Holocene Regional Geomagnetic Field Models of the Arctic

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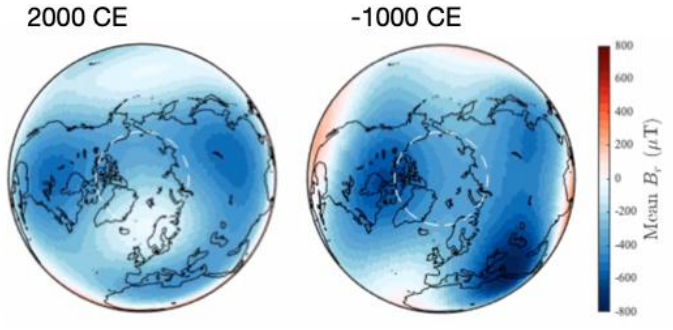
Context and Project

The Arctic has experienced some of the most striking geomagnetic changes over the past centuries, most notably the recent rapid migration of the North Magnetic Pole from Canada to Siberia and evolution of major geomagnetic flux lobes in North America and Siberia. These are seen below in snapshots of the vertical component of the magnetic field at the surface of Earth's core at 2000 CE and 1000 BCE.



These phenomena make the Arctic a unique vantage point for investigating geomagnetic field variability and gaining insights into Earth's dynamo. However, instrumental observations span only a few hundred years, and longer-term global models are limited in resolution making it difficult to determine whether recent changes reflect typical geomagnetic secular variations or are indicative of longer-term changes in the structure and dynamics of the magnetic field. Over the past two decades, numerous marine and lacustrine sediment cores have been collected across the Arctic, providing valuable archives of past geomagnetic field variability and an exceptional opportunity to develop regional geomagnetic reconstructions at higher resolution than currently mapped and extending far beyond the instrumental record.

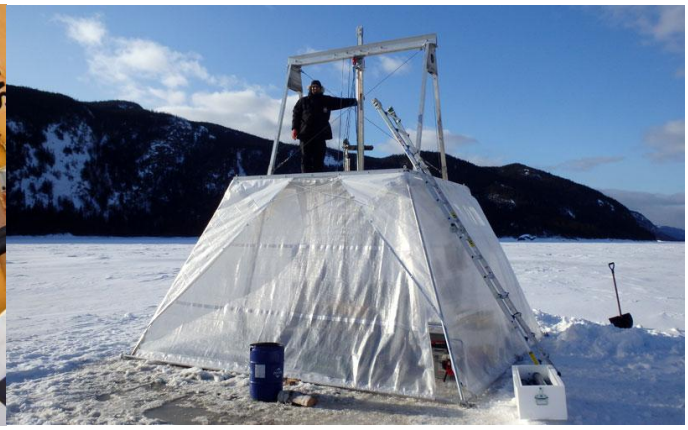
The project will capitalize on an extensive and unique paleomagnetic database assembled over the past two decades at ISMER. This database comprises marine and lacustrine sediment cores collected across various Arctic environments and includes high-resolution records of Holocene paleomagnetic secular variations (inclination and declination) and relative paleointensity (RPI). These records are supported by chronologies based on radiocarbon dating, varve counting, and/or ^{210}Pb dating. **The selected candidate will integrate and analyze these existing paleomagnetic records to develop regional geomagnetic reconstructions, assess their spatial and temporal coherence, and use them to constrain and validate regional Arctic geomagnetic field models.** The resulting models will provide an unprecedented opportunity to investigate geomagnetic field variability across the Arctic at millennial and, where data permits, centennial timescales.

By developing and validating high-resolution regional geomagnetic field models for several Arctic regions covering the Holocene, this project will provide new insights into centennial to millennial-scale geomagnetic field variability, particularly the recent rapid migration of the North Magnetic Pole and the evolution and dynamics of the North American, European and Siberian geomagnetic flux lobes. By combining ISMER's extensive paleomagnetic database with state-of-the-art geomagnetic modeling approaches, the project will advance our understanding of Earth's geodynamo.

Research environment and supervision. The PhD candidate will join the *Institut des sciences de la mer* (ISMER) at the *Université du Québec à Rimouski* (UQAR), one of Canada's leading research institutes in marine sciences. The candidate will be jointly supervised by Guillaume St-Onge at ISMER, an internationally recognized expert in Arctic paleomagnetism, and Catherine Constable at Scripps Institution of Oceanography, an internationally recognized expert in geomagnetic field modeling and Earth's magnetic field dynamics.

The project will benefit from ISMER's extensive expertise in marine and lacustrine paleomagnetism, sedimentology, and Arctic research, as well as its unique collection of sediment cores and associated paleomagnetic and chronological datasets. This expertise will be complemented by access to Scripps' leading capabilities, infrastructure, and expertise in geomagnetic field modeling. This collaboration offers an exceptional opportunity to work at the intersection of marine geosciences, paleomagnetism, and numerical modeling within an international research environment, including planned research visits to Scripps Institution of Oceanography in La Jolla, California.





Candidate profile
We are seeking a highly motivated candidate with a strong background in one or more of the following fields:

- Geophysics, Earth sciences, marine geology, or related disciplines.
- Paleomagnetism and/or rock magnetism.
- Geomagnetic field modeling and data analysis.
- Numerical modeling and scientific programming (e.g., Python, MATLAB, or equivalent).
- Experience working with sedimentary records, chronological data, or statistical modeling would be an asset. An interest in Arctic research and interdisciplinary science is highly desirable.

Doctoral scholarship and application
A competitive doctoral scholarship is available. Please consult the following link for further information: https://www.uqar.ca/en/the-institut-des-sciences-de-la-mer-of-the-universite-du-quebec-a-rimouski-ismer-uqar/opportunities/excellence-doctoral-scholarships/

Interested candidates are invited to initially submit the following documents:

- A complete curriculum vitae, including scientific publications and presentations, scholarships, awards, sea-going or field work research experiences, and other relevant activities.
- A cover letter outlining the applicant's academic background and explaining how their experience and interests align with the proposed project.
- Academic transcripts from all universities attended.

Applications should be sent to:
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