ÉCOLE DOCTORALE SCIENCES DE LA TERRE

PhD project starting in September 2013

TITLE : Anisotropic Tomography of the mantle below the Indian Ocean around du manteau "La Réunion" volcanic plume

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Thesis Subject : (1 - 2 pages)

The RHUM-RUM project (Réunion Hotspot and Upper Mantle – Réunion's Unterer Mantel) is a joint project lead by IPG-Paris and Munich University, funded by ANR in France and DFG in Germany for years 2012-2016. The primary scientific objective of RHUM-RUM is the imaging of the volcanic plume associated with La Réunion hotspot, from lithosphere down to the core-mantle boundary in order to understand its dynamics. The origin at depth and the role of plumes in global geodynamics is still very controversial and not well understood. This project is a flagship of IPGP for the next years and will unite the efforts of 3 groups in IPG (Seismology, Marine Geosciences, Volcanology) and other French and German groups. It relies on a close French-German cooperation where we will share marine facilities (oceanographic vessels), instruments (broadband land seismometers and ocean bottom stations) and scientific tasks.

Since La Réunion is located in the middle of the Indian ocean, the project is based on the deployment of a large seismic network of ocean bottom stations, jointly provided by the INSU pool (9 broadband OBS) and the DEPAS pool (48 wideband stations). It was deployed by the IPEV vessel Marion-Dufresne and operated since sept.-oct. 2012. It is complemented by numerous land-based stations (La Réunion, Mauritius, Eparses islands, Madagascar). The recovery of instruments and data is scheduled in oct. 2013 by the German vessel Meteor. In the sharing of scientific tasks between French and German institutes, the IPG-Paris is in charge of deriving the anisotropic tomography of the mantle in the Indian Ocean centered around La Reunion plume.

The first goal of the thesis is to build up the seismic database that will be used for retrieving the structure of the mantle from the surface down to 1500km depth. This work of extracting, selecting and organizing the database should be performed during the first year of the thesis. Surface wave phase and group velocities will first be computed and inverted to get a reference model of the whole region. During the second part of the thesis, the student will implement at the regional scale, the new technique of full seismic waveform inversion which is now operational (Capdeville et al., Geophys. J. Int., in Press, 2013). The technique is based on the homogenization technique, and the computation of synthetic seismograms in 3D anisotropic models will be performed using the Spectral Element Method (code RegSEM; Cupillard et al., 2012). Finally, the integration (compatibility or discrepancy) of results from body waves and surface waves, is envisaged for the end of the thesis.

The project necessitates a good basic knowledge in seismology and computer sciences.