American Mineralogist, Volume 104, pages 1603–1607, 2019

Melting in the Fe-FeO system to 204 GPa: Implications for oxygen in Earth's core

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Abstract

We performed melting experiments on Fe-O alloys up to 204 GPa and 3500 K in a diamond-anvil cell (DAC) and determined the liquidus phase relations in the Fe-FeO system based on textural and chemical characterizations of recovered samples. Liquid-liquid immiscibility was observed up to 29 GPa. Oxygen concentration in eutectic liquid increased from >8 wt% O at 44 GPa to 13 wt% at 204 GPa and is extrapolated to be about 15 wt% at the inner core boundary (ICB) conditions. These results support O-rich liquid core, although oxygen cannot be a single core light element. We estimated the range of possible liquid core compositions in Fe-O-Si-C-S and found that the upper bounds for silicon and carbon concentrations are constrained by the crystallization of dense inner core at the ICB.

Keywords: Core, oxygen, Fe-FeO system, eutectic melting, high pressure