Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.38275

Effect of Ferric Iron on Equation of State of Post-Perovskite at Earth's Lowermost Mantle Conditions

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Magnesium silicate post-perovskite (PPv) is expected to be the dominant mineral in Earth's lowermost mantle. Iron (Fe), a major impurity in PPv, occurs as Fe^{2+} or Fe^{3+}. Fe^{2+} primarily substitutes for Mg, forming an $Fe^{2+}SiO_3$ component, whereas Fe^{3+} is expected to enter PPv through charge-coupled substitution on both Mg and Si sites, forming an $Fe^{3+}Fe^{3+}O_3$ component. Although previous studies have shown that iron incorporation can significantly influence the elastic properties of PPv, the relative contributions of the $Fe^{2+}SiO_3$ and $Fe^{3+}Fe^{3+}O_3$ components remain insufficiently constrained. Here we report laser-heated diamond anvil cell (DAC) experiments on Fe-bearing glass with different $Fe^{3+}/\Sigma Fe$ ratios. Single phase PPv was synthesized at ~130 GPa and 2500 K. In situ synchrotron X-ray diffraction at APS 13-ID-D was used to determine the crystal structure and high-pressure high-temperature equation of state of PPv, and $Fe^{3+}/\Sigma Fe$ in recovered samples was quantified by X-ray absorption near-edge structure spectroscopy. Our preliminary results show that incorporation of the $Fe^{3+}Fe^{3+}O_3$ component increases the unit-cell volume of PPv relative to $MgSiO_3$ end member. Together with existing results PPv, these observations help constrain lowermost-mantle composition and dynamics and improve interpretation of geophysical data.