The University of Oxford Department of Earth Sciences

EARTHSCIENCES

UNIVERSITY OF OXFORD

Using Banded Iron Formations to Improve the Precambrian Paleointensity Record

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Key Words	**Paleomagnetism, Great Oxygenation Event, Inner Core Nucleation**

Overview

Banded irons formations (BIFs) are enigmatic deposits that reflect the conditions in Earth's early oceans. BIF mineralogy is dominated by magnetic minerals such as magnetite and hematite. Their mineralogy, and continuous deposition through much of geologic time, make BIFs a compelling target for filling in gaps in the paleomagnetic record.

The aim of this project is to improve the paleointenstiy record using the paleomagnetism of BIFs in under-sampled time periods e.g. 700 Ma and 3000 Ma. These time periods are of particular interest for looking for trends in magnetic field intensity relating to the great oxygenation event (GOE) and inner core nucleation.

It has been proposed that the GOE was caused by significant loss of hydrogen from the atmosphere, resulting in more oxidized conditions. One mechanism by which this could occur is if H^+ ions could escape along open magnetic field lines. This effect is exaggerated when the magnetic field is weaker, however there is currently insufficient paleomagnetic data leading up to the GOE to test this hypothesis.

The age of the inner core is still debated, as is the change in magnetic field intensity that we should expect when the core begins to solidify. In order to identify trends in magnetic field strength that may relate to inner core nucleation, the resolution of the paleomagnetic record needs to be significantly improved. BIFs offer the opportunity to improve the resolution of the paleomagnetic record throughout the Precambrian in order to identify statistically robust variations in paleointensity over time.

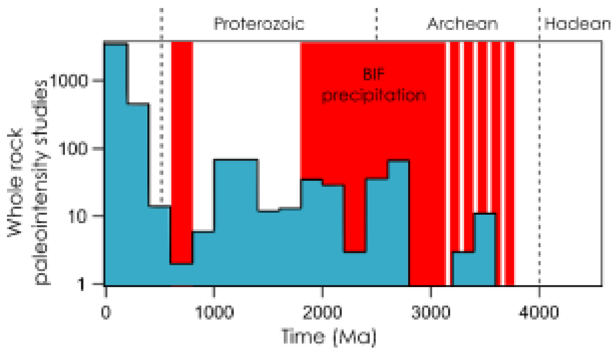

Figure showing the current gaps in the whole rock paleomagnetic record (blue) and time periods of banded iron formation precipitation (red). The relationship between the two means that BIFs could be an ideal target for filling in these gaps.

Methodology

Fieldwork will be conducted in various localities in Canada, Australia and/or South Africa to collect block samples and oriented drill cores for paleomagnetic analysis.

The paleomagnetism of samples will be measured using a superconducting rock magnetometer. Samples will be thermally demagnetized using a controlled-atmosphere furnace. The rock magnetic properties of samples will be characterized using the quantum diamond microscope and vibrating sample magnetometer, and supplemented with scanning electron microscopy.

Timeline

Year 1: Carry out preliminary paleomagnetic measurements on BIFs, develop an experimental protocol for extracting the most reliable paleointensity estimates.

Years 2 and 3: Collect BIF samples during field seasons. Compile improved paleomagnetic record from analysed data. Present research at national paleomagnetic conference.

Year 4: Thesis writing. Attend AGU Fall meeting. Publish results of experimental work.

Training & Skills

The successful student will join the Oxford Magnetism Group at the University of Oxford, UK, which has a history of research excellence in rock magnetism, early Earth and planetary magnetism and tectonic reconstructions. They will also have the opportunity to integrate with faculty at external institutions and industry partners at annual career fairs.

The student will be trained how to plan and conduct a field campaign, and to prepare and analyze samples returned to the laboratory for study using a range of novel paleomagnetic techniques. They will also receive training in preparing samples for isotope geochemical analyses, and to image samples using the scanning electron microsope, including EBSD.

The student will also be mentored on how to prepare scientific results for presentation at international conferences to an expert and/or general audience, and how to write papers for publication in high-profile, international journals.

References & Further Reading

K. O. Konhauser et al., Iron formations: A global record of Neoarchaean to Palaeoproterozoic environmental history. In *Earth Science Reviews* (2017).

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Further Information

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