



Supplement of

Incorporation of W^{6+} into hematite ($\alpha\text{-Fe}_2\text{O}_3$) in the form of ferberite nanolamellae

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Table S1. Electron microprobe analyses of hematite from Hodruša. All values in weight %.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
1	0.07	3.96	95.52	99.55	2	0.07	3.23	96.51	99.80
3	0.08	3.06	96.78	99.92	4	0.05	3.33	96.49	99.88
5	0.08	1.99	97.35	99.42	6	0.03	2.76	96.98	99.77
7	0.08	3.68	96.06	99.83	8	0.09	3.22	95.81	99.12
9	0.06	3.75	95.56	99.37	10	0.08	3.72	95.99	99.79
11	0.05	2.71	97.04	99.79	12	0.06	3.48	96.36	99.91
13	0.07	3.13	96.28	99.47	14	0.07	3.76	95.93	99.77
15	0.10	3.91	95.73	99.74	16	0.09	3.93	96.08	100.10
17	0.10	4.67	94.85	99.62	18	0.17	4.31	94.86	99.35
19	0.10	4.70	94.95	99.76	20	0.13	3.83	95.66	99.62
21	1.24	0.33	98.21	99.78	22	1.57	0.12	97.91	99.60
23	1.46	0.18	97.89	99.54	24	1.17	0.27	98.22	99.66
25	1.02	0.28	98.41	99.71	26	1.00	0.40	98.55	99.96
27	1.64	0.21	98.01	99.85	28	0.78	0.27	98.98	100.03
29	1.19	0.26	98.02	99.48	30	0.21	0.61	98.28	99.10
31	0.30	0.65	97.98	98.94	32	0.30	0.42	99.27	99.98
33	0.42	0.52	98.22	99.16	34	0.28	0.54	99.14	99.96
35	0.16	0.77	98.74	99.66	36	0.09	0.29	99.18	99.56
37	0.10	0.51	98.92	99.53	38	0.09	0.68	98.69	99.46
39	0.31	0.63	98.71	99.65	40	0.35	0.33	98.81	99.49
41	0.08	3.11	96.48	99.67	42	0.05	2.19	97.18	99.43
43	0.07	3.25	95.98	99.31	44	0.05	2.57	96.58	99.21
45	0.04	3.01	95.92	98.98	46	0.09	3.81	95.88	99.78
47	0.06	3.56	95.75	99.37	48	0.19	3.53	95.55	99.27
49	0.19	3.40	95.73	99.33	50	0.19	3.51	95.69	99.39
51	0.17	3.39	95.62	99.18	52	0.15	3.13	96.44	99.71
53	0.19	3.48	95.43	99.10	54	0.17	3.44	95.73	99.35
55	0.21	3.59	95.73	99.54	56	0.18	3.47	95.28	98.93
57	0.16	3.40	95.22	98.79	58	0.15	3.78	95.58	99.51
59	0.21	3.38	95.48	99.07	60	0.16	3.59	95.42	99.17
61	0.22	3.28	95.56	99.06	62	0.11	3.77	95.72	99.60
63	0.16	3.54	95.58	99.28	64	0.13	3.52	96.15	99.80
65	0.11	3.68	95.72	99.51	66	0.14	3.57	95.78	99.49
67	0.10	2.89	96.25	99.24	68	0.16	3.40	95.88	99.44
69	0.17	3.37	96.01	99.54	70	0.14	3.47	95.68	99.29
71	0.08	3.56	95.81	99.44	72	0.06	2.50	96.88	99.43
73	0.14	3.11	96.22	99.48	74	0.13	3.22	95.99	99.34
75	0.09	3.34	95.88	99.31	76	0.12	3.77	95.88	99.77
77	0.13	3.24	95.82	99.19	78	0.07	2.90	96.38	99.35
79	0.13	3.40	95.66	99.20	80	0.10	3.10	95.85	99.05
81	0.07	0.92	98.35	99.34	82	0.33	0.53	98.37	99.22
83	0.48	0.64	98.02	99.14	84	0.06	0.57	98.27	98.90
85	0.12	0.53	98.54	99.19	86	0.14	0.71	98.52	99.38
87	0.10	0.68	98.55	99.33	88	0.21	0.73	98.52	99.47

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
89	0.14	0.60	98.68	99.42	90	0.08	1.26	97.92	99.26
91	0.10	0.67	98.61	99.38	92	0.10	0.53	98.47	99.10
93	0.11	0.94	98.55	99.60	94	0.15	0.93	98.29	99.38
95	0.27	0.47	98.44	99.18	96	0.18	0.51	98.45	99.14
97	0.13	0.88	98.35	99.36	98	0.32	0.55	98.48	99.35
99	0.11	0.60	98.61	99.32	100	0.11	0.61	98.88	99.60
101	0.10	0.73	98.24	99.07	102	0.10	0.47	98.78	99.35
103	0.07	0.89	98.57	99.53	104	0.14	0.71	98.39	99.24
105	0.20	0.47	98.69	99.36	106	0.08	0.46	98.88	99.41
107	0.16	0.55	98.91	99.62	108	0.09	0.49	99.02	99.60
109	0.23	0.43	98.65	99.31	110	0.73	0.40	98.42	99.55
111	1.00	0.44	97.85	99.29	112	1.16	0.21	97.97	99.33
113	0.77	0.29	97.94	98.99	114	1.15	0.21	98.08	99.44
115	1.43	0.22	97.44	99.09	116	0.99	0.07	94.32	95.38
117	1.46	0.18	96.91	98.54	118	1.12	0.25	98.04	99.41
119	1.75	0.16	93.79	95.70	120	0.08	3.24	96.02	99.34
121	0.13	3.38	96.22	99.73	122	0.06	3.09	96.55	99.70
123	0.13	3.23	96.36	99.73	124	0.14	3.62	95.82	99.58
125	0.16	3.62	95.59	99.37	126	0.12	3.52	96.03	99.67
127	0.10	3.64	95.85	99.59	128	0.13	3.47	96.14	99.73
129	0.15	3.48	95.63	99.26	130	0.18	3.38	95.92	99.48
131	0.11	3.34	95.79	99.25	132	0.10	3.80	95.61	99.50
133	0.09	3.27	95.99	99.35	134	0.11	3.54	95.81	99.46
135	0.09	3.57	96.06	99.72	136	0.09	3.62	96.08	99.78
137	0.20	3.20	96.09	99.50	138	0.07	3.24	96.54	99.85
139	0.07	2.79	96.81	99.66	140	0.07	2.62	97.02	99.72
141	0.18	3.57	96.12	99.87	142	0.12	3.77	95.76	99.66
143	0.16	3.39	96.24	99.79	144	0.19	3.76	95.52	99.47
145	0.20	3.78	95.88	99.86	146	0.12	3.95	95.12	99.18
147	0.15	3.82	95.53	99.51	148	0.13	3.86	95.63	99.63
149	0.09	3.96	95.76	99.82	150	0.09	3.81	95.71	99.60
151	0.21	4.04	95.45	99.70	152	0.21	3.68	95.56	99.46
153	0.20	3.48	95.91	99.59	154	0.19	3.67	95.92	99.78
155	0.23	3.72	95.61	99.56	156	0.19	3.82	95.86	99.88
157	0.11	3.33	96.39	99.83	158	0.04	2.46	97.52	100.02
159	0.08	3.87	95.93	99.89	160	0.15	3.39	95.83	99.38
161	1.26	0.58	97.76	99.61	162	0.20	0.65	98.81	99.66
163	1.24	0.51	98.24	99.99	164	1.01	0.44	98.31	99.76
165	1.41	0.36	97.65	99.42	166	0.66	0.51	98.02	99.20
167	1.58	0.28	97.31	99.16	168	0.58	0.54	98.69	99.81
169	0.83	0.48	98.62	99.93	170	0.45	0.43	98.98	99.86
171	0.71	0.40	98.45	99.56	172	0.13	0.41	99.14	99.68
173	0.06	1.20	98.64	99.90	174	1.49	0.35	97.75	99.58
175	1.47	0.48	97.56	99.52	176	1.69	0.26	97.39	99.34

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
177	1.49	0.40	98.02	99.91	178	1.82	0.16	97.91	99.88
179	1.39	0.55	96.46	98.40	180	1.61	0.43	97.12	99.17
181	1.55	0.51	97.58	99.64	182	1.58	0.47	97.21	99.26
183	1.73	0.36	97.32	99.41	184	1.70	0.38	97.29	99.37
185	2.02	0.13	97.39	99.54	186	1.95	0.18	97.11	99.23
187	1.86	0.15	97.42	99.43	188	1.95	0.18	97.15	99.27
189	2.00	0.16	97.84	100.00	190	1.97	0.14	97.48	99.59
191	1.37	0.16	97.66	99.20	192	0.98	0.21	98.37	99.56
193	1.29	0.31	97.97	99.57	194	0.92	0.45	98.24	99.61
195	1.27	0.28	97.72	99.27	196	1.32	0.25	97.74	99.31
197	1.24	0.12	97.92	99.28	198	1.20	0.10	98.41	99.70
199	1.09	0.37	97.92	99.38	200	0.97	0.26	98.35	99.58
201	0.13	3.28	96.18	99.58	202	0.14	3.54	95.89	99.58
203	0.12	3.77	96.01	99.90	204	0.13	3.86	95.92	99.91
205	0.11	3.54	96.42	100.08	206	0.09	3.77	95.85	99.71
207	0.13	3.75	95.88	99.75	208	0.10	3.61	95.93	99.64
209	0.08	3.58	96.01	99.66	210	0.18	3.85	95.36	99.39
211	0.17	3.72	95.92	99.81	212	0.16	3.69	95.11	98.96
213	0.19	3.52	96.12	99.83	214	0.25	3.08	95.86	99.19
215	0.08	3.37	96.36	99.81	216	0.06	2.96	97.08	100.10
217	0.07	2.69	97.05	99.80	218	0.05	3.01	96.81	99.88
219	0.05	3.62	95.82	99.49	220	0.06	4.15	96.11	100.31
221	0.42	0.35	98.68	99.45	222	1.14	0.35	97.99	99.49
223	1.37	0.53	97.68	99.58	224	1.20	0.54	97.76	99.51
225	0.76	0.59	98.75	100.10	226	1.29	0.29	97.98	99.56
227	1.10	0.19	98.39	99.68	228	1.29	0.24	98.35	99.89
229	0.85	0.33	98.88	100.06	230	1.15	0.02	98.12	99.30
231	0.53	0.33	98.82	99.69	232	1.05	0.26	98.15	99.46
233	1.27	0.24	97.86	99.37	234	0.36	0.47	98.75	99.58
235	1.09	0.24	98.04	99.36	236	1.04	0.13	98.51	99.67
237	0.47	0.58	98.47	99.52	238	1.57	0.06	98.11	99.74
239	1.26	0.28	97.82	99.36	240	1.22	0.61	97.14	98.97
241	0.09	3.77	95.61	99.47	242	0.08	3.78	96.18	100.04
243	0.07	4.10	95.43	99.61	244	0.10	3.37	96.36	99.83
245	0.12	3.47	96.69	100.28	246	0.09	3.54	95.89	99.53
247	0.07	3.22	96.24	99.52	248	0.08	3.47	95.71	99.26
249	0.40	1.00	97.76	99.17	250	0.04	2.60	97.06	99.70
251	0.07	3.17	96.46	99.70	252	0.07	2.52	97.48	100.07
253	0.05	2.81	96.64	99.50	254	0.08	3.59	96.08	99.75
255	0.03	3.30	96.16	99.50	256	0.03	2.08	97.02	99.13
257	0.25	3.86	95.36	99.47	258	0.09	3.48	95.61	99.17
259	0.15	3.58	95.72	99.45	260	0.11	3.49	96.06	99.66
261	1.39	0.64	96.54	98.56	262	1.51	0.54	96.34	98.39
263	1.14	0.91	97.12	99.17	264	1.05	0.80	97.76	99.61

