Constraining the magnetic characteristics of oil-water contacts

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Using the Gray-Milne Travel Bursary, I was able to able to attend a visiting fellowship to the Institute for Rock Magnetism (IRM) in Minneapolis, USA, where I collected vital data for my PhD. The primary objective of the trip was to constrain magnetic characteristics at the base of oil columns, which have recently been identified to show magnetic enhancements, with the potential to help improve yield from current reservoirs, thereby reducing the need for further hydrocarbon exploration and exploitation. The funding gave me the opportunity to use magnetic instrumentation, such as Quantum Design Magnetic Properties Measurement System 3 (MPMS-3) (Figure 1), where samples were subjected strong magnetic fields (up to 5 T), before being cooled and warmed between 2 K and 300 K, to identify magnetic mineralogy and grain sizes.

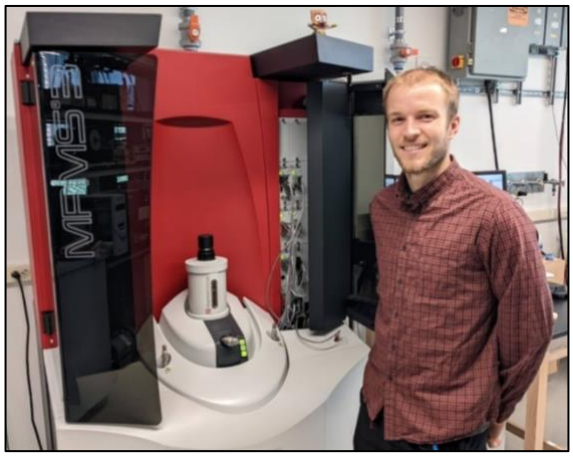

Figure 1 Use of the MPMS-3 at the IRM

Preliminary results of samples taken from the Wytch Farm oilfield, UK, showed an abundance of the iron phosphate mineral, vivianite, indicated by a characteristic drop in magnetic remanence at 7.5 K (Figure 2a). Previous studies have typically started warming from 10 K, therefore, the collection of this new data highlights that vivianite may play large role in the magnetic signatures observed in hydrocarbon reservoirs. Furthermore, magnetic remanence continues to drop until close to 30 K which represents a higher coercivity component, possibly siderite (Figure 2a). Previous work in the Natural Magnetism Group at Imperial College London has identified a correlation between siderite and vertical migration, therefore, the identification here may help constrain previous migration pathways within the Wytch Farm oilfield. At the oil-water contact (OWC), drops in magnetisation at 260 K and ~120 K are indicative of magnetite and hematite, respectively (Figure 2b). In this well, more magnetite was present at the OWC than in the oil column above, or unstained samples below, possibly due to microbiological influences.

This grant has allowed me to develop a greater understanding of magnetic characteristics at OWCs and has provided further ideas for future research into understanding the causes and universality of these enhancements. I would like to thank the British Geophysical Association (BGA) for giving me this wonderful opportunity.

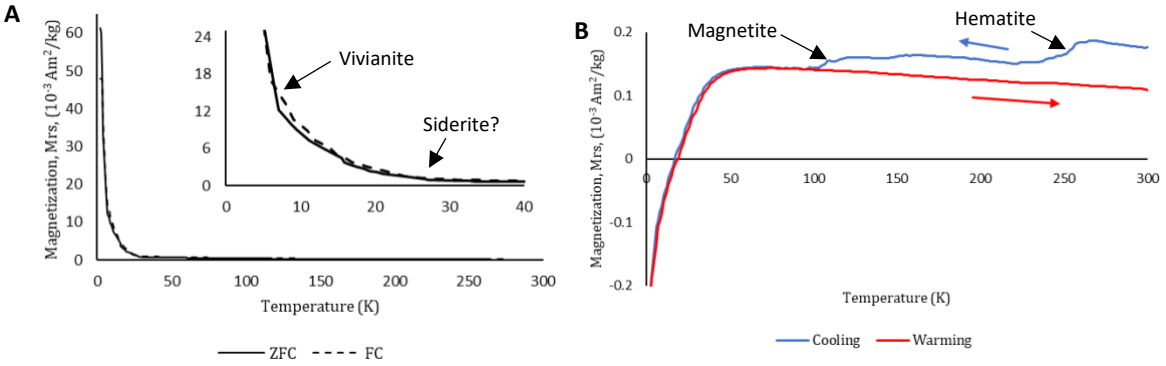

Figure 2 a) FC-ZFC curve and b) RT SIRM curve using a field of 5 T between 2 to 300 K.