

Supplementary Material 4. Calculation of Fe^{3+} fraction using Electron Energy Loss Spectroscopy on a Transmission Electron Microscope (see Fig.6b). All spectra were fitted using Lorentzian function. *Laihunite* and *oxyfayalite* analyses were made in the dark lamellae of each zone.

Phase	N	Peaks position					Peak area		Result	
		X1 (Fe^{2+})	X2 (Fe^{3+})	X3	X4	X5	A1 (Fe^{2+})	A2 (Fe^{3+})	X Fe^{2+}	X Fe^{3+}
fayalite1	3	708.73	709.71	716.75			142335.89	0.00	1.00	0.00
fayalite2	4	713.17	716.07	726.15	734.78		269346.29	0.00	1.00	0.00
laihunite1	4	708.89	709.62	710.52	717.56		129762.57	220158.02	0.37	0.63
laihunite2 (0.03eV)	4	712.76	714.08	716.40	727.01		143405.61	199898.13	0.42	0.58
Mean value									0.39	0.61
1σ									0.03	0.03
oxyfayalite1a	3	708.92	709.76	717.54			99776.17	729726.04	0.12	0.88
oxyfayalite1b	4	708.89	709.74	711.43	717.59		152153.63	548561.89	0.22	0.78
oxyfayalite1c	5	708.88	709.73	711.61	717.52	723.97	141409.21	584701.27	0.19	0.81
oxyfayalite2 (0.03eV)	5	712.50	713.80	717.39	726.64	735.01	143170.44	408424.10	0.26	0.74
oxyfayalite3 (0.03eV)	5	712.80	714.45	717.64	727.41	735.18	10488.71	80649.16	0.12	0.88
oxyfayalite4 (0.03eV)	4	712.61	714.11	716.63	727.34		76247.52	454909.20	0.14	0.86
Mean value									0.18	0.82
1σ									0.06	0.06

$$\text{XFe}^{2+} = \text{Fe}^{2+}/(\text{Fe}^{2+} + \text{Fe}^{3+}) \text{ and } \text{XFe}^{3+} = \text{Fe}^{3+}/(\text{Fe}^{2+} + \text{Fe}^{3+}).$$

N = number of peaks selected for the Origin 7.5 treatment

Oxyfayalite1a, 1b and 1c are data obtained using the same spectrum with various treatments.