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
265	0.20	0.62	98.81	99.63	266	0.46	0.78	98.47	99.71
267	1.55	0.58	96.99	99.13	268	0.42	0.80	98.34	99.56
269	0.15	0.62	98.71	99.48	270	1.49	0.68	97.38	99.55
271	0.16	0.42	99.08	99.66	272	0.62	0.58	98.32	99.52
273	1.62	0.41	97.62	99.65	274	0.89	0.51	98.12	99.52
275	0.76	0.48	98.15	99.39	276	1.02	0.40	98.34	99.75
277	1.26	0.26	97.85	99.37	278	1.10	0.52	97.88	99.50
279	1.49	0.43	97.55	99.47	280	1.86	0.14	97.52	99.52
281	0.04	2.96	96.94	99.94	282	0.09	3.62	95.93	99.64
283	0.04	1.89	97.69	99.63	284	0.08	3.75	96.39	100.21
285	0.08	3.64	96.25	99.97	286	0.10	3.09	96.82	100.01
287	0.09	3.95	95.52	99.56	288	0.08	3.72	96.16	99.96
289	0.06	2.60	97.06	99.72	290	0.07	2.91	97.31	100.29
291	0.11	3.52	95.83	99.46	292	0.09	3.10	96.45	99.64
293	0.08	2.85	97.15	100.08	294	0.04	3.13	96.51	99.67
295	0.06	2.82	97.09	99.98	296	0.08	3.69	95.98	99.75
297	0.10	3.85	95.98	99.92	298	0.12	3.68	95.71	99.51
299	0.09	3.80	95.93	99.82	300	0.13	3.91	95.58	99.61
301	0.14	3.47	95.92	99.53	302	0.09	3.01	96.81	99.91
303	0.09	3.33	96.46	99.89	304	0.06	2.88	97.42	100.35
305	0.07	2.33	97.34	99.74	306	0.10	3.04	96.58	99.71
307	0.08	2.82	97.15	100.05	308	0.07	3.61	96.38	100.06
309	0.08	3.40	96.45	99.93	310	0.09	3.47	96.19	99.75
311	0.39	0.47	98.69	99.55	312	1.01	0.54	98.61	100.15
313	1.14	0.25	98.31	99.70	314	0.45	0.69	98.72	99.87
315	1.53	0.19	97.56	99.29	316	1.72	0.20	97.81	99.72
317	1.47	0.13	97.94	99.53	318	1.73	0.18	97.75	99.65
319	1.34	0.42	97.91	99.66	320	0.63	0.51	98.69	99.84
321	0.48	0.65	98.32	99.45	322	0.28	0.80	98.52	99.60
323	0.92	0.79	98.24	99.95	324	0.03	0.92	98.91	99.86
325	0.06	0.53	99.12	99.72	326	0.74	0.47	98.85	100.06
327	0.68	0.41	98.75	99.85	328	0.47	0.42	98.55	99.44
329	0.86	0.60	98.54	100.00	330	1.31	0.39	98.05	99.75
331	0.08	2.02	97.86	99.97	332	0.04	2.81	96.85	99.71
333	0.09	3.04	96.89	100.02	334	0.06	2.85	96.82	99.74
335	0.11	3.90	95.38	99.38	336	0.11	3.88	96.25	100.25
337	0.14	3.75	95.29	99.18	338	0.14	3.54	96.42	100.10
339	0.20	3.44	96.19	99.84	340	0.25	3.42	95.55	99.22
341	0.07	2.64	97.16	99.87	342	0.17	3.71	95.82	99.70
343	0.16	3.73	95.93	99.82	344	0.06	3.30	96.66	100.03
345	0.05	3.82	96.02	99.90	346	0.05	3.49	96.28	99.82
347	0.06	3.80	96.61	100.46	348	0.04	3.38	96.51	99.93
349	0.02	2.66	97.08	99.76	350	0.05	4.19	95.71	99.95
351	0.97	0.19	98.09	99.25	352	1.66	0.20	97.55	99.41

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
353	1.23	0.21	98.17	99.60	354	1.25	0.26	98.09	99.61
355	1.00	0.36	98.99	100.35	356	0.19	0.28	99.19	99.66
357	0.18	0.67	98.72	99.58	358	0.80	0.29	98.38	99.47
359	0.50	0.23	98.82	99.56	360	1.33	0.11	98.37	99.81
361	0.89	0.16	98.58	99.63	362	0.99	0.29	98.61	99.88
363	0.84	0.32	98.72	99.88	364	0.51	0.26	99.07	99.84
365	1.51	0.15	98.07	99.73	366	1.68	0.24	97.62	99.54
367	1.59	0.21	97.85	99.65	368	1.45	0.19	98.04	99.68
369	1.55	0.16	97.88	99.60	370	1.07	0.33	98.07	99.46
371	0.10	3.32	96.59	100.01	372	0.06	2.75	97.25	100.06
373	0.23	3.42	96.72	100.37	374	0.04	2.79	97.49	100.32
375	0.14	3.30	96.66	100.11	376	0.12	3.06	96.62	99.80
377	0.27	3.63	96.41	100.31	378	0.15	3.04	96.76	99.96
379	0.07	2.90	97.08	100.05	380	0.05	0.58	99.18	99.81
381	0.03	2.17	97.61	99.81	382	0.03	1.82	98.42	100.27
383	0.08	2.90	96.79	99.77	384	0.07	2.16	97.68	99.91
385	0.06	2.80	97.26	100.12	386	1.42	0.25	98.07	99.73
387	1.36	0.31	98.32	100.00	388	1.56	0.46	98.02	100.04
389	1.27	0.18	98.15	99.60	390	1.37	0.40	98.32	100.10
391	1.58	0.32	98.41	100.31	392	1.35	0.49	98.38	100.22
393	1.82	0.34	97.66	99.82	394	1.32	0.40	98.07	99.79
395	0.55	0.59	98.87	100.00	396	0.61	0.68	99.14	100.43
397	0.51	0.52	99.12	100.16	398	0.88	0.76	98.49	100.13
399	1.25	0.42	98.35	100.02	400	0.70	0.58	98.74	100.02
401	0.05	3.78	96.02	99.85	402	0.05	2.01	97.42	99.47
403	0.06	3.52	96.14	99.71	404	0.10	3.80	95.49	99.38
405	0.08	3.46	96.08	99.61	406	0.07	3.67	95.79	99.53
407	0.12	3.83	95.88	99.83	408	0.07	3.85	95.75	99.66
409	0.08	4.28	95.53	99.89	410	0.07	4.67	94.98	99.71
411	0.08	4.54	95.28	99.89	412	0.09	4.69	94.93	99.72
413	0.09	4.63	95.09	99.81	414	0.08	4.60	95.53	100.21
415	0.03	2.99	96.18	99.20	416	0.04	2.95	96.56	99.55
417	0.09	4.59	95.19	99.87	418	0.06	2.88	96.98	99.91
419	0.17	3.76	95.59	99.52	420	0.18	3.66	95.96	99.80
421	1.72	0.73	97.49	99.94	422	0.06	3.06	97.12	100.25
423	0.07	4.70	94.63	99.40	424	0.09	4.17	95.36	99.62
425	0.14	4.04	95.36	99.54	426	0.14	4.35	95.08	99.56
427	0.14	3.82	95.73	99.70	428	0.13	4.07	95.58	99.78
429	0.10	3.80	95.85	99.75	430	0.09	4.09	95.72	99.90
431	0.14	3.93	95.72	99.79	432	0.19	3.76	95.13	99.08
433	0.18	3.37	95.55	99.10	434	0.10	4.19	95.01	99.29
435	0.11	4.44	95.79	100.34	436	0.10	3.95	95.61	99.65
437	0.11	3.93	95.78	99.82	438	0.07	4.48	94.82	99.37
439	0.11	4.34	95.36	99.81	440	0.09	4.33	95.06	99.48

