Chemical evolution of the outer core: Insights from high-pressure experiments

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The chemical evolution of the outer core is controlled by chemical transfer across its upper and lower boundaries. Crystallization of the inner core can modify the composition of the outer core for elements that are strongly enriched in the solid alloy. High-pressure diffusion experiments indicate that inner core crystallization is likely to be a purely fractional process. The partition coefficients for siderophile elements between the inner and outer core are critical, but are not well known because they depend strongly on the concentration and identity of light alloying elements in the outer core, and may also depend significantly on pressure. Recent progress in determining and modeling the relevant partition coefficients will be discussed.

Chemical exchange across the core-mantle boundary (CMB), driven for example by an initial disequilibrium between core and mantle at the pressure and temperature of the CMB, may also have affected the composition of the core. A key issue is whether chemical transport in the mantle is rapid enough to allow substantial exchange with the outer core. Experimental and theoretical constraints on chemical diffusivities in liquid and solid silicates and oxides at high pressure will be presented.