Project EARTH-16-RK2: Magma/mantle dynamics: production and extraction of melt from the convecting mantle

Supervisor: Dr Richard Katz (Earth Sciences)

Mantle melting and melt segregation are the primary means of chemical differentiation of the Earth, yet our understanding of melt transport processes remains limited. A leading theory states that melt segregates from its source by percolation through the pores of the crystalline mantle under the force of buoyancy. This theory is expressed in terms of partial differential equations; solutions of these equations can be obtained using numerical algorithms on supercomputers, and can be interpreted in terms of the dynamics of coupled magma and mantle dynamics. There are many extensions of this theory that remain completely unexplored, but which may provide significant new insight into the inner workings of the mantle.

This project area therefore includes a broad range of possible subjects, ranging from the fluid dynamics of two-phase flows at the laboratory scale to the geodynamics of melting and melt segregation at plate tectonic boundaries. Laboratory experiments on partially molten rock analogues could be developed, and numerical modelling of flows is a core expertise of the research group in Oxford. Model extensions to capture geochemical transport would provide a means for comparison with measurements of erupted lavas. There is hence scope for collaboration with seismologists, rock mechanicians, and geochemists to better understand the link between partial melting and observable features of the mantle system.

The successful applicant, whose first degree might be in Earth sciences, engineering, physics or mathematics, will have an excellent training in maths and physics and an interest in modeling of geophysical phenomena.