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
441	0.11	4.57	95.22	99.90	442	0.05	3.75	95.66	99.46
443	0.03	3.69	96.05	99.77	444	0.07	4.45	95.35	99.87
445	0.03	2.86	96.44	99.33	446	0.21	3.95	95.41	99.56
447	0.05	4.57	95.49	100.11	448	0.16	3.93	94.92	99.02
449	0.18	3.81	95.19	99.18	450	0.14	4.25	95.29	99.68
451	1.93	0.27	96.81	99.01	452	2.00	0.19	97.15	99.34
453	1.93	0.50	96.89	99.32	454	1.72	0.59	96.98	99.29
455	1.78	0.72	96.96	99.46	456	0.20	1.13	97.89	99.22
457	0.29	1.20	97.82	99.31	458	0.51	1.14	97.71	99.36
459	0.48	1.03	97.69	99.20	460	0.36	0.74	98.27	99.37
461	1.23	0.95	97.31	99.48	462	1.84	0.45	97.31	99.60
463	1.53	0.59	97.44	99.56	464	1.73	0.44	96.94	99.10
465	1.36	0.69	97.24	99.29	466	2.00	0.42	96.39	98.81
467	1.74	0.43	96.66	98.83	468	1.80	0.50	96.85	99.15
469	0.95	0.90	97.82	99.67	470	1.32	0.76	97.24	99.31
471	1.43	0.82	96.78	99.03	472	1.88	0.40	96.69	98.98
473	1.84	0.34	97.34	99.52	474	1.67	0.40	97.11	99.17
475	1.83	0.68	96.82	99.33	476	1.66	0.72	96.99	99.38
477	1.78	0.64	97.21	99.62	478	1.63	0.61	96.98	99.22
479	1.88	0.28	96.84	99.00	480	1.47	0.52	96.78	98.77
481	1.93	0.45	97.06	99.44	482	1.91	0.31	96.81	99.03
483	1.66	0.73	96.65	99.03	484	1.76	0.66	96.72	99.14
485	1.41	0.75	96.76	98.92	486	1.64	0.46	97.18	99.28
487	1.59	0.86	97.11	99.56	488	1.39	0.88	96.85	99.12
489	1.54	0.67	96.69	98.91	490	0.92	1.24	96.64	98.79
491	1.03	1.29	97.04	99.35	492	0.99	1.32	97.16	99.48
493	1.08	1.12	96.48	98.69	494	1.04	1.16	96.65	98.85
495	1.07	1.23	96.41	98.71	496	1.31	0.98	97.19	99.48
497	1.59	0.72	96.48	98.79	498	1.37	0.76	97.06	99.20
499	0.82	0.67	97.85	99.35	500	0.89	0.80	98.08	99.77
501	0.08	4.29	95.15	99.52	502	0.23	3.99	95.23	99.45
503	0.14	4.20	94.88	99.22	504	0.17	4.09	95.19	99.45
505	0.10	4.35	95.02	99.47	506	0.08	4.24	95.78	100.09
507	0.11	4.25	95.23	99.59	508	0.09	4.28	95.19	99.56
509	0.07	3.95	95.29	99.31	510	0.08	3.92	95.05	99.05
511	0.12	3.85	95.81	99.77	512	0.11	3.82	95.65	99.58
513	0.08	3.88	95.93	99.90	514	0.10	3.81	95.65	99.56
515	0.09	3.69	95.96	99.75	516	0.05	3.73	95.82	99.61
517	0.07	3.15	97.14	100.36	518	0.04	2.52	97.09	99.65
519	0.03	2.66	97.44	100.13	520	0.05	2.18	97.61	99.84
521	0.03	3.00	96.65	99.68	522	0.03	2.85	97.32	100.20
523	0.15	3.27	96.01	99.42	524	0.09	3.58	96.69	100.36
525	0.07	3.51	93.88	97.45	526	0.02	4.00	95.55	99.57
527	0.04	3.97	95.59	99.60	528	0.05	3.47	96.58	100.10

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
529	0.05	3.19	96.21	99.45	530	0.32	3.44	95.61	99.37
531	0.06	4.77	94.98	99.80	532	0.12	4.54	94.95	99.61
533	0.07	3.62	96.49	100.19	534	0.12	4.34	95.62	100.07
535	0.11	3.87	95.43	99.41	536	0.18	3.97	95.45	99.60
537	0.19	4.17	95.26	99.63	538	0.09	3.32	96.12	99.53
539	0.06	3.25	96.69	100.01	540	0.07	3.69	96.48	100.24
541	0.17	4.06	95.68	99.91	542	0.06	3.93	96.03	100.03
543	0.24	4.21	95.02	99.48	544	0.13	3.71	96.42	100.26
545	0.19	4.01	96.16	100.36	546	0.18	4.34	95.39	99.91
547	0.09	3.80	95.18	99.07	548	0.03	3.25	96.58	99.86
549	0.03	3.00	96.75	99.78	550	0.06	3.61	96.19	99.86
551	1.77	0.52	97.66	99.96	552	1.58	0.88	97.16	99.62
553	1.72	0.62	97.72	100.06	554	1.61	0.61	97.09	99.31
555	1.53	0.72	97.62	99.86	556	1.53	0.83	97.45	99.81
557	1.59	0.47	97.79	99.85	558	1.77	0.39	97.38	99.54
559	1.80	0.37	97.15	99.32	560	1.98	0.30	97.29	99.58
561	1.93	0.35	97.58	99.85	562	2.06	0.17	96.92	99.15
563	2.02	0.46	97.39	99.87	564	1.75	0.51	97.25	99.51
565	1.46	0.90	97.05	99.41	566	1.70	0.60	97.66	99.96
567	1.62	0.68	97.21	99.51	568	1.57	0.57	97.65	99.79
569	1.77	0.65	96.91	99.33	570	1.46	0.51	97.72	99.69
571	1.58	0.73	96.91	99.22	572	1.28	0.85	97.09	99.22
573	1.74	0.70	97.35	99.79	574	2.10	0.26	97.31	99.66
575	0.34	0.79	99.19	100.33	576	0.33	0.92	99.11	100.36
577	0.24	0.98	99.31	100.52	578	0.17	0.97	99.42	100.56
579	0.36	0.79	99.01	100.16	580	0.31	0.98	98.99	100.29
581	0.09	1.18	98.57	99.84	582	0.12	0.90	98.77	99.78
583	0.15	0.99	98.32	99.46	584	0.11	0.71	98.64	99.46
585	1.53	0.66	97.52	99.71	586	1.62	0.58	97.45	99.65
587	1.42	0.89	97.35	99.66	588	1.77	0.66	97.14	99.57
589	1.70	0.70	97.28	99.68	590	1.06	0.98	97.99	100.04
591	1.78	0.61	97.55	99.94	592	1.67	0.55	97.51	99.73
593	1.71	0.28	97.35	99.34	594	1.81	0.45	97.39	99.65
595	1.88	0.40	97.26	99.55	596	1.68	0.08	97.54	99.29
597	1.29	0.27	98.05	99.61	598	1.64	0.63	97.68	99.95
599	0.74	0.67	98.34	99.75	600	0.12	0.86	98.61	99.59
601	0.05	3.13	97.61	100.78	602	0.08	3.23	96.85	100.16
603	0.17	2.88	96.24	99.28	604	0.12	2.94	96.54	99.60
605	0.17	2.53	97.15	99.86	606	0.19	2.57	97.36	100.12
607	0.17	2.67	96.55	99.40	608	0.18	2.51	97.09	99.79
609	0.22	3.25	96.31	99.78	610	0.21	3.13	96.16	99.50
611	0.16	2.98	96.48	99.61	612	0.10	3.22	96.79	100.10
613	0.02	2.65	97.29	99.96	614	0.12	2.70	97.36	100.19
615	0.04	2.66	97.55	100.25	616	0.05	2.47	97.54	100.06

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
617	0.05	3.03	97.04	100.12	618	0.06	2.60	97.29	99.95
619	0.02	2.53	97.65	100.21	620	0.15	3.05	96.49	99.70
621	0.05	2.76	97.19	100.00	622	0.10	3.00	97.15	100.25
623	0.09	2.95	96.58	99.62	624	0.05	2.79	97.29	100.13
625	0.25	3.17	96.41	99.82	626	0.03	2.16	97.85	100.04
627	0.02	1.80	97.91	99.73	628	0.03	3.01	96.92	99.97
629	0.03	2.24	97.68	99.95	630	0.04	1.78	97.86	99.68
631	0.12	3.54	96.51	100.17	632	0.08	3.38	96.52	99.98
633	0.04	2.23	97.92	100.19	634	0.03	1.46	98.75	100.24
635	0.05	1.50	98.39	99.94	636	0.04	3.11	97.19	100.35
637	0.06	3.05	97.42	100.54	638	0.12	3.22	96.65	99.98
639	0.10	1.13	97.97	99.19	640	0.13	0.79	98.71	99.63
641	0.04	2.85	97.02	99.91	642	0.08	2.89	96.88	99.85
643	0.03	3.11	97.02	100.17	644	0.03	2.99	97.28	100.30
645	0.05	2.82	97.34	100.21	646	0.04	2.23	97.72	99.99
647	0.21	3.61	95.59	99.41	648	0.08	4.17	95.51	99.76
649	0.10	2.90	96.85	99.85	650	0.04	2.07	97.84	99.95
651	1.63	0.33	97.14	99.10	652	1.66	0.33	97.45	99.45
653	1.38	0.69	97.14	99.21	654	1.26	0.28	97.69	99.24
655	1.52	0.28	97.62	99.42	656	0.31	0.38	98.97	99.65
657	0.13	0.33	99.24	99.70	658	0.38	0.54	98.58	99.49
659	0.13	0.21	99.38	99.72	660	0.18	0.18	98.94	99.30
661	0.30	0.39	98.68	99.37	662	0.30	0.38	98.67	99.35
663	0.06	0.53	98.95	99.54	664	0.10	0.35	99.01	99.47
665	0.13	0.49	99.04	99.67	666	0.05	0.59	99.04	99.68
667	0.08	0.46	99.24	99.77	668	0.78	0.40	98.98	100.16
669	0.20	0.29	99.22	99.71	670	0.60	0.43	98.72	99.75
671	0.03	0.68	98.99	99.71	672	0.47	0.48	98.52	99.47
673	0.29	0.46	99.11	99.86	674	0.19	0.18	99.25	99.63
675	0.13	1.07	98.75	99.95	676	0.13	0.95	99.08	100.16
677	0.29	0.85	98.98	100.12	678	0.37	1.06	98.25	99.68
679	0.26	0.83	99.38	100.47	680	0.08	0.96	99.64	100.68
681	0.49	0.73	98.72	99.94	682	0.42	0.81	98.79	100.02
683	0.81	0.65	99.02	100.48	684	0.24	0.72	99.45	100.42
685	0.13	1.21	98.71	100.05	686	0.05	1.04	99.15	100.24
687	1.00	0.49	98.54	100.03	688	0.14	0.49	98.78	99.41
689	0.12	0.66	98.79	99.58	690	0.14	0.98	98.99	100.11
691	1.09	0.28	98.29	99.66	692	0.40	0.81	98.69	99.90
693	0.30	1.03	98.71	100.04	694	0.30	0.96	98.95	100.21
695	0.23	0.97	98.61	99.81	696	0.39	0.85	98.88	100.11
697	1.18	0.52	98.19	99.89	698	0.36	0.77	98.67	99.80
699	0.80	0.70	98.68	100.18	700	0.39	0.92	98.97	100.27
701	0.12	4.58	95.21	99.90	702	0.08	3.34	96.26	99.68
703	0.08	3.91	95.85	99.84	704	0.04	4.43	95.82	100.28

