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The role of iron chemistry on the interpretation of lower mantle heterogeneities

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Iron is a major element in the mantle and its chemical behavior (partitioning, spin transition..) affect the physical and transport properties of the phases which host it. Such variations can provide explanations of major heterogeneities observed in the mantle. Magnesium silicate perovskite (Mg,Fe)SiO_3 (Mg-*pv*) and ferropericlase (Mg,Fe)O (*fp*) are the dominant phases in the lower-mantle and can potentially host significant amount of iron. It is thus of prime importance to constrain element partitioning at high pressure for improving models of the deep Earth. We investigated iron partitioning between Mg-*pv* and *fp* synthetised under lower-mantle conditions (up to 115 GPa and 2200 K) in a laser heated diamond anvil cell (LH-DAC). Recovered samples were thinned to electron transparency by focussed ion beam (FIB) and characterized by analytical transmission electron microscopy (ATEM). Addititional informations on trace elements were provided by measurements using nanometer scale ion probe (nanoSIMS). Iron concentrations in both phases were obtained from EDX measurements and nanoSIMS and are in excellent agreement. Our results are the first to show that recently reported transitions in the lower-mantle directly affect the evolution of Fe-Mg partitioning between both phases. Mg-*pv* is increasingly iron-depleted above 70-80 GPa possibly due to the high spin-low spin transition of iron in *fp*. Conversely, the perovskite to post-perovskite transition is accompanied by a strong iron enrichment of the silicate phase. We will discuss the implications of these partitioning variations in terms of potential heterogeneities. We will also address shortly the early history of the Earth, as the observation of nanoparticles of metallic iron in the Mg-*pv* bearing runs suggests the disproportionation of ferrous iron and the self-oxidation of the mantle while these particles were not observed when the post-perovskite (*ppv*) phase was present. Implications on the oxidation state of the Earth and core segregation will be discussed.

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