G5

Title: The Mechanisms of Deep Focus Earthquakes.

Supervisors: Dan McKenzie and Keith Priestley.

Importance of the research: Earthquakes occur to depths of almost 700 km within plates that have been subducted at island arcs to form sinking slabs, and in some other areas that are not so obviously related to oceanic plate subduction. Such sinking slabs provide the major driving force for plate motions, and the earthquake mechanisms show in detail how such forces are transmitted to the plates at the surface. There has been surprisingly little work on such earthquakes in the last 20 years (see Frohlich 2006). The physical processes that allow slip to occur on faults at such great depths is still a complete mystery. The aim of the project is to obtain accurate relative locations and mechanisms of intermediate and deep focus earthquakes to determine the geometry of the active zones and to relate this to other information about the sinking slabs, such as the seismic velocity perturbations, temperature structure, subduction geometry, plate structure, and the location of phase changes.

What the project involves: There are two major components to this project: the location of earthquakes and the determination of their mechanisms. Because of the large, and unknown, velocity anomalies associated with sinking slabs, absolute locations of earthquakes in such regions suffer from systematic errors. However standard programs are available that can determine the relative location of separate events if these occur in the same region. The accuracy with which relative locations can be determined depends on the distance between events, but is a few km for closely spaced earthquakes. Mechanisms are routinely generated by the Harvard Moment Tensor program. However, their accuracy can be improved by detailed modelling of the wave forms.

What the student will do: The necessary seismological programs are available at Bullard Labs. The student will carry out detailed studies of particular regions where large numbers of intermediate and deep focus earthquakes have occurred, with the aim of understanding the detailed geometry of the deformation, and of relating the observed features to the larger scale structure and dynamics of the slabs in which the events occur. The project will involve a considerable amount of program development, and will suit a student with a good background in maths and physics who is interested in the large scale dynamics of the Earth.

Training: The student will receive a training in seismic data analysis, programming, and the use of simple physical models to understand complex processes. Previous students with similar training have been in considerable demand, and several now occupy senior university positions in the UK and US. They have also done well in research and management position in major oil and mining companies, and in service companies like Schlumberger. A new (and to me unexpected) demand for such people is financial modelling in the City.

References:

Emmerson B and McKenzie D. 2007 Thermal structure and seimicity of subducting lithosphere. Phys Earth planet. Int. doi:10.1016/j.pepi.2007.05.007

Frohlich C. 2006 Deep earthquakes. Cambridge University Press.