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
705	0.06	4.25	95.55	99.86	706	0.09	4.40	95.23	99.72
707	0.05	4.25	95.55	99.84	708	0.05	3.92	96.62	100.59
709	0.04	3.88	95.45	99.37	710	0.08	4.53	95.46	100.07
711	0.05	3.97	96.32	100.34	712	0.08	4.36	95.65	100.09
713	0.04	3.78	96.71	100.53	714	0.05	3.69	96.32	100.07
715	0.05	3.47	96.68	100.20	716	0.05	1.88	98.38	100.31
717	0.04	3.77	95.93	99.74	718	0.07	4.44	95.93	100.44
719	0.04	2.96	97.59	100.60	720	0.04	3.10	97.02	100.17
721	0.06	2.64	97.92	100.62	722	0.02	2.76	97.01	99.79
723	0.04	2.64	97.36	100.04	724	0.03	2.60	97.54	100.17
725	0.04	3.81	96.74	100.59	726	2.02	0.30	97.14	99.46
727	1.73	0.45	97.16	99.34	728	1.88	0.37	97.05	99.30
729	1.87	0.49	97.34	99.70	730	1.35	0.87	97.61	99.83
731	1.32	0.75	96.98	99.04	732	1.34	0.83	97.18	99.35
733	1.65	0.43	97.85	99.93	734	1.68	0.38	97.51	99.57
735	0.83	0.57	98.01	99.41	736	1.44	0.69	98.02	100.16
737	1.44	0.70	97.69	99.83	738	1.88	0.37	97.58	99.83
739	1.77	0.52	97.76	100.06	740	1.93	0.40	97.61	99.93
741	1.95	0.42	97.35	99.71	742	1.89	0.39	97.44	99.72
743	1.87	0.37	97.35	99.59	744	1.88	0.39	97.46	99.74
745	1.98	0.15	97.76	99.90	746	1.82	0.29	98.05	100.16
747	1.52	0.86	97.71	100.08	748	1.62	0.53	97.92	100.07
749	1.31	0.58	98.52	100.41	750	1.38	0.28	98.61	100.27
751	0.05	2.82	97.05	99.92	752	0.01	3.63	96.52	100.17
753	0.04	1.70	98.24	99.98	754	0.10	3.25	96.45	99.80
755	0.07	1.59	97.78	99.44	756	0.18	3.61	96.01	99.79
757	0.03	2.40	97.68	100.10	758	0.11	3.96	96.22	100.29
759	0.11	4.22	95.49	99.83	760	0.18	1.43	90.16	91.76
761	0.09	3.81	95.91	99.80	762	0.10	3.97	95.95	100.02
763	0.06	4.00	96.24	100.29	764	0.09	4.10	95.32	99.51
765	0.12	3.72	96.14	99.97	766	0.07	3.99	95.82	99.87
767	0.06	3.87	96.02	99.95	768	0.10	3.19	96.24	99.53
769	0.13	3.96	96.12	100.21	770	0.12	4.35	95.12	99.59
771	0.15	4.19	95.31	99.64	772	0.21	4.22	95.28	99.71
773	0.15	3.85	95.93	99.93	774	0.16	3.59	95.83	99.59
775	0.25	2.74	96.31	99.29	776	1.65	0.67	97.18	99.50
777	1.78	0.52	97.04	99.34	778	2.02	0.35	96.98	99.36
779	1.91	0.15	97.61	99.66	780	0.99	0.20	98.19	99.39
781	1.82	0.18	97.59	99.60	782	1.71	0.63	97.28	99.61
783	1.56	0.69	96.96	99.22	784	1.59	0.67	96.98	99.24
785	1.98	0.20	97.29	99.48	786	0.30	0.45	94.42	95.17
787	1.04	0.61	98.31	99.96	788	1.67	0.78	96.31	98.75
789	1.40	0.84	96.99	99.23	790	1.34	1.10	96.98	99.42
791	1.17	1.23	96.42	98.82	792	1.70	0.57	96.88	99.15

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
793	1.85	0.46	97.19	99.51	794	1.36	1.07	96.68	99.11
795	1.56	0.78	96.98	99.32	796	1.69	0.50	97.94	100.13
797	1.18	0.97	97.69	99.85	798	1.25	0.88	96.96	99.10
799	1.59	0.74	97.64	99.97	800	1.40	0.63	97.75	99.78
801	0.10	4.10	95.89	100.09	802	0.20	3.28	96.75	100.23
803	0.07	3.22	96.24	99.52	804	0.11	3.28	97.22	100.61
805	0.06	3.75	96.45	100.26	806	0.10	3.95	96.02	100.06
807	0.07	3.58	96.41	100.06	808	0.10	3.59	96.49	100.19
809	0.15	3.35	96.39	99.90	810	0.13	3.73	96.16	100.02
811	0.20	3.22	96.64	100.05	812	0.06	2.01	98.29	100.36
813	0.14	1.54	97.48	99.16	814	0.09	3.10	96.41	99.60
815	0.21	2.30	97.14	99.64	816	0.17	3.64	96.06	99.87
817	0.16	3.44	96.26	99.87	818	0.14	3.75	95.96	99.85
819	0.16	3.23	96.39	99.78	820	0.04	3.37	96.88	100.28
821	0.09	4.06	96.08	100.23	822	0.06	3.61	96.61	100.28
823	0.08	2.38	97.58	100.04	824	0.18	3.51	96.78	100.46
825	0.12	3.32	96.88	100.31	826	0.09	3.33	96.98	100.40
827	0.20	3.48	96.34	100.01	828	0.07	2.60	97.98	100.65
829	0.06	3.93	96.99	100.99	830	0.09	4.28	96.31	100.67
831	0.04	1.75	97.94	99.73	832	0.07	2.93	97.64	100.63
833	0.21	2.55	95.81	98.57	834	0.04	2.79	97.41	100.24
835	0.24	0.16	98.07	98.47	836	0.11	3.78	96.68	100.57
837	0.27	3.29	95.91	99.47	838	0.28	3.37	95.92	99.56
839	0.22	3.61	95.75	99.57	840	1.37	0.85	97.12	99.34
841	0.28	1.95	98.18	100.42	842	0.25	2.47	96.94	99.66
843	0.23	3.10	96.42	99.75	844	0.24	2.88	97.01	100.12
845	0.22	1.92	97.55	99.68	846	0.07	2.53	97.15	99.76
847	0.14	2.67	96.86	99.68	848	0.18	3.14	97.05	100.37
849	0.21	2.94	97.19	100.34	850	0.05	1.74	98.11	99.89
851	0.07	1.89	98.18	100.14	852	0.23	2.17	96.96	99.37
853	0.29	3.40	95.73	99.43	854	0.22	3.39	95.93	99.55
855	1.55	0.15	95.62	97.32	856	0.69	1.97	96.79	99.45
857	0.04	3.44	97.12	100.61	858	0.05	1.21	98.84	100.10
859	0.19	0.35	86.91	87.46	860	0.07	4.33	96.02	100.42
861	0.11	4.12	96.36	100.60	862	0.10	3.44	96.72	100.26
863	0.04	1.65	98.22	99.91	864	0.07	3.86	96.35	100.28
865	0.15	3.68	96.31	100.14	866	1.16	0.65	97.48	99.29
867	0.41	2.41	97.15	99.97	868	0.08	3.35	96.14	99.57
869	0.10	1.46	98.29	99.86	870	0.21	3.66	90.54	94.41
871	0.19	2.28	97.81	100.28	872	0.70	2.89	93.48	97.07
873	0.09	4.01	96.08	100.18	874	0.10	3.49	96.95	100.54
875	0.17	1.64	55.96	57.77	876	0.12	2.94	97.49	100.55
877	0.14	1.89	98.44	100.47	878	0.08	3.75	96.58	100.40
879	0.06	3.57	97.21	100.83	880	0.19	4.25	95.18	99.62

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
881	0.15	4.22	95.58	99.95	882	0.14	4.30	95.52	99.96
883	0.17	4.30	95.33	99.81	884	0.14	4.04	95.46	99.63
885	0.17	3.97	95.32	99.46	886	0.15	4.36	94.93	99.45
887	0.14	4.34	95.71	100.18	888	0.12	4.31	95.28	99.71
889	0.11	4.21	95.28	99.60	890	0.10	0.99	98.01	99.09
891	0.17	4.15	95.33	99.65	892	0.13	3.57	95.85	99.55
893	0.13	4.10	95.53	99.76	894	0.08	4.40	95.69	100.17
895	0.16	3.88	95.22	99.26	896	0.14	3.63	95.98	99.75
897	0.16	4.35	95.09	99.60	898	0.22	4.45	94.85	99.52
899	0.21	4.45	95.11	99.77	900	0.14	5.03	95.06	100.23
901	0.13	4.43	94.88	99.44	902	0.19	3.87	95.03	99.10
903	0.12	4.69	94.99	99.80	904	0.14	4.60	94.71	99.45
905	0.05	4.15	94.76	98.96	906	0.12	4.44	94.91	99.47
907	0.09	4.43	95.29	99.81	908	0.12	3.90	95.43	99.45
909	0.09	3.39	95.61	99.09	910	0.14	3.93	95.41	99.48
911	0.22	4.02	95.48	99.72	912	0.16	4.28	94.89	99.32
913	0.10	4.65	94.23	98.99	914	0.12	4.70	93.96	98.79
915	0.23	4.04	95.19	99.46	916	0.19	4.01	95.19	99.39
917	0.18	3.97	95.09	99.25	918	0.14	4.07	95.33	99.55
919	0.13	3.85	95.83	99.81	920	0.13	3.62	95.68	99.43
921	0.10	3.58	95.93	99.62	922	0.15	3.96	95.39	99.50
923	0.11	3.90	95.75	99.75	924	0.16	4.05	95.16	99.37
925	0.16	4.06	95.35	99.57	926	0.14	4.16	95.18	99.47
927	0.14	3.87	95.88	99.89	928	0.16	4.10	95.68	99.94
929	0.10	3.27	95.65	99.02	930	0.16	3.82	95.69	99.68
931	0.15	3.95	95.31	99.40	932	0.14	4.06	95.09	99.29
933	0.14	4.11	95.39	99.64	934	0.15	4.20	95.48	99.83
935	0.12	3.81	95.51	99.43	936	0.10	3.62	95.86	99.59
937	0.10	3.37	95.85	99.31	938	0.12	3.85	95.65	99.62
939	0.07	3.18	96.15	99.40	940	0.15	3.92	95.28	99.35
941	0.14	4.01	95.66	99.81	942	0.11	4.29	95.06	99.46
943	0.22	3.87	95.18	99.27	944	0.18	3.91	95.12	99.21
945	0.16	4.15	95.18	99.48	946	0.15	4.39	94.89	99.43
947	0.15	4.57	94.79	99.50	948	0.17	4.64	94.16	98.97
949	0.18	4.53	93.80	98.52	950	0.20	4.26	93.48	97.94
951	0.15	4.29	92.59	97.02	952	0.12	4.35	92.70	97.18
953	0.18	4.12	94.23	98.53	954	0.11	4.41	94.51	99.03
955	0.10	4.44	94.71	99.25	956	0.14	4.35	95.06	99.55
957	0.20	4.34	95.13	99.67	958	0.18	4.33	94.72	99.22
959	0.16	4.50	94.66	99.33	960	0.19	4.29	94.88	99.35
961	0.19	4.14	95.33	99.66	962	0.14	4.02	94.46	98.62
963	0.18	4.12	95.41	99.71	964	0.25	2.79	76.38	79.41
965	0.68	0.04	25.85	26.57	966	0.08	3.37	96.19	99.64
967	0.16	4.12	94.55	98.83	968	0.14	4.11	95.38	99.63

