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

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Titre du sujet: Nature of Moho and lithosphere-asthenosphere boundary beneath ocean spreading centre

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Equipe d'accueil : *à préciser et supprimer la ligne inutile*

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Développement du sujet : (Maximum 2 pages)

The *Moho* and *lithosphere-asthenosphere boundary (LAB*) are two of the most important boundaries in the Earth. The Moho is the greatest manifestation of the chemically differentiated Earth, separating light rocks in the crust from dense rocks in the mantle whereas the LAB is fundamental for plate tectonics, defining the boundary between the floating rigid lithosphere and the weak, deformable asthenosphere (Audhkhasi and Singh, 2022). They are both first born at mid-ocean ridges, where two-thirds of the Earth's crust and lithosphere are formed, and then evolve with the age, but what happens during the early part of their lives remains an enigma. Together, they serve as the location where coupling and exchange take place between the shallow and deep mantle, and therefore, it is fundamental to understand their origins at ocean spreading centre.

As a part of a large ambitious project, we plan to acquire deep seismic reflection/refraction data using a large number of smart ocean bottom nodes (OBN). Smart OBNs, developed by industry, are lightweight, small and compact Ocean Bottom Seismometers (OBSs), based on MEM technology that can record four component data (pressure and three accelerations) down to 1 Hz frequency. We plan to deploy over 2700 OBNs along four profiles, 100-350 km long, at 200 m interval, recording large airgun array source at 75 m (300 m) interval and providing combined seismic reflection and refraction data of unprecedented quality and density.

In this project, we plan to focus on a 100-km long profile along the ridge axis, recording a maximum offset of 150 km. We plan to use a combination of traveltime tomography and full waveform inversion (Shipp and Singh, 2002) to determine P- and S-wave velocities to characterise the nature of the lower crust beneath the upper crust melt sill (Axial Melt Len, AML, Singh et al, 1998), lower crustal melt sills (Marjanovic et al., 2014) and layering in the lower (Guo et al., 2022) etc. We should also be able to quantify the nature Moho (Singh et al, 2006) (thickness, % melt) and amount of melt (%) in the uppermost mantle. We also plan to look at a part of the ridge axis perpendicular profile to image the AML crossing the Moho (Singh et al., 2006; Kent et al., 2025). We expect to determine both P- and S-wave velocities on a very fine scale (100-200 m) (Shipp and Singh, 2002).

A student with strong background in quantitative geophysics with interest in solving fundamental geodynamic problems are encouraged to apply. The student is expected to participate in the survey design using synthetic seismogram modelling and participate in the OBN data acquisition. The student will receive training on advanced data analysis and will work closely with our industry (ShearWater) and international colleagues (Woods Hole, Universities of Hawaii and Oxford).

References

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