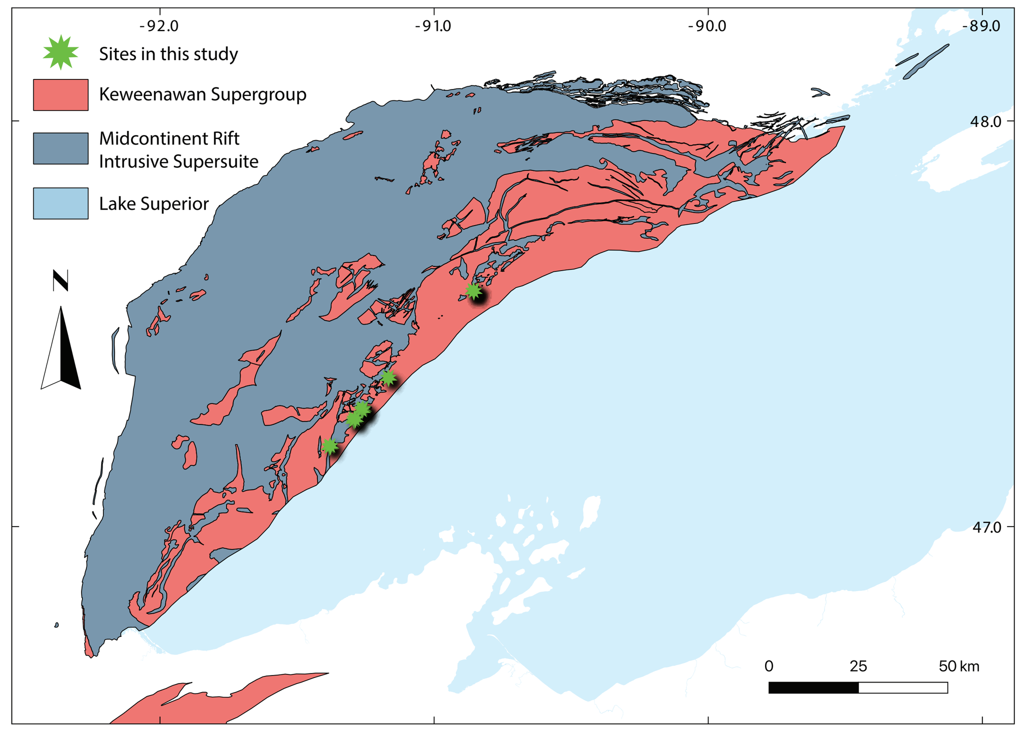

A 1.1 Billion-Year-Old Anisotropy Experiment: A Study of Anorthosite Xenoliths within the Beaver River Diabase

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Introduction and Background

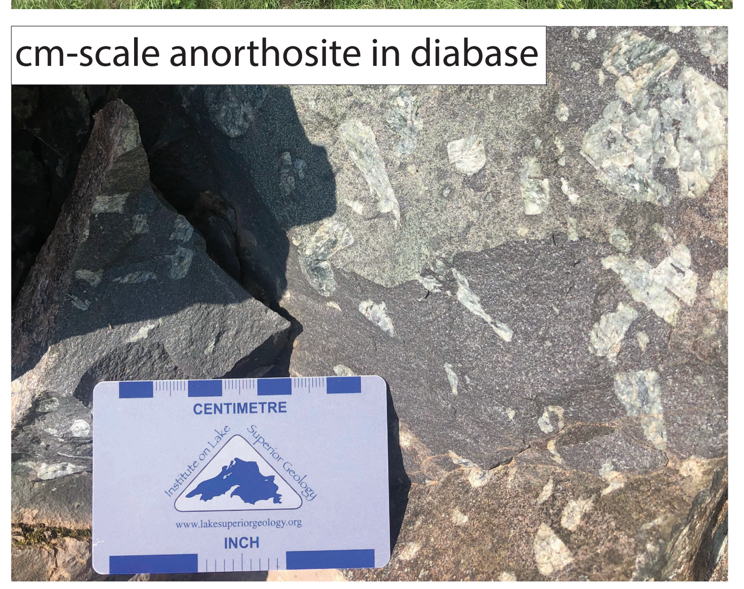
Anorthosites are attractive paleomagnetic recorders as silicate-hosted magnetite inclusions can be single-domain and be shielded from alteration. However, petrofabrics within anorthosites may result in magnetic remanence anisotropy that is potentially detrimental to recovering paleomagnetic direction and intensity. The ca. 1095 Ma Beaver River diabase of the North American Midcontinent Rift contains abundant nearly pure plagioclase anorthosite xenoliths that are hypothesized to have been liberated from the lower crust by the magma enroute to becoming embedded in shallow crustal sills. These xenoliths range in scale from centimeters to >100 meters. In this study, we compare the remanent paleomagnetic directions recorded by anorthosite xenoliths to those of the Beaver River diabase host rocks. Given that both lithologies should record the same thermal remanent magnetization, this comparison provides a means to assess the effects of remanence anisotropy on the paleodirection recorded by the anorthosites.