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
969	0.15	3.75	95.89	99.78	970	0.09	3.38	95.86	99.34
971	0.13	3.22	95.93	99.28	972	0.21	3.33	95.71	99.24
973	0.16	3.69	95.71	99.56	974	0.17	4.09	95.19	99.45
975	0.12	3.81	95.32	99.24	976	0.21	4.12	95.52	99.85
977	0.18	4.43	95.03	99.64	978	0.23	4.31	95.35	99.89
979	0.21	4.10	95.13	99.44	980	0.19	4.02	95.41	99.62
981	0.20	4.10	95.58	99.88	982	0.22	4.24	95.56	100.02
983	0.20	4.34	95.38	99.92	984	0.22	4.28	95.38	99.87
985	0.12	1.87	96.92	98.91	986	0.19	3.73	95.82	99.74
987	0.19	3.62	96.31	100.11	988	0.16	3.43	96.15	99.74
989	0.15	3.03	97.19	100.37	990	0.21	3.17	96.12	99.49
991	0.19	3.61	95.55	99.35	992	0.17	3.86	95.22	99.25
993	0.18	3.73	95.29	99.20	994	0.18	4.15	95.75	100.08
995	0.22	3.78	95.83	99.84	996	0.21	3.90	95.52	99.62
997	0.27	3.87	95.42	99.56	998	0.19	3.95	95.76	99.90
999	0.20	3.69	95.59	99.49	1000	0.24	3.80	95.68	99.71
1001	1.52	0.90	96.98	99.40	1002	1.66	0.60	97.34	99.59
1003	1.34	0.63	97.79	99.76	1004	1.31	0.95	97.35	99.61
1005	0.13	0.11	99.55	99.79	1006	1.48	0.60	97.74	99.82
1007	1.38	0.77	96.91	99.06	1008	1.47	0.66	97.38	99.51
1009	1.93	0.53	97.15	99.61	1010	1.07	1.08	95.49	97.65
1011	1.20	0.79	96.91	98.90	1012	1.64	0.75	97.11	99.49
1013	1.41	0.73	97.05	99.20	1014	0.74	0.85	87.17	88.76
1015	1.13	0.87	97.66	99.66	1016	1.41	0.41	96.99	98.81
1017	0.04	0.53	98.64	99.21	1018	0.01	0.29	99.19	99.49
1019	1.91	0.28	97.99	100.18	1020	1.75	0.27	97.84	99.86
1021	1.59	0.30	98.05	99.93	1022	1.78	0.28	97.69	99.76
1023	1.74	0.25	97.62	99.62	1024	1.30	0.18	98.04	99.52
1025	1.12	0.35	98.27	99.74	1026	1.09	0.27	98.87	100.23
1027	1.53	0.35	97.99	99.87	1028	0.86	0.43	98.64	99.92
1029	1.40	0.25	97.88	99.53	1030	0.58	0.47	98.57	99.61
1031	0.61	0.51	98.37	99.48	1032	0.49	0.55	98.74	99.78
1033	0.26	0.38	99.61	100.25	1034	0.49	0.42	98.97	99.87
1035	0.55	0.46	99.02	100.02	1036	0.90	0.25	98.35	99.50
1037	0.66	0.30	98.39	99.35	1038	0.83	0.36	98.31	99.50
1039	0.74	0.48	98.92	100.14	1040	0.89	0.35	98.85	100.09
1041	0.09	0.96	98.75	99.80	1042	0.56	0.68	98.69	99.94
1043	0.70	0.57	98.75	100.02	1044	0.71	0.44	98.89	100.04
1045	1.22	0.07	98.31	99.60	1046	1.34	0.29	98.72	100.35
1047	0.43	0.72	98.58	99.73	1048	0.25	0.76	99.21	100.22
1049	1.21	0.30	98.29	99.80	1050	1.31	0.21	97.98	99.50
1051	0.06	0.46	99.71	100.23	1052	0.04	0.59	99.64	100.27
1053	0.17	0.44	99.07	99.68	1054	0.04	0.65	99.14	99.83
1055	0.06	0.32	99.37	99.74	1056	0.63	0.46	98.91	100.00

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
1057	0.45	0.50	98.78	99.72	1058	0.28	0.59	99.72	100.60
1059	0.31	0.58	98.91	99.80	1060	0.54	0.47	98.58	99.59
1061	0.17	0.76	99.22	100.14	1062	0.14	0.83	98.92	99.90
1063	0.22	0.48	99.04	99.74	1064	0.51	0.63	98.92	100.06
1065	0.54	0.46	98.59	99.59	1066	1.03	0.48	98.17	99.68
1067	0.63	0.47	98.91	100.01	1068	0.52	0.66	98.48	99.66
1069	0.40	0.55	99.17	100.12	1070	0.55	0.28	98.87	99.70
1071	0.25	0.74	98.92	99.91	1072	0.23	0.87	98.85	99.95
1073	0.42	0.60	98.85	99.87	1074	0.44	0.59	99.01	100.03
1075	0.40	0.45	98.79	99.64	1076	0.38	0.46	99.12	99.96
1077	0.34	0.48	99.34	100.16	1078	0.78	0.31	99.01	100.09
1079	0.17	0.60	98.89	99.66	1080	0.65	0.35	99.27	100.27
1081	0.30	0.74	98.82	99.86	1082	0.94	0.19	98.64	99.77
1083	0.38	0.40	99.17	99.94	1084	0.41	0.41	99.38	100.20
1085	0.12	0.40	99.35	99.86	1086	0.41	0.46	99.32	100.19
1087	0.23	0.86	99.02	100.11	1088	0.12	0.90	99.22	100.24
1089	0.20	0.71	99.05	99.96	1090	0.12	0.68	98.92	99.72
1091	1.79	0.41	97.68	99.88	1092	2.04	0.21	97.65	99.90
1093	0.37	0.46	99.14	99.97	1094	0.38	0.41	98.69	99.48
1095	1.53	0.31	98.34	100.17	1096	1.53	0.27	98.19	100.00
1097	0.89	0.18	96.72	97.79	1098	0.04	2.91	96.59	99.55
1099	0.40	0.49	98.15	99.05	1100	1.34	0.24	98.72	100.30
1101	1.85	0.37	97.86	100.09	1102	1.89	0.40	97.92	100.21
1103	1.93	0.41	97.88	100.22	1104	1.84	0.38	97.84	100.05
1105	0.40	2.90	96.95	100.25	1106	1.87	0.44	97.71	100.02
1107	1.46	0.69	97.72	99.88	1108	1.44	0.58	97.48	99.50
1109	1.74	0.46	97.97	100.16	1110	1.67	0.46	98.05	100.18
1111	1.79	0.39	98.55	100.73	1112	1.62	0.39	98.28	100.29
1113	1.60	0.32	97.94	99.86	1114	1.58	0.43	97.95	99.97
1115	1.84	0.31	97.94	100.08	1116	1.74	0.34	98.25	100.33
1117	1.83	0.13	96.56	98.52	1118	1.57	0.29	97.91	99.76
1119	1.98	0.21	98.11	100.31	1120	1.87	0.26	97.72	99.85
1121	1.79	0.35	98.17	100.31	1122	1.89	0.23	97.41	99.52
1123	1.89	0.28	98.02	100.19	1124	2.02	0.00	98.07	100.09
1125	1.93	0.09	97.75	99.77	1126	1.91	0.15	97.75	99.81
1127	1.71	0.33	98.22	100.26	1128	1.98	0.26	97.72	99.96
1129	2.02	0.20	97.71	99.93	1130	1.63	0.26	98.47	100.35
1131	1.83	0.15	97.97	99.95	1132	1.81	0.33	98.07	100.21
1133	1.03	0.48	98.55	100.06	1134	0.98	0.49	99.08	100.56
1135	0.84	0.50	99.02	100.36	1136	2.00	0.16	97.91	100.07
1137	1.29	0.35	98.37	100.00	1138	1.35	0.28	97.78	99.41
1139	1.18	0.21	98.58	99.97	1140	0.61	0.32	99.37	100.29
1141	0.46	0.58	98.89	99.93	1142	0.79	0.75	98.77	100.31
1143	1.59	0.04	98.47	100.09	1144	0.65	0.38	99.65	100.68

Table S2. continued.

Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total	Point	Al ₂ O ₃	WO ₃	Fe ₂ O ₃	total
1145	1.11	0.23	98.99	100.34	1146	1.45	0.32	98.42	100.20
1147	1.24	0.25	98.85	100.34	1148	0.53	0.26	99.59	100.39
1149	0.07	0.22	100.07	100.36	1150	0.24	0.49	99.84	100.57
1151	0.17	0.45	99.71	100.32	1152	0.11	0.54	99.78	100.43
1153	0.09	0.58	99.65	100.32	1154	0.13	0.96	99.28	100.37
1155	0.05	1.27	99.19	100.51	1156	0.08	0.99	99.64	100.70
1157	0.11	0.95	99.59	100.65	1158	0.13	0.96	99.55	100.64
1159	0.12	0.70	99.61	100.43	1160	0.11	0.76	99.27	100.13
1161	0.12	0.66	99.80	100.58	1162	0.14	0.83	99.62	100.60
1163	0.35	0.64	99.47	100.46	1164	0.65	0.68	99.32	100.65
1165	0.20	0.69	99.32	100.21	1166	0.16	0.67	100.01	100.84
1167	0.14	0.77	99.58	100.49	1168	0.14	0.67	99.49	100.31
1169	0.40	0.72	99.70	100.81	1170	0.58	0.74	99.21	100.53
1171	0.62	0.85	98.71	100.17	1172	0.98	0.27	98.88	100.13
1173	1.34	0.39	98.69	100.41	1174	0.72	0.48	98.89	100.09
1175	1.21	0.18	99.21	100.60	1176	0.33	0.52	99.81	100.66
1177	0.08	0.33	99.92	100.34	1178	0.09	0.84	99.87	100.79
1179	1.27	0.23	98.62	100.13	1180	0.96	0.43	99.01	100.40
1181	1.10	0.37	99.05	100.52	1182	1.46	0.20	98.27	99.93
1183	0.88	0.39	99.19	100.46	1184	0.20	0.81	99.48	100.49
1185	0.18	0.72	99.85	100.76	1186	0.12	0.64	99.21	99.97
1187	0.11	0.49	100.05	100.65	1188	0.12	0.71	99.49	100.32
1189	0.18	0.63	99.78	100.58	1190	0.12	0.60	99.55	100.27
1191	0.17	0.87	99.27	100.31	1192	0.48	0.97	98.94	100.39
1193	0.15	0.71	99.78	100.64	1194	0.09	0.61	99.51	100.21
1195	0.19	0.90	99.41	100.50	1196	0.28	0.95	99.19	100.42
1197	0.34	1.11	99.35	100.80	1198	0.04	0.77	99.38	100.19
1199	0.05	0.85	99.07	99.96	1200	0.80	0.36	99.02	100.18

