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Experimental constraints on Earth's core formation

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The Earth contains a Fe-rich metallic core that segregated from the primitive silicate mantle very early in its 4.5 billion year history. One major consequence of this segregation is the depletion of the Earth's mantle from the siderophile elements "high core affinity" relative to primitive solar system abundances. The way in which siderophile elements partition between metal and silicate depends strongly on pressure (P), temperature (T), oxygen fugacity (fO_2) and chemical compositions of both metal and silicate phases.

In the present presentation, I will discuss the experimental results of metal-silicate partitioning of Ni and Co that show a marked change with increasing pressure (e.g. Bouhifd and Jephcoat, 2011; Siebert et al., 2012; Fischer et al., 2015 for the most recent studies). This behavior coincides with a change in the coordination of silicon (in a basaltic melt composition) from 4-fold coordination under ambient conditions to 6-fold coordination at about 35 GPa, indicating that melt compressibility may controls siderophile-element partitioning (Sanloup et al., 2013). I will also discuss the impact of Earth's core formation on "lithophile" elements such as Sm, Nd, Ta and Nb (e.g. Bouhifd et al. 2015; Cartier et al., 2014), as well as the impact of sulphur on the behavior of various elements during core formation (e.g. Boujibar et al., 2014; Wohlers and Wood, 2015). By combining the metal-silicate partitioning data from siderophile, lithophile and chalcophile elements I will present and discuss the most plausible conditions for Earth's core formation.

References

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