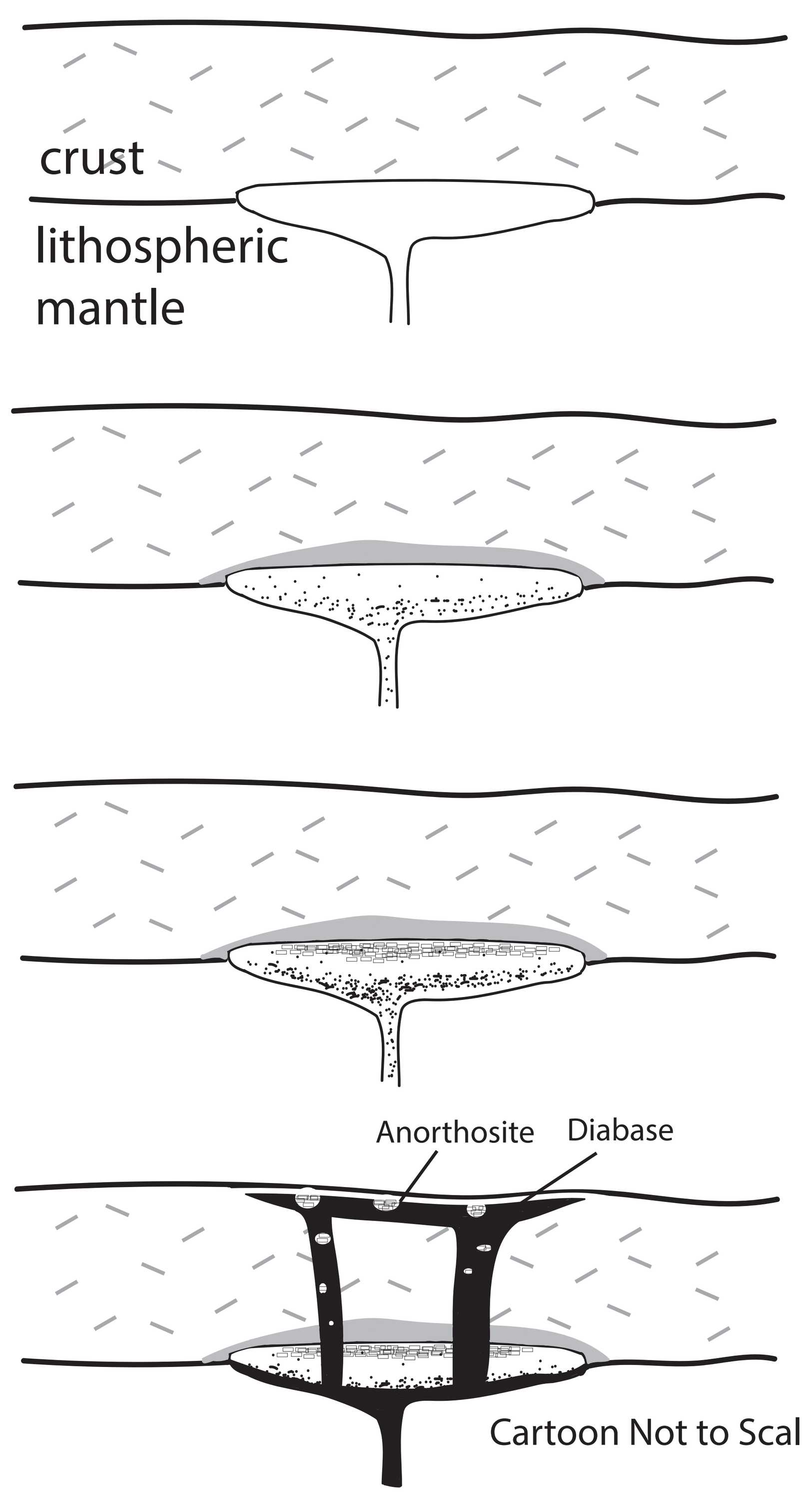
Research Questions:

1. Did the anorthosite xenoliths acquire a thermal remanence at the time of emplacement?

2. Is the anorthosite remanence aligned with host diabase or skewed due to anisotropy?

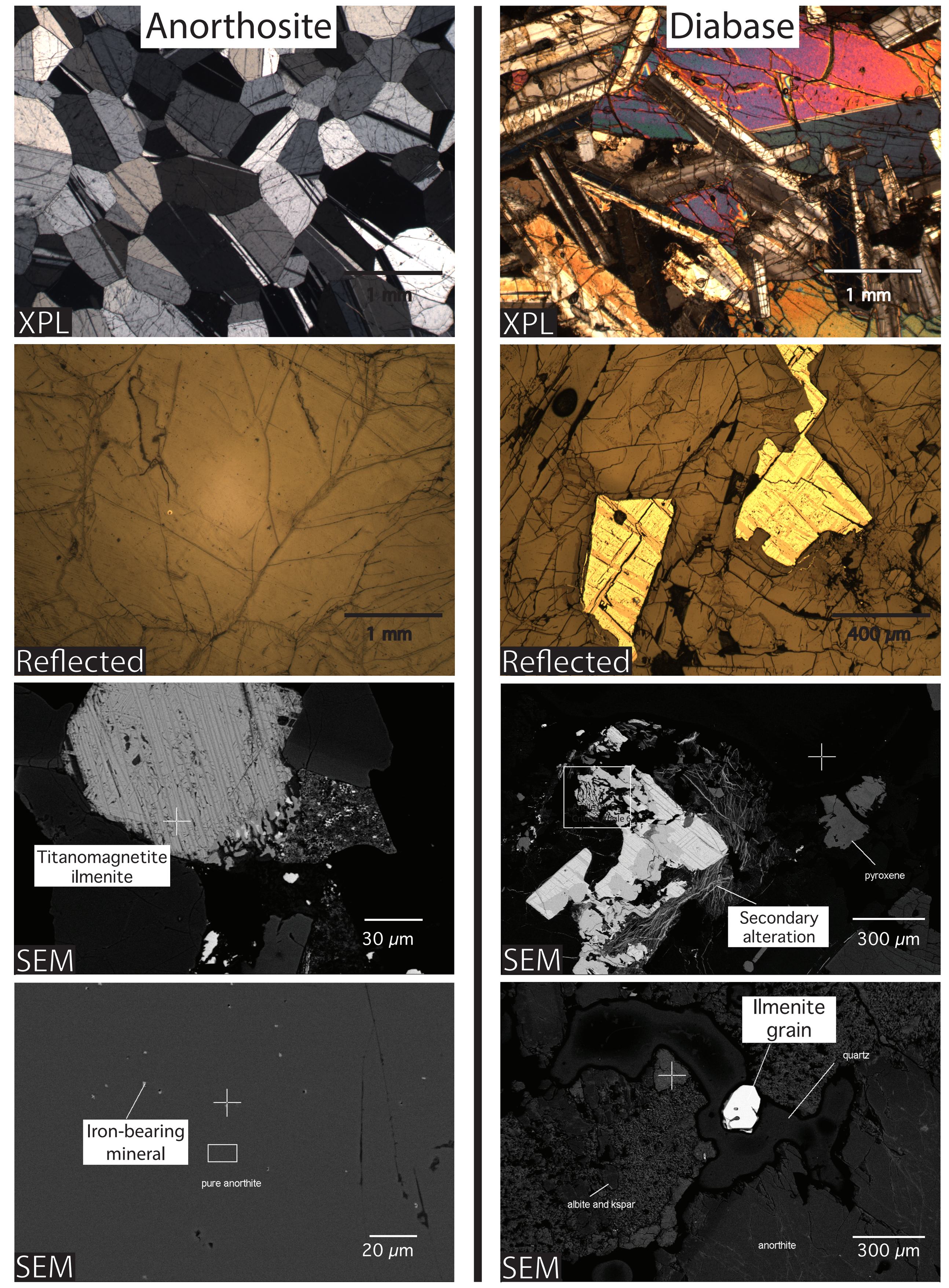
3. Do the plagioclase crystals contain magnetite ideal for paleointensity experiments?



