UNDERSTANDING MAGNETIC ENHANCEMENT IN HYDROCARBON RESERVOIRS

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Background
From both direct sampling of cores from numerous countries (e.g., Emmerton et al., 2013), and through simulation of the ‘oil-kitchen’ in the laboratory through controlled pyrolysis (Abubakar et al., 2015), we know that magnetic minerals are formed during hydrocarbon formation, and are also associated with hydrocarbon migration. We also know that with time the magnetic minerals that give rise to the magnetic signal can alter due to processes like biodegradation.

Recent experimental work by the Natural Magnetism Group has found that there are enhanced magnetic signals at and oil-water contact and gas-oil contact in drill cores from several wells in the North Sea. The question remains as to what processes cause this enhancement, for example, thermodynamic effects, biodegradation etc.? How do these processes affect the magnetic mineralogy? How stable are these enhancements; can they be used to identify palaeo-contacts? What is the effect of depth and temperature on these processes? Are these processes universal? Can this enhancement be used to improve yield from mature hydrocarbon reservoirs, through a better understanding of the reservoir history?

Project
The PhD student's project will answer these questions. Using the data already collected from the North Sea cores as guide, the student will undertake detailed, high-resolution sampling near the oil-water contact and gas-oil contact of North Sea drill cores from the BGS core store at Keyworth. To understand the universality of this, the student will also magnetically study samples taken from a gas-water contact from the Devonian Nisku Formation in Alberta, Canada. The chemistry of this section has been previously studied in detail (Machel et al., 1995), but no magnetic work has been conducted on this section. With these samples, the student will then determine the abundance, morphology, size and mineralogy of the magnetic minerals, using a combination of high- and low-temperature magnetic measurements, combined with magnetic hysteresis measurements and scanning and transmission electron microscopy. With this information it should be possible to answer many of the questions listed above.

Student Profile
This project is primarily lab-based 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, Chemistry, Material Science or Physics and a good background in laboratory-skills.


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