsilite	AA_Brucite	FeOxide
Spinel_ss	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	Fayalite	Spinel_ss	Spinel_ss
ettr_ss	AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]	Spinel_ss	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	FeOxide	
AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]	ettr_ss		FeOxide	Illite	
	FeOxide		AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]		
background species/mechanisms					
Illite	Hydroxide_ss	FeMoO ₄	Illite	Wustite_Periclase_ss	Wustite_Periclase_ss
Kalsilite	Ca ₅ [OH][AsO ₄] ₃ [c]	Fe[VO ₃] ₂			
MiLeSlag_Fluoromayenite	Ca[OH] ₂ .A[OH] ₂ (3)	Wustite_Periclase_ss			
	Fluorite				
	Dolo-Ba				
	Dolo-Sr				
	Ca ₄ Pb[PO ₄] ₃ Cl				
	CaMoO ₄ [s]				
	Chloroapatite				
	MiLeSlag_Fluoromayenite				

A = Co, Ni, Cu.

Table S20. Calculated leaching controlling phases and mechanisms for sample EAFS2_2.

Al	Ca	Fe	Si	Mg	Mn
predominant species/mechanisms					
Diaspore	AA_Calcite	Fayalite	Illite	FeOxide	Rhodochrosite
Spinel_ss	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	Spinel_ss	Fayalite	AA_Brucite	FeOxide
AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]	AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	Spinel_ss	Spinel_ss
ettr_ss	FeOxide		AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]		
			FeOxide		
			Larnite		
background species/mechanisms					
Illite	Hydroxide_ss	FeMoO ₄	Illite	Wustite_Periclase_ss	Wustite_Periclase_ss
MiLeSlag_Fluoromayenite	ettr_ss	Fe[VO ₃] ₂		Illite	
	Ca ₅ [OH][AsO ₄] ₃ [c]	Wustite_Periclase_ss			
	Ca[OH] ₂ .A[OH] ₂ (4)				
	Fluorite				
	Dolo-Ba				
	CaMoO ₄ [s]				
	Chloroapatite				
	MiLeSlag_Fluoromayenite				
	Larnite				

A = Co, Ni, Cu, Zn.

Table S21. Calculated leaching controlling phases and mechanisms for sample EAFS2_A.

Al	Ca	Fe	Si	Mg	Mn
predominant species/mechanisms					
Diaspore	AA_Calcite	Fayalite	Nepheline	FeOxide	FeOxide
Spinel_ss	MiLeSlag_Fluoromayenite	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	Illite	AA_Brucite	Spinel_ss
AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	Spinel_ss	Larnite	Spinel_ss	
ettr_ss	AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]		Fayalite		
	FeOxide		AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]		
			AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]		
			FeOxide		
background species/mechanisms					
Illite	Hydroxide_ss	FeMoO ₄	Illite	Illite	Wustite_Periclase_ss
MiLeSlag_Fluoromayenite	ettr_ss	Fe[VO ₃] ₂			
Nepheline	Ca ₅ [OH][AsO ₄] ₃ [c]				
	Fluorite				
	Dolo-Ba				
	CaMoO ₄ [s]				
	Chloroapatite				
	Ca ₄ Pb[PO ₄] ₃ Cl				
	Larnite				
	Ca[OH] ₂ .A[OH] ₂ (4)				

A = Co, Ni, Cu, Zn.

Table S22. Calculated leaching controlling phases and mechanisms for sample EAFS2_B.

Al	Ca	Fe	Si	Mg	Mn
predominant species/mechanisms					
Diaspore	AA_Calcite	Fayalite	Illite	Illite	Rhodochrosite
AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	Fayalite	AA_Brucite	Spinel_ss
ettr_ss	AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]		AA_2CaO_Fe ₂ O ₃ _SiO ₂ _8H ₂ O[s]	Spinel_ss	FeOxide
	FeOxide		AA_2CaO_Al ₂ O ₃ _SiO ₂ _8H ₂ O[s]	FeOxide	
			FeOxide		
background species/mechanisms					
Spinel_ss	Hydroxide_ss	Wustite_Periclase_ss		Dolo-Mg	Wustite_Periclase_ss
Illite	ettr_ss	AA_3CaO_Fe ₂ O ₃ _6H ₂ O[s]		Wustite-Periclase_ss	
MiLeSlag_Fluoromayenite	AA_3CaO_Fe ₂ O ₃ _6H ₂ O[s]	Fe[VO ₃] ₂			
	CaxPb _{5-x} [PO ₄] ₃ Cl (3)				
	Ca[OH] ₂ .A[OH] ₂ (4)				
	Fluorite				
	Dolo-Ba				
	Dolo-Sr				
	Dolo-Mg				
	Chloroapatite				
	MiLeSlag_Fluoromayenite				

X = 1,3,4 and A = Co, Ni, Cu, Zn .

