

Ferric iron content in (Mg,Fe)SiO₃ perovskite and post-perovskite at deep lower mantle conditions

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ABSTRACT

We have determined the Fe³⁺/ΣFe ratio of Al-free (Mg,Fe)SiO₃ perovskite, post-perovskite, and (Mg,Fe)O ferropericlasite synthesized at 99 to 187 GPa and 1830 to 3500 K based on the electron energy-loss near-edge structure (ELNES) spectroscopy. The results demonstrate that post-perovskite includes minor amounts of ferric iron with Fe³⁺/ΣFe ratios of 0.11 to 0.21. These values are substantially lower than those of Al-rich post-perovskite (Fe³⁺/ΣFe = 0.59 to 0.69) reported in a previous study, suggesting that the Fe³⁺-Al³⁺ coupled substitution is important in post-perovskite, as in the case of perovskite. The Al-bearing post-perovskite in a pyrolitic mantle composition likely contains a considerable amount of ferric iron, which affects various physical properties in the lowermost mantle.

Keywords: Post-perovskite, perovskite, ferric iron, lower mantle, D'' layer