Table S2. Paths, coordination number (n), interatomic distance (d) and σ^2 of the model of ferberite (Escobar et al. 1971) fit to the respective spectra of hematite A, B and C, compared to the corresponding literature values for ferberite.

		hematite A		hematite B		hematite C		ferberite		
paths	n	d (Å)	σ^2	d (Å)	σ^2	d (Å)	σ^2	paths	n	d (Å)
W–O	1	1.732±0.010	0.004	1.747±0.011	0.004	1.740±0.011	0.004	W–O	2	1.883
	3	1.857±0.004	0.004	1.848±0.004	0.004	1.850±0.004	0.004		2	1.991
	2	1.975±0.004	0.004	1.966±0.004	0.004	1.968±0.004	0.004		2	2.109
W–W	2	3.110±0.014	0.003	3.095±0.015	0.003	3.109±0.015	0.002	W–W	2	3.233
	2	4.548±0.010	0.003	4.534±0.010	0.003	4.548±0.010	0.002		2	4.417
	2	4.667±0.008	0.003	4.662±0.012	0.003	4.688±0.008	0.002		2	4.750
	2	5.101±0.010	0.003	5.087±0.010	0.003	5.101±0.010	0.002		2	4.970
	2	5.669±0.008	0.003	5.664±0.012	0.003	5.699±0.008	0.002		2	5.720
	2	5.851±0.010	0.003	5.837±0.010	0.003	5.851±0.010	0.002		2	5.740
	2	5.871±0.010	0.003	5.857±0.010	0.003	5.871±0.010	0.002		2	5.752
W–Fe	2	3.407±0.004	0.003	3.402±0.005	0.003	3.426±0.004	0.002	W–Fe	2	3.525
	2	3.416±0.004	0.003	3.412±0.005	0.003	3.436±0.004	0.002		2	3.535
	2	3.584±0.014	0.003	3.570±0.015	0.003	3.584±0.015	0.002		2	3.707
	2	3.645±0.008	0.003	3.640±0.012	0.003	3.666±0.008	0.002		2	3.728
	2	6.126±0.010	0.003	6.112±0.010	0.003	6.126±0.010	0.002		2	5.995
	2	6.132±0.010	0.003	6.118±0.010	0.003	6.132±0.010	0.002		2	6.000
W–O–O–W	4	3.033	-	3.031	-	3.029	-	W–O–O–W	4	3.312
	2	3.080	-	3.079	-	3.076	-		2	3.360
	4	3.109	-	3.108	-	3.105	-		4	3.389
	4	3.121	-	3.119	-	3.116	-		4	3.400
	4	3.128	-	3.126	-	3.124	-		4	3.407
	4	3.155	-	3.154	-	3.151	-		4	3.435
	2	3.657	-	3.656	-	3.653	-		2	3.936
	4	3.695	-	3.693	-	3.691	-		4	3.974
	4	3.698	-	3.697	-	3.944	-		4	3.978

$\Delta E_0=2.31$, $N_{var}=10$, $N_{ind}=20.4$, $R=0.019$, k-range=3.0-9.5, R- range=1-6	$\Delta E_0=1.48$, $N_{var}=10$, $N_{ind}=20.4$, $R=0.020$, k- range=3.0-9.5, R- range=1-6	$\Delta E_0=2.97$, $N_{var}=10$, $N_{ind}=20.4$, $R=0.019$, k- range=3.0-9.5, R- range=1-6
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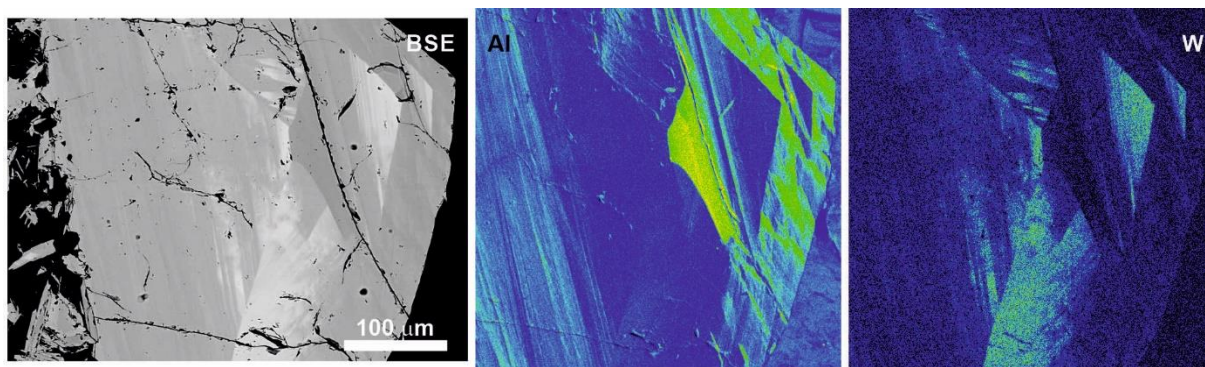


Fig. S1. Back-scattered electron (BSE) image and distribution of selected elements in one of the hematite crystals with W-enriched zones.

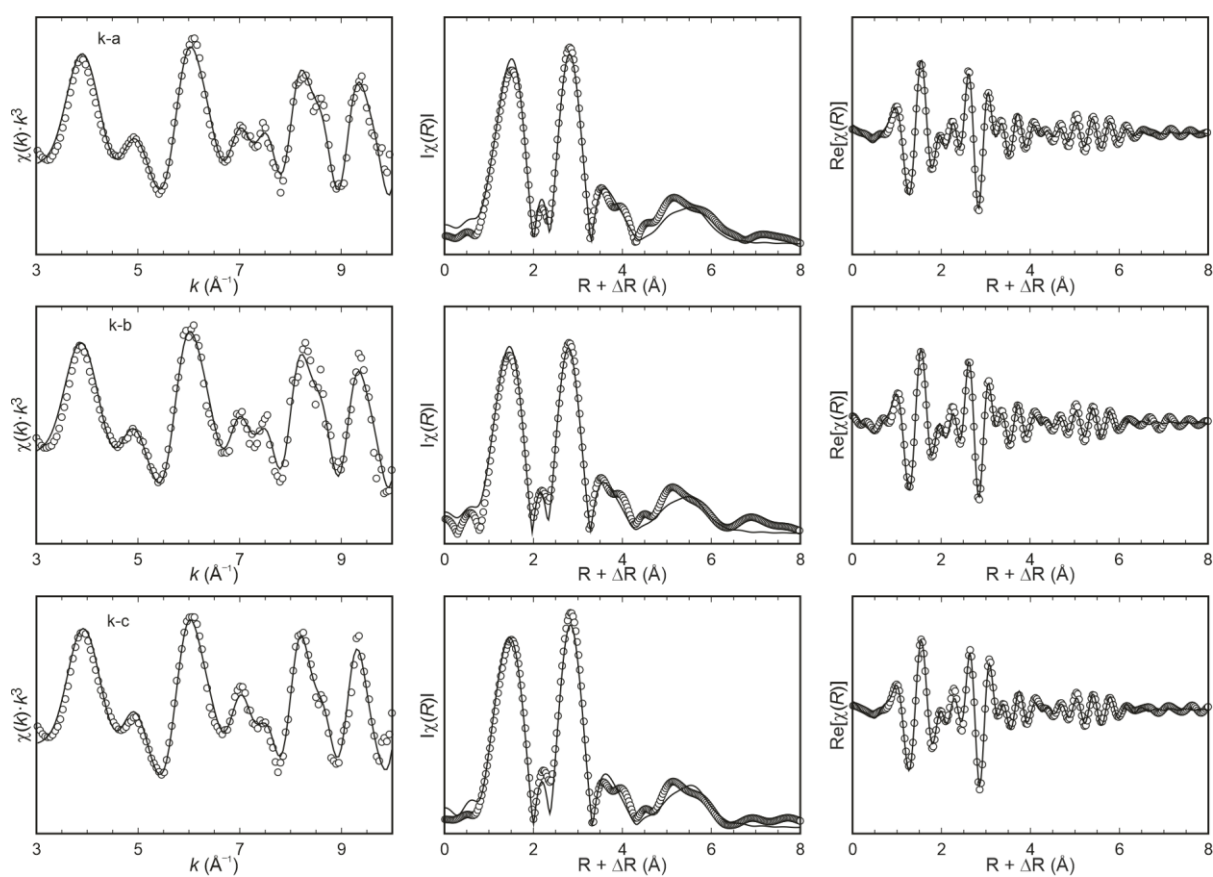


Fig. S2. The EXAFS and Fourier-transform EXAFS spectra (at the W L_3 edge) of the W-rich hematite crystals A, B, and C (crystals selected for the XAS measurements). Circles represent the measured and processed data, the lines represent the fits.

Additional information and images to the TEM investigation of W-bearing hematite

Fig. S3 shows a TEM low magnification image of the entire hematite lamella. Based on information obtained by estimation of spot SAED pattern, recorded from area with diameter 300 nm, it can be concluded that major host phase of the lamella is hematite single crystal (Fig. S3, right).

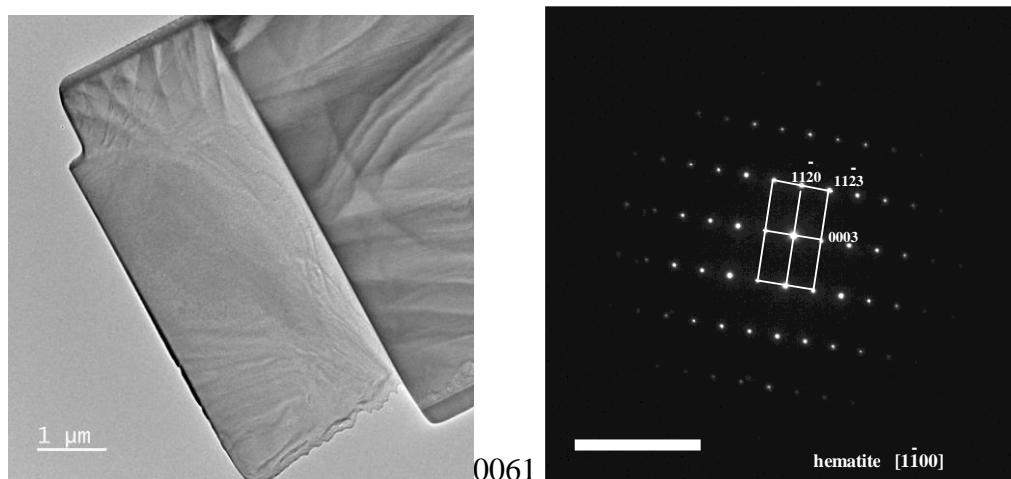


Fig. S3. (left) Low-magnification TEM image of hematite lamella. (right) SAED pattern recorded from this lamella.

