Magnesium Exsolution in Earth's Core?

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Magnesium is almost immiscible with iron at ambient pressure and temperature. The solubility of periclase in iron is likewise very low under most experimentally accessible conditions. However, magnesium-bearing minerals may have partitioned into Earth's core at extremely high pressure/temperature conditions during core/mantle differentiation, possibly aided by giant impacts. I will present a thermodynamic model for the alloying and partitioning of magnesium and iron under core conditions, guided by recent experiments. Temperature effects may dominate the partitioning behavior, but pressure effects are likely non-negligible. In particular, the enthalpy of mixing of magnesium in iron decreases with increasing pressure. But this effect is small compared to both the predicted change in partitioning behavior with temperature and the increase in the Gibbs energy of the governing exchange reaction with pressure at all temperatures. Key questions are whether magnesium will exsolve from the cooling core and whether this tends to begin at the top or bottom of the core. The answers depend on the core's temperature profile, the equations of state for the relevant minerals, and, perhaps most critically, the effects of multiple components, especially oxygen and silicon.