Experimental and Theoretical Investigation of Core-Mantle Interactions

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The dynamics of the Earth's mantle is controlled by thermochemical convection. Compared to a chemically homogeneous system, the Earth's mantle has three sources of density anomalies that interact with thermal anomalies and determine the overall thermal evolution of the planet. First, chemical anomalies generated by partial melting and magmatic differentiation at the surface of the planet. The second source of anomalies, called primitive, corresponds to inhomogeneities in the deep Earth as a result of the primordial formation and differentiation of the planet. A third source of chemical anomalies corresponds to chemical reactions at the core- mantle boundary. Traditionally considered fairly limited because they involve reactions between solids and liquids, these interactions could be a major source of chemical evolution of the mantle if liquid is present at the base of the mantle - or has been for a significant period time - as postulated in the basal magma ocean hypothesis. We aim to provide experimental constraints on the equilibria between liquid silicate / metal at the bottom of the magma ocean and to integrate them into models of the formation, differentiation and evolution of Earth's mantle. Experiments will be performed sharing siderophile elements between molten metal and molten silicate at CMB conditions. The second step is to model the composition of a "CMB" component and incorporate this composition in the evolution of the early Earth. This should allow for a more precise idea of the conditions of basal magma ocean, and to shed a new light on the primordial compositional stratification of the terrestrial magma ocean.