DETERMINING ANCIENT FIELD INTENSITIES FROM SHOCK REMANENT MAGNETISATIONS IN ROCKS AND METEORITES

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Background
To understand how the geomagnetic field has changed in the past, we look at the magnetic remanence recorded by rocks and meteorites. Determining an ancient magnetic field’s direction is relatively straightforward, however, estimating the ancient magnetic field intensity (palaeointensity) is more difficult. Currently all palaeointensity determinations are obtained from minerals whose natural remanent magnetisation (NRM) is thought to be a thermostmanent magnetisation (TRM) in origin. A TRM is the remanent magnetisation acquired by magnetic minerals as they cool from above their ferromagnetic ordering temperature (the Curie temperature) to ambient temperature in the presence of a field, e.g., lavas normally carry TRMs. Such magnetisations can be stable for billions of years, however, there are many cases in nature where the magnetisations are acquired through other mechanisms. One such mechanism is shock. In the early Solar System rocks were routinely impacted; impacts are known to induce remanent magnetisations called shock remanent magnetisations (SRM). These SRMs retain information about the ambient magnetic fields during the time of impact and can be stable for billions of years. However, we have no practical model for quantifying the intensity of the ancient magnetic field recorded by SRM.

Project
The aim of this studentship is to develop and test a Preisach-based protocol that will use only room-temperature measurements to determine the palaeointensity recorded by a shock-induced SRM. Adrian Muxworthy has previously developed Preisach-based protocol for determining palaeointensities from rocks carrying TRMs (Muxworthy & Heslop, 2011; Muxworthy et al., 2011) and chemical remanent magnetisations (CRM, in prep.) A Preisach SRM model will be developed. The proposed new method will be empirically tested using synthetic samples induced with SRMs. To estimate the relative contributions from pressure and temperature, we will use iSALE (Collins et al., 2004; Muxworthy et al., 2017), which will allow for accurate shock and temperature values to be used in the Preisach model.

Student Profile
This project is primarily a computational in nature and would suit a candidate with strong interest in cutting edge rock magnetism and possessing excellent organizational and time management skills. Candidates should have a degree in Earth Science, Material Science or Physics, and good numerical skills.


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