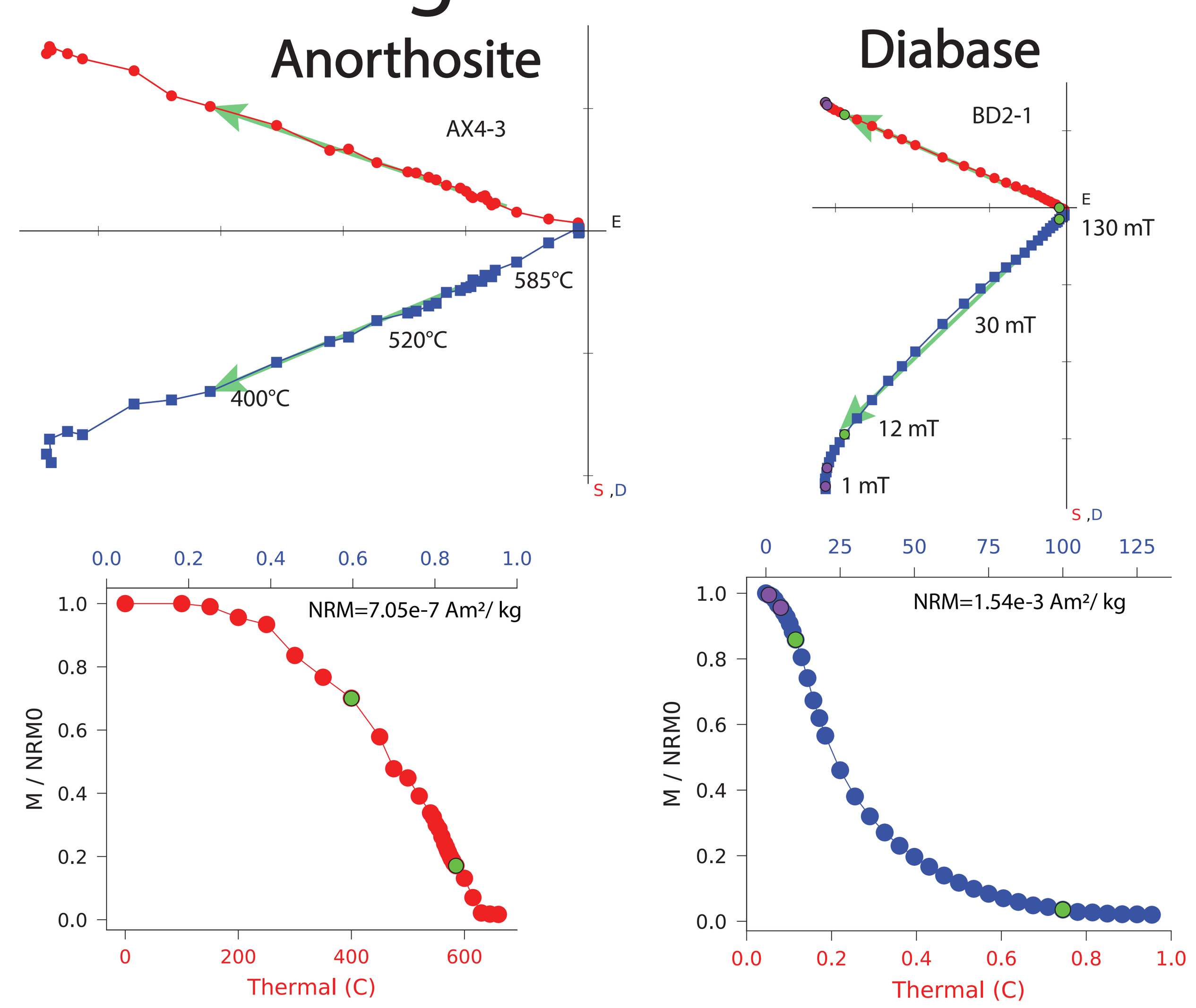


Field photos of anorthosites and diabase, and schematic formation diagram for the Beaver Bay Complex modified from Ashwal (1993).