6. X-ray Diffraction (XRD) Pattern of Sample EAFS1

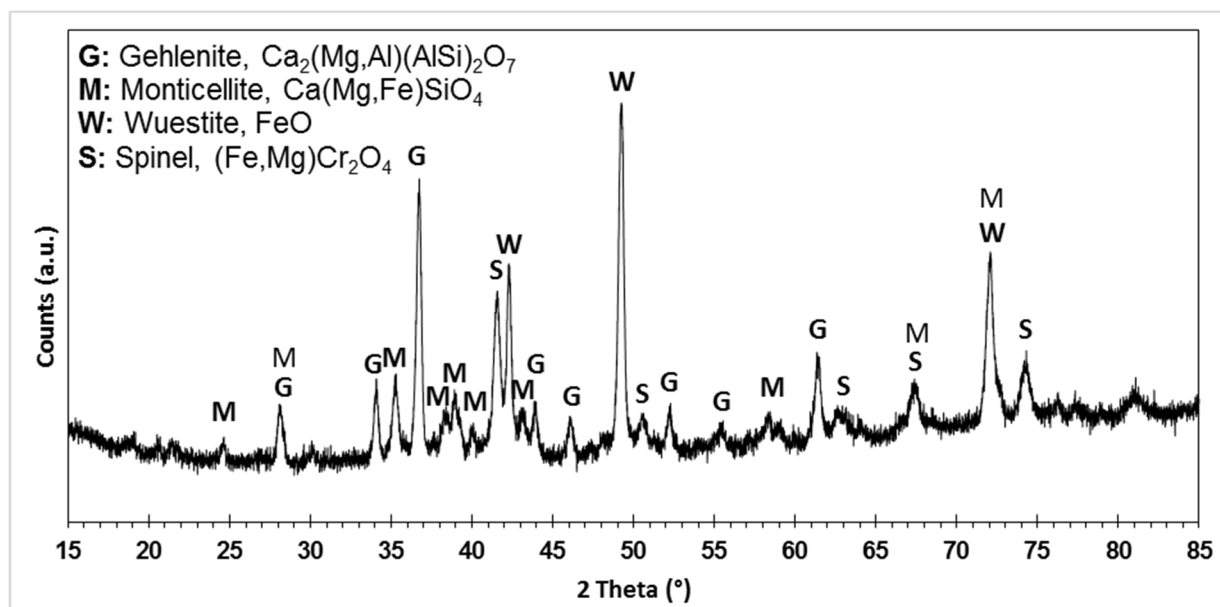


Figure S2. XRD pattern of sample EAFS1.

Table S23. Phase list of sample EAFS1.

Visible	Ref. Code	Score	Compound Name	Displacement [°2Th.]	Scale Factor	Chemical Formula
*	01-079-2422	72	Calcium Magnesium Aluminum Silicate	0.000	0.530	$\text{Ca}_2(\text{Mg}_{0.25}\text{Al}_{0.75})(\text{Si}_{1.25}\text{Al}_{0.75}\text{O}_7)$
*	98-004-1216	57	Wuestite	0.000	0.700	$\text{Fe}_{0.925}\text{O}_1$
*	98-008-5372	62	Chromite	0.000	0.404	$\text{Cr}_2\text{Fe}_{0.87}\text{Mg}_{0.13}\text{O}_4$
*	98-004-5700	32	Monticellite	0.000	0.140	$\text{Ca}_1\text{Fe}_{0.07}\text{Mg}_{0.93}\text{O}_4\text{Si}_1$

