ÉCOLE DOCTORALE
SCIENCES DE LA TERRE ET DE L'ENVIRONNEMENT
ET PHYSIQUE DE L'UNIVERS, PARIS

Subject offered for a contract starting october 2015

SUBJECT TITTLE: Core-Mantle Interactions and Deep Geochemical Reservoirs

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Host lab/ Team : **IPGP – Géophysique expérimentale – UMR7154**
IPGP – Dynamique des fluides géologiques – UMR7154

Financing: Doctoral contract with or without assignment

For more information go to http://ed560.ipgp.fr, section: Offres de these (PhD offer), You must apply on the Doctoral School website

Presentation of the subject: (1 or 2 pages)

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. In particular, the existence of a terrestrial magma ocean in the early stages of Earth's evolution - the basal magma ocean hypothesis - played an important role in the generation of a density contrast between the shallow mantle and deep mantle. Despite the fact that a primitive source has been integrated into the convection models in the last 10 years, the constraints on the nature and origin remain scarce. 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.
This PhD project aims to provide experimental constraints on the equilibria between solid silicate / 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.

The first stage of the thesis is experimental and will be to conduct experiments sharing siderophile elements between molten metal and molten silicate at CMB conditions, i.e., 135 GPa, 4300 K. These experiments will be performed at IPGP, and analysis of the samples will be obtained using the FIB, SEM, EPMA, and possible TEM.

The second step is to model the composition of a “CMB” component and incorporate this composition in the evolution of the early Earth, alongside traditional components such as depleted mantle and recycled crust that constrain the composition of the "deep mantle" component identified in basalts of oceanic islands (OIB). 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.