Quantitative EDX analysis recorded from the entire area of lamella showed that lamella consists mainly of Fe and O, and small amount of W (60.4 at.%O, 39.3 at.%Fe, and 0.3 at.% W). Further TEM and STEM study of hematite lamella revealed the alteration of brighter and darker bands, as can be seen in Fig. S4.

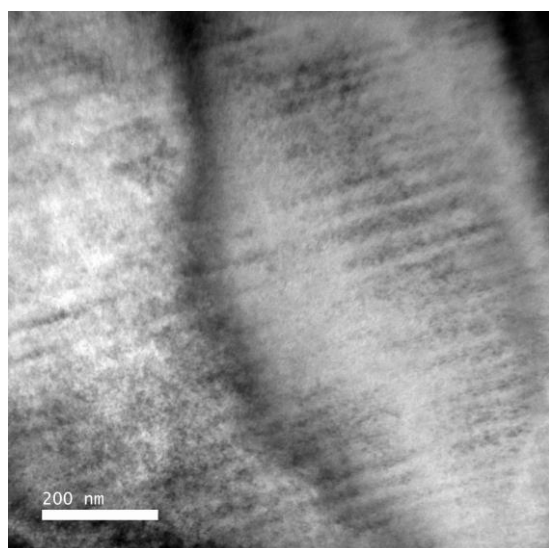


Fig. S4. Low magnification BF TEM image of compositional variation in hematite. Darker lamellae correspond to the domains with higher W content.

This indicates the W oscillatory zonation within hematite single crystal. Variation of the chemical composition was clearly confirmed by EDS spectroscopy. It is evident from comparison low magnification BF STEM image and EDS mapping that dark bands in BF STEM image corresponds to the areas with higher content of W. Higher content of W in dark zones is evident also from EDS line profile in Fig. S5. Thickness of W zones is variable and they are up to 30 nm in size. The oscillatory banding of hematite is manifested also in Fig. S4.

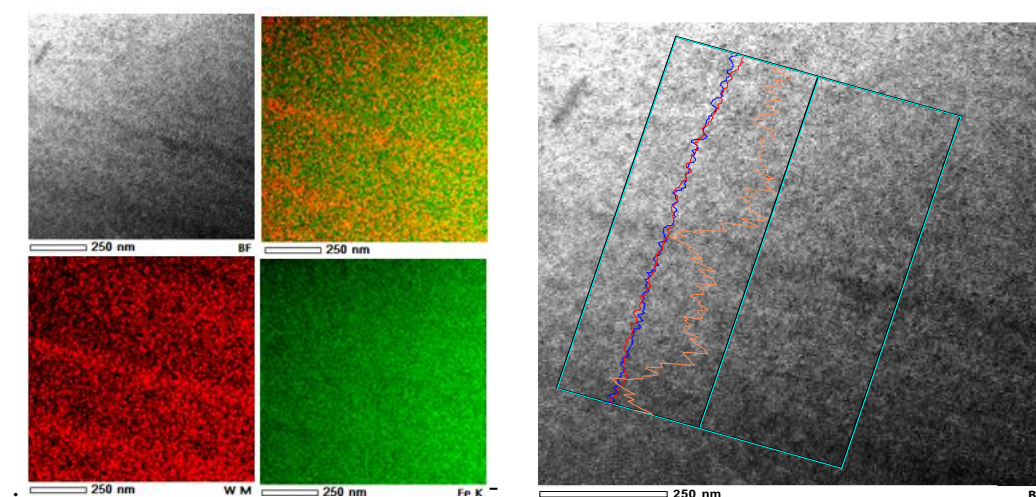


Fig. S5. (a) BF STEM, (b) overlaid W-M and Fe-K EDS maps, W-M spectroscopic map, Fe-K spectroscopic map, (c) line profile showing compositional variations of W in hematite.

Electron diffraction, HRTEM and STEM characterizations were used to determine exact phase composition of sample based on crystallography informations. HRTEM image recorded from thin region of lamella is in Fig. S6. It displays termination one of dark W-bearing band in hosted hematite. It is supposed that darker area in this image correspond to phase containing W.

By estimation of relevant FFT pattern (white motif) acquired from entire recorded area it was determined that the observed lattice spacings of 0.458 nm, 0.251 nm, and 0.220 nm correspond to the 0003, $11\bar{2}0$, and $11\bar{2}3$ interplanar spacings of the hematite structure, respectively. The observed angle between the (0001) and the ($11\bar{2}0$) planes is 90.1° , which is quite close to the theoretical value of 90° of hematite (PDF: 98-001-5840). The (0001), ($11\bar{2}0$), and ($11\bar{2}3$) crystal planes belong to $[1\bar{1}00]$ zone axis of hematite.

Simultaneously with hematite, ferberite FeWO_4 (green motif in FFT pattern in Fig. S6) was identified in this sample as well. Measured interplanar spacings of 0.34 nm, 0.57 nm, and 0.29 nm correspond to (010), (101), and (111) type planes of monoclinic FeWO_4 . Observed angles between the (010) and (101) planes and (111) and (101) planes are 90.5° and 31.6° , which is close to the theoretical values of 90° and 30.8° , respectively, for ferberite (PDF: 98-001-5193). In this case, ferberite single crystal is oriented along $[\bar{1}01]$ direction.

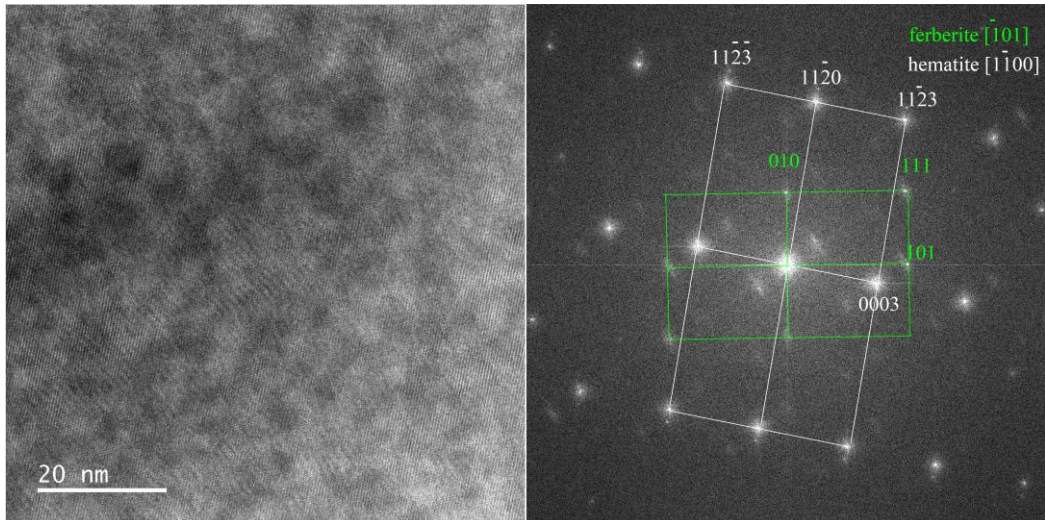


Fig. S6. (a) TEM image of dark W-bearing band in hosted hematite. (b) relevant FFT pattern

For comparison, theoretical electron diffraction patterns of hematite and ferberite single crystals oriented along identical $[1\bar{1}00]$ and $[\bar{1}01]$ directions, respectively, obtained using DiffGen software included in NanoMegas software package (NanoMegas, <https://www.nanomegas.com/>) are in Figs. S7a,b.

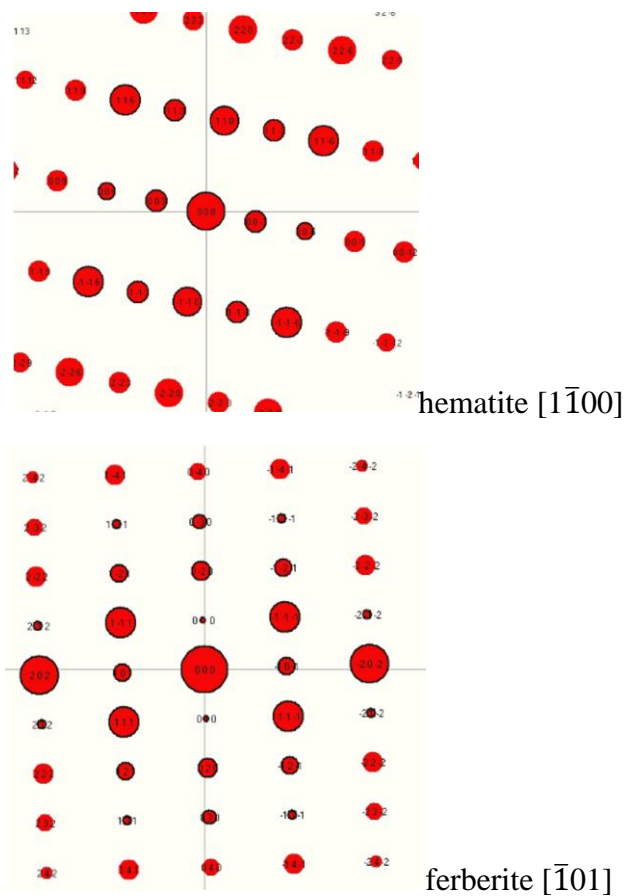


Fig. S7. Diffraction patterns simulated for (a) hematite along $[1\bar{1}00]$ direction and (b) for ferberite in $[\bar{1}01]$ direction.

IFFT image in Fig. S8 was obtained by masking of $11\bar{2}0$, 0003 , and $11\bar{2}3$ hematite reflections in respective FFT pattern, Fig. S7b. Therefore, the bright areas in Fig. S8 correspond to those regions on the experimental image contributing significantly to the intensity of the selected hematite reflections.

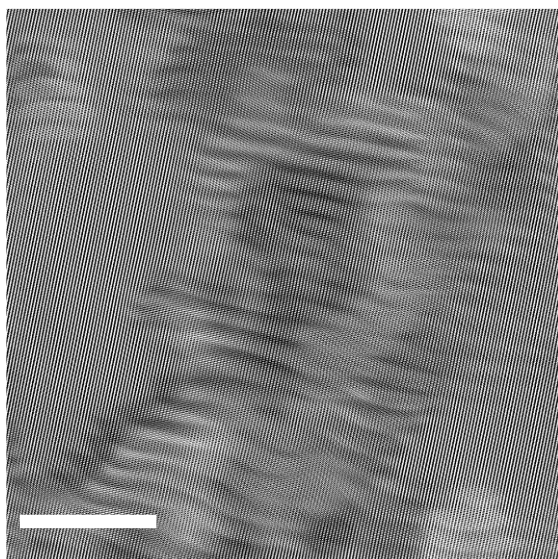


Fig. S8. IFFT image obtained by $11\bar{2}0$, 0003 , $11\bar{2}3$ reflections of hematite

Moreover, in agreement with XAS spectroscopy, hematite and magnetite coexistence was revealed by HAADF STEM. An example HAADF STEM image of magnetite single crystal oriented along $[1\bar{1}0]$ direction is Fig. S9. By evaluation of respective FFT pattern measured interplanar spacings of 0.485 nm, 0.415 nm, and 0.299 nm correspond to $\{111\}$, $\{002\}$, and $\{113\}$ type planes of cubic Fe_3O_4 . Observed angle between the (001) and (111) planes is 54.0° , which is close to the theoretical value of 54.74° for magnetite. The determined angle 30.0° between (113) and (111) planes also corresponds with that theoretical 29.5° .