7. Calculated Leaching Controlling Phases and Mechanisms for V (Predominant and Background) by Using LeachXSM

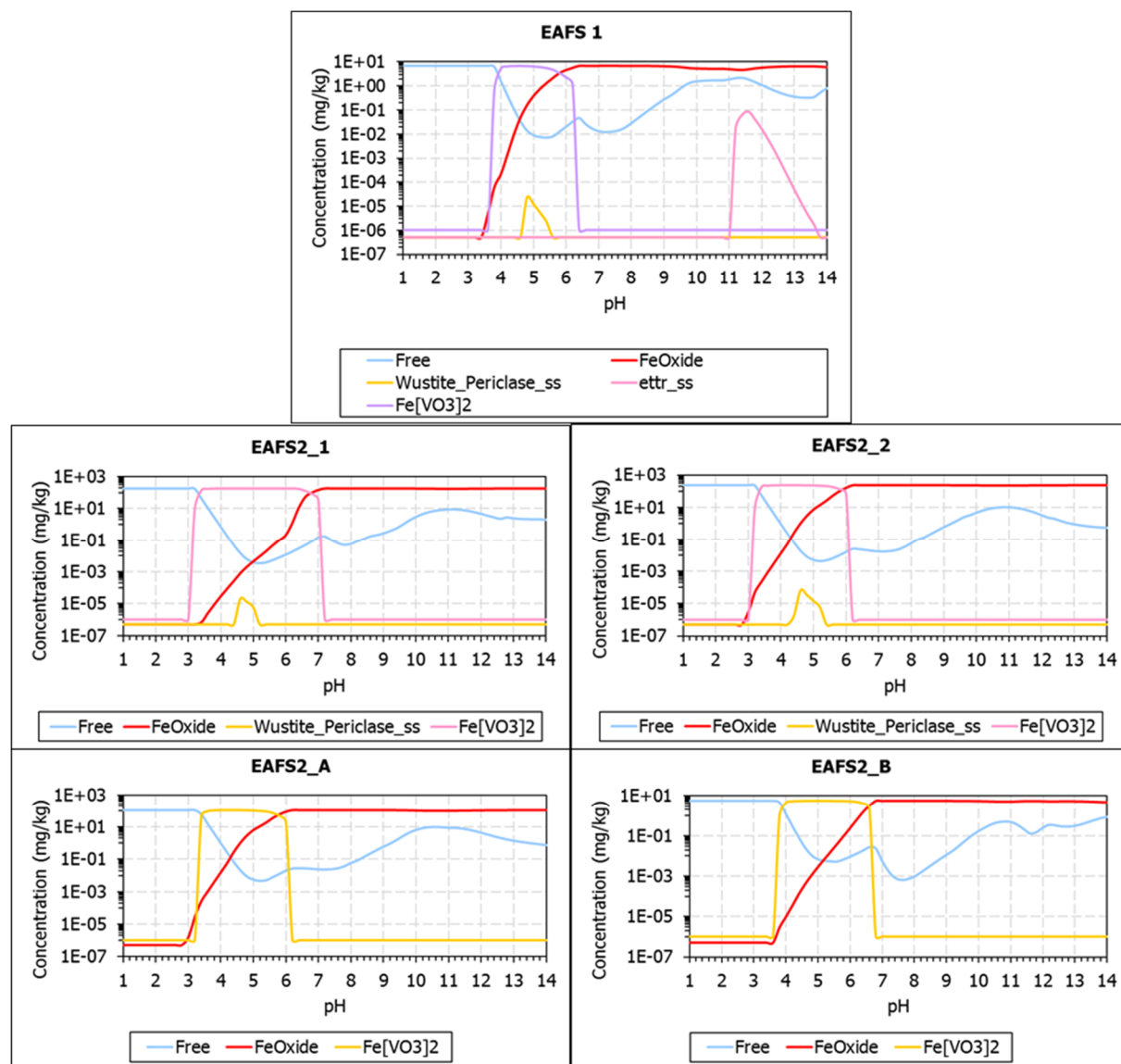


Figure S3. Calculated leaching controlling phases and mechanisms for V (predominant and background species) for samples EAFS1, EAFS2_1, EAFS2_2, EAFS2_A and EAFS2_B.

