

## Investigating the disproportionation of iron in the lower mantle

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It has been proposed that metallic iron exists as an accessory phase in the lower mantle, as a result of a disproportionation of  $\text{Fe}^{2+}$  to  $\text{Fe}^0$  and  $\text{Fe}^{3+}$ . If correct, this has significant implications for the siderophile element geochemistry of the lower mantle, notably through its impact on isotopic tracers such as Re and Os, as well as on platinum group elements. Metallic iron could also serve as a likely host for volatile elements in the lower mantle, such as C, S, and H, impacting the mantle's carbon and hydrogen budgets. It is understood that bridgmanite is the dominant phase in the lower mantle, and it has been shown that the presence of Al promotes the partitioning of  $\text{Fe}^{3+}$  into the perovskite structure. Specifically, the  $\text{Al}^{3+}$  prefers to occupy the B cation site of the perovskite structure, promoting the coupled substitution of  $\text{Al}^{3+}$  for  $\text{Si}^{4+}$  and  $\text{Fe}^{3+}$  for  $\text{Mg}^{2+}$  to maintain charge balance. The oxidation of iron from  $\text{Fe}^{2+}$  in the upper mantle regime to  $\text{Fe}^{3+}$  in the lower mantle must then also be balanced by a reduction of some Fe to metal. Frost et al. [2004] proposed that this disproportionation process occurs in the lower mantle, where the formation of aluminous perovskite implies the precipitation of approximately 1 wt% metallic Fe-rich alloy. However, there has been little subsequent study since this mechanism was proposed to specifically confirm the presence of metallic iron in assemblages at deeper lower mantle pressure and temperature conditions. We investigate the behavior of a natural almandine-pyrope garnet at high pressure and temperatures with XRD and EDS methods to determine if the iron disproportionation reaction can occur in the lower mantle.