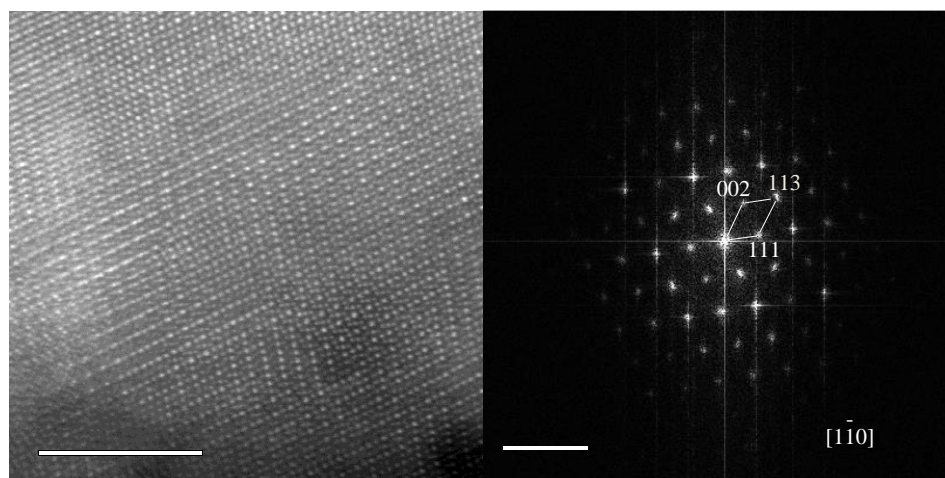


Fig. S9. (0143) HAADF STEM atomic resolution image of magnetite crystal oriented along $[1\bar{1}0]$ direction. Bright spots are columns of Fe atoms.

More detailed HAADF and BF STEM images with atomic resolution hematite and magnetite are in Figs. S10a, b and Fig. S11a, b. They display Fe atomic column distribution along $\langle 1\bar{1}00 \rangle$ and $\langle 110 \rangle$ zone axis in hematite and magnetite, respectively. Since HAADF STEM images are sensitive to the atomic number of elements, bright spots in HAADF images represent columns of Fe atoms.

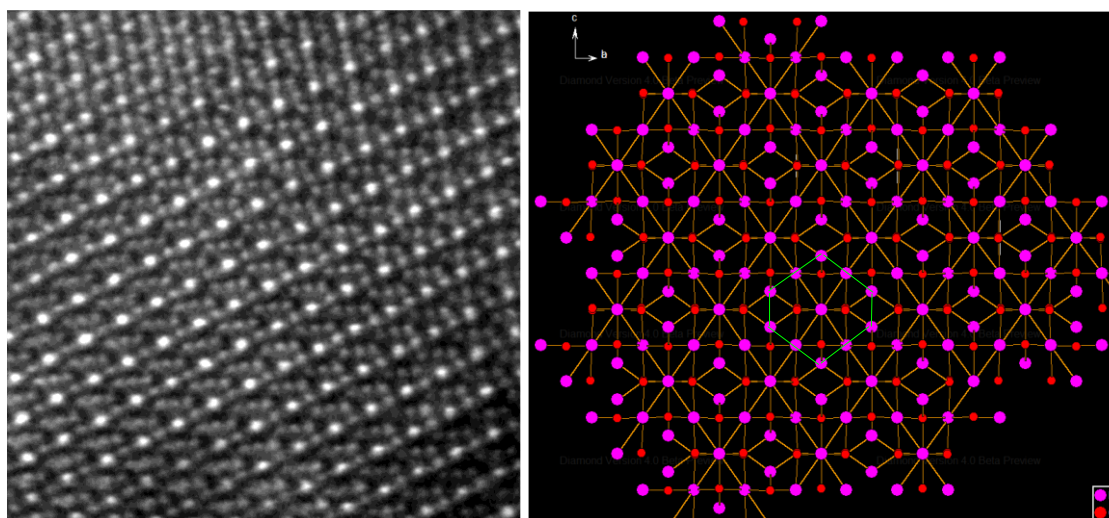


Fig. S10. (a) HAADF STEM image of magnetite along $[1\bar{1}0]$ direction. Bright spots are columns of Fe atoms creating irregular hexagons (b) the simulation of magnetite structure oriented in $[1\bar{1}0]$ zone axis. One of irregular Fe hexagons is marked.

More detailed atomic structure of hematite single crystal oriented in $[1\bar{1}00]$ zone axis with respective power spectrum is in Fig. S11a, b.

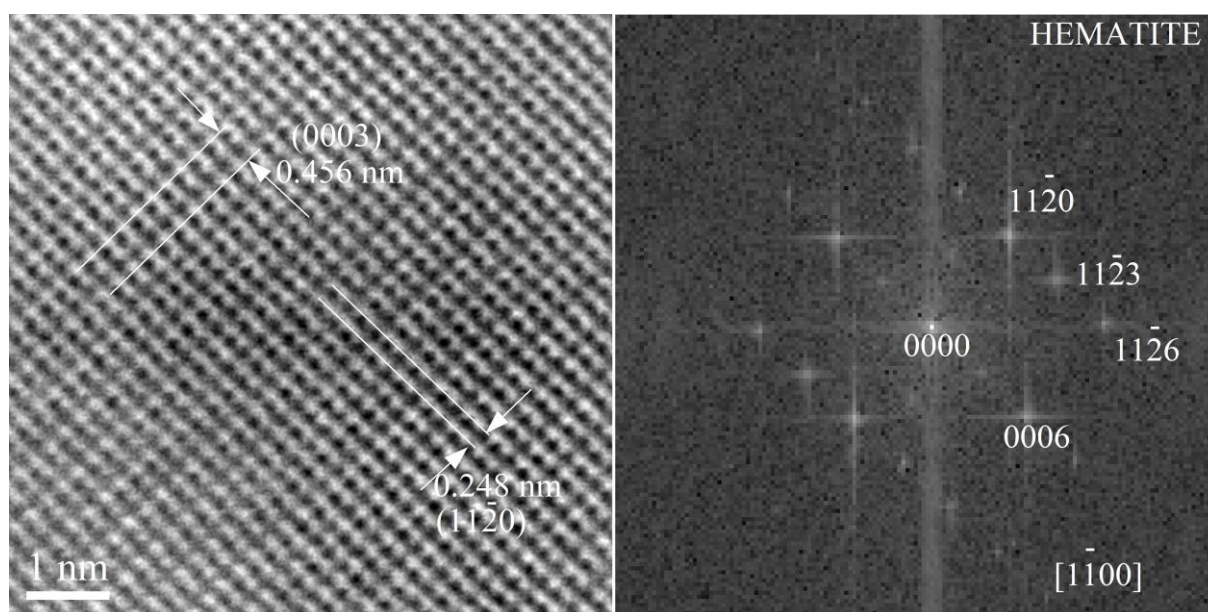


Fig. S11. (a) HAADF STEM image of hematite single crystal oriented in $[1\bar{1}00]$ zone axis (b) power spectrum

Interface of magnetite and hematite is manifested in Fig. S12.

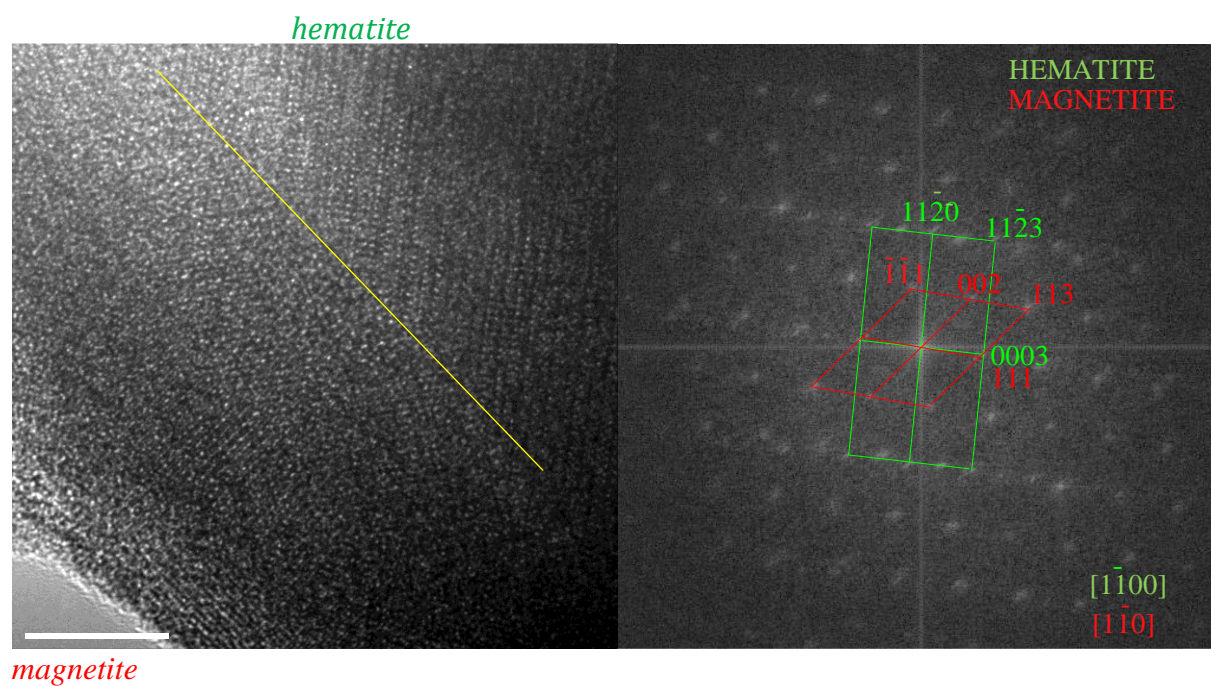


Fig. S12. (a) HRTEM of lamella near the edge. Interface of hematite and magnetite is depicted. Respective power spectrum in (b) confirms the presence hematite single crystal oriented along $[1\bar{1}00]$ and magnetite oriented in $[1\bar{1}0]$ directions.