8. Calculation of a Simplified Slag System Using LeachXS™

Input:

- dissolved species: $\text{Fe}(\text{OH})^{4-}$, CrO_4^{2-} , Mg^{2+} and Mn^{2+}
- $\text{pe} + \text{pH} = 10$
- $\text{L/S} = 10$
- no adsorbing surfaces selected
- only one mineral phase selected: either spinel solid solution or wuestite solid solution

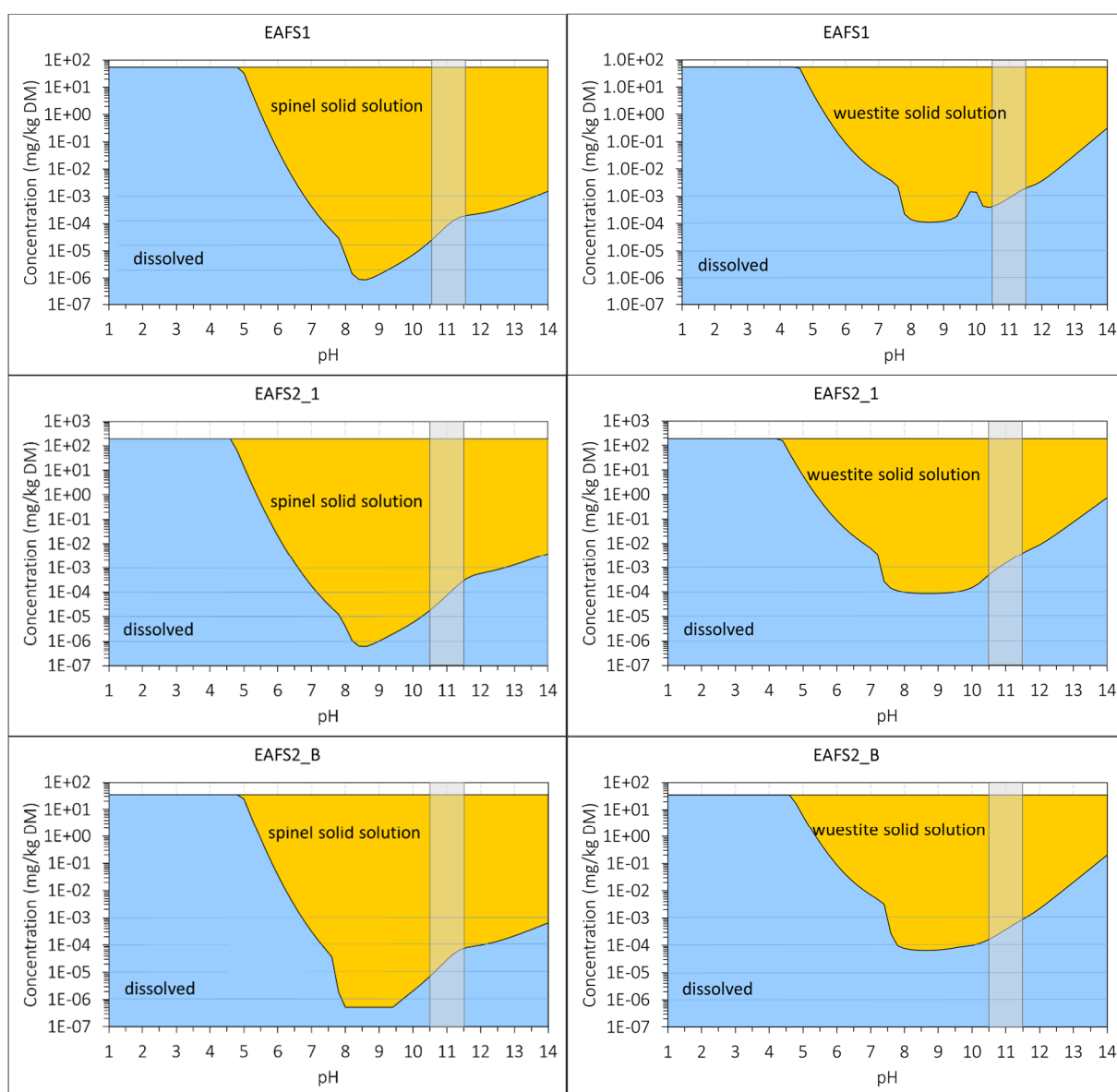


Figure S4. Hydrogeochemical modeling results for Cr in a simplified slag system with the dissolved species $\text{Fe}(\text{OH})^{4-}$, CrO_4^{2-} , Mg^{2+} and Mn^{2+} for sample EAFS1, EAFS2_1 and EAFS2_B. Left: precipitation of spinel solid solution. Right: precipitation of wuestite solid solution. Grey bar indicates natural pH range.