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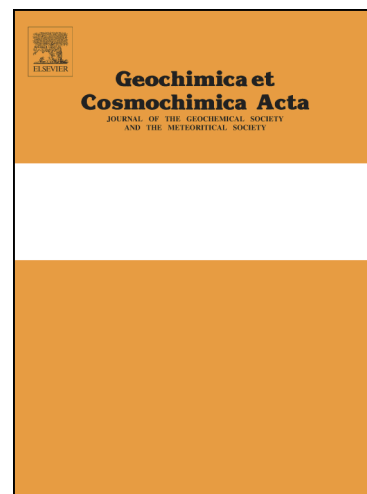
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Pressure-dependent compatibility of iron in garnet: insights into the origin of ferropicritic melt

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Abstract

Iron-rich silicate melts in the Earth's deep mantle have been seismologically and geochemically inferred in recent years. The origin of local enrichments in iron and low-velocity seismic anomalies that have been detected in dense mantle domains are critical to understanding the mantle's evolution, which has been canonically explained by long-term chemical reactions between the Earth's silicate mantle and its liquid iron outer core. However, the Pleistocene alkaline ferropicrites (~0.73 Ma) from Wudi, North China, show chemical and Sr-Nd-Os isotopic features that suggest derivation from the preferential melting of silica-deficient eclogite, a lithology of delaminated mafic lower continental crust that had stagnated at mid-upper mantle depths during the Mesozoic decratonization of the North China block. These rocks are characterized by substantial enrichment in iron (14.9–15.2 wt% Fe₂O₃), relative depletion in silica (40–41 wt% SiO₂) and decoupled Y and heavy rare earth element (HREE) compositions. These ferropicrites have particularly higher Y/Yb ratios than the other Cenozoic basalts from North China. The pressure-dependent compatibility of Fe, Y and Yb in eclogitic garnet can adequately explain the Fe-enrichment and Y-HREE decoupling of the Wudi ferropicrites and indicates that the eclogites were melted at pressures of 5–8 GPa, as also constrained by previous high-P-T experiments. This

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