Sujet proposé pour un début de contrat en Septembre 2011

TITRE du SUJET : Modes propres de basse fréquence et structure des superplumes à la base du manteau terrestre.

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Financement: **ERC "Advanced grant" - net: 1990euros/month (brut: 2315 euros/month)**

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L'imagerie sismique nous a montré la présence de deux vastes provinces antipodales de vitesses sismiques lentes à la base du manteau sous l'Afrique et sous le Pacifique. La nature précise de ces "superplumes" nous échappe, ainsi que leur rôle dans la circulation globale du manteau. Il est donc important de séparer la contribution thermique à ces anomalies, de celle due à leur composition chimique. Je propose un sujet de thèse basé sur la mesure des spectres de modes propres de la Terre à très basse fréquence.

Global seismic imaging has revealed the presence of two large low shear velocity provinces (LLSVP) at the base of the mantle surrounded by a ring of fast velocities. These LLSVP's, often called "superplumes", are located quasi antipodally and form a simple "degree 2" structure, which is correlated with the distribution of hotspots at the earth's surface and with that of seismic attenuation in the transition zone. While their low velocities indicate that they may represent upwellings in the large scale circulation of the mantle, there is also evidence that they may be compositionally distinct: forward modelling of diffracted waves interacting with the boundaries of the LLSVP's indicates that these are sharp - that is the shear velocity gradients across them are stronger than expected for a purely thermal anomaly, at least in the first ~200 km above the core-mantle boundary.
Separating the thermal and compositional components of the LLSVP's is an important problem for the modeling of dynamics of the mantle. Because these structures are dominated by long wavelengths, and because normal modes have some sensitivity to large scale variations in density and attenuation, they are ideally suited to try and address this issue. The study of density heterogeneity using normal modes has been attempted before (10 years ago) with controversial results. However, since then, several major earthquakes of M>8 have occurred and provide a mode dataset of unprecedented quality, so that the time is ripe to revisit the question of density, as well as the yet never addressed question of attenuation - an equally challenging task, although preliminary results are promising.

This thesis will include the collection and processing of a large amount of very low frequency data from recent (and older) major earthquakes at stations of the international global seismic network to study a variety of questions on long wavelength elastic, anelastic and density structure of the mantle and core. In addition to data processing, this will involve further improvements of a methodology first developed in Chaincy Kuo's PhD thesis work (Kuo and Romanowicz, 2002; see also Durek and Romanowicz, 1999), that inverts normal mode spectra (including mode coupling) directly for earth structure.

References

Durek, J., and B. Romanowicz (1999) Inner core anisotropy inferred by direct inversion of normal mode spectra, *Geophys. J. Int.*, *139*(3), 599-622.

Kuo, C., and B. Romanowicz (2002) On the resolution of density anomalies in the Earth’s mantle using spectral fitting of normal mode data, *Geophys. J. Int.*, *150*, 162-179.

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