Proposed Research Studentship

Microgeodynamic modeling of deep mantle melting

Supervisor(s): Saswata Hier-Majumder

Project Description:

Partial melting in the Earth's deep interior influences large scale geodynamic processes and provides potential reservoirs for incompatible radiogenic elements. Recent research indicates the potential presence of such partially molten regions above the core-mantle boundary, mantle transition zone, and the lithosphere-asthenosphere boundary. The fingerprint of such partially molten regions is typically identified by observing the reduction in the speed of seismic waves traveling through these regions.

One crucial element in identifying the presence of such partially molten layers and quantifying the degree of melting is the microstructural model used to convert the reduction in seismic wave speeds to melt volume fraction. A major area of our research is to develop robust models of microstructure that take into account several crucial geometric and dynamic aspects of microstructure evolution using novel numerical tools. This new area of research, geodynamics, has been extremely useful in quantifying the degree of melting in the ultralow velocity zones above the core-mantle boundary, the low velocity layers above the mantle transition zone, and the lithosphere-asthenosphere boundary.

The work in this project will focus on further developing preexisting microstructural models using the fast multipole boundary elements method. Using this technique, we recently created the first grain-scale numerical simulation of deformation in partially molten rocks. The researcher will be able to develop the existing 2D numerical model in 3D. The resulting microstructure will be used to predict the development of anisotropic features of seismic data. The numerical simulations will be carried out in ARCHER, the UK national supercomputing facility, while the numerical data will be analyzed and processed using the high end computer labs in the Department of Earth Sciences.
For further information please contact Dr. Hier-Majumder (Saswata.Hier-Majumder@rhul.ac.uk)

References:

- Sifré, D., Gardés, E., Massuyeau, M., Hashim, L., **Hier-Majumder, S.**, & Gaillard, F. (**2014**). Electrical conductivity during incipient melting in the oceanic low-velocity zone. Nature, 509(7498), 81-85. doi:10.1038/nature13245.
- Wimert, J., and **S. Hier-Majumder** (**2012**), A three-dimensional microgeodynamic model of melt geometry in the Earth's deep interior, J. Geophys. Res., 117, B04203, doi:10.1029/2011JB009012.
- **Hier-Majumder, S. (2011),** Development of anisotropic mobility during two-phase flow. Geophysical Journal International, 186:1, 59-68, doi: 10.1111/j.1365-246X.2011.05024.x.
- **Hier-Majumder, S.** and M. E. Abbott, (**2010**) The influence of dihedral angle on seismic velocities of partially molten rocks, Earth and Planetary Science Letters, 299, 23-32 doi:10.1016/j.epsl.2010.08.007.
- **Hier-Majumder, S.**, (**2008**), Influence of contiguity on seismic velocities of partially molten aggregates, J. Geophys. Res., 113, B12205, doi:10.1029/2008JB005662.

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Applicants are requested to send an additional copy of their CV directly to the lead supervisor of the project in which they are interested. Please also contact the supervisor if you have any questions about the project itself