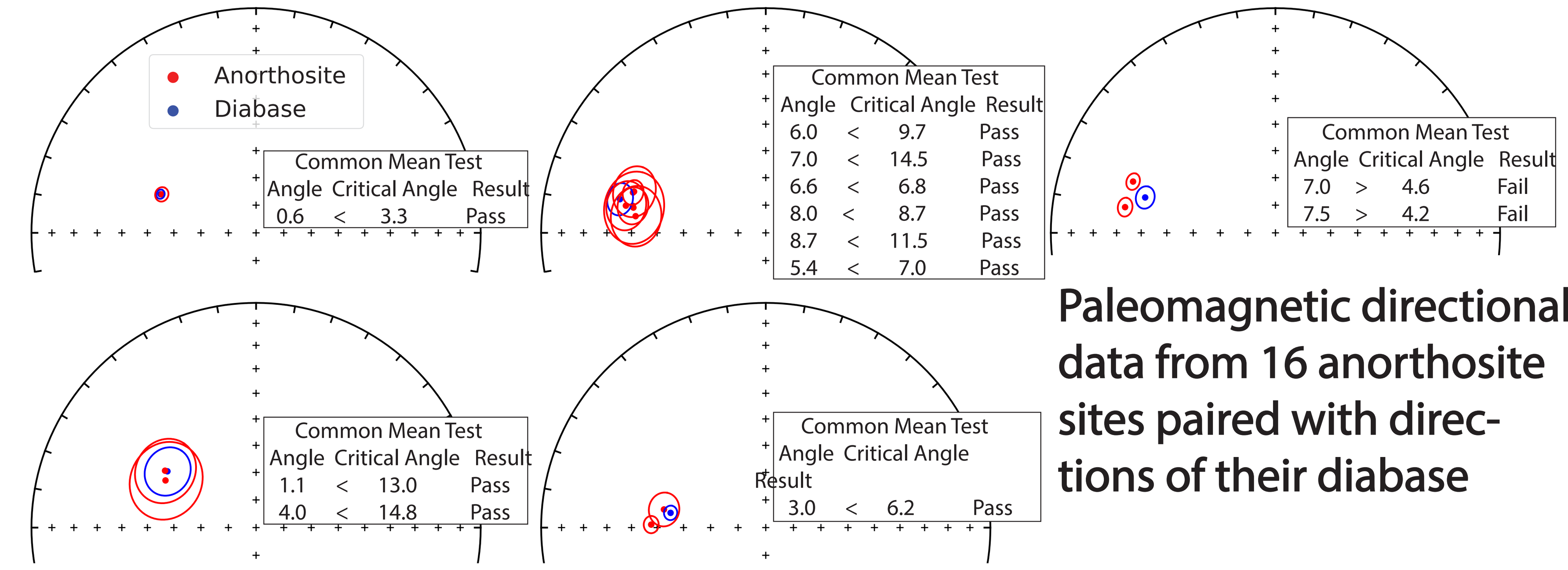
Petrography



Demagnetization Results

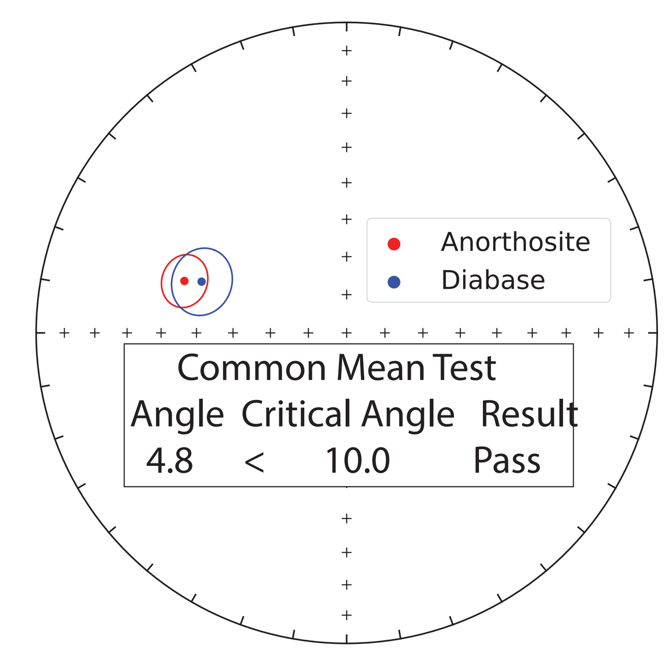


Paired Diabase-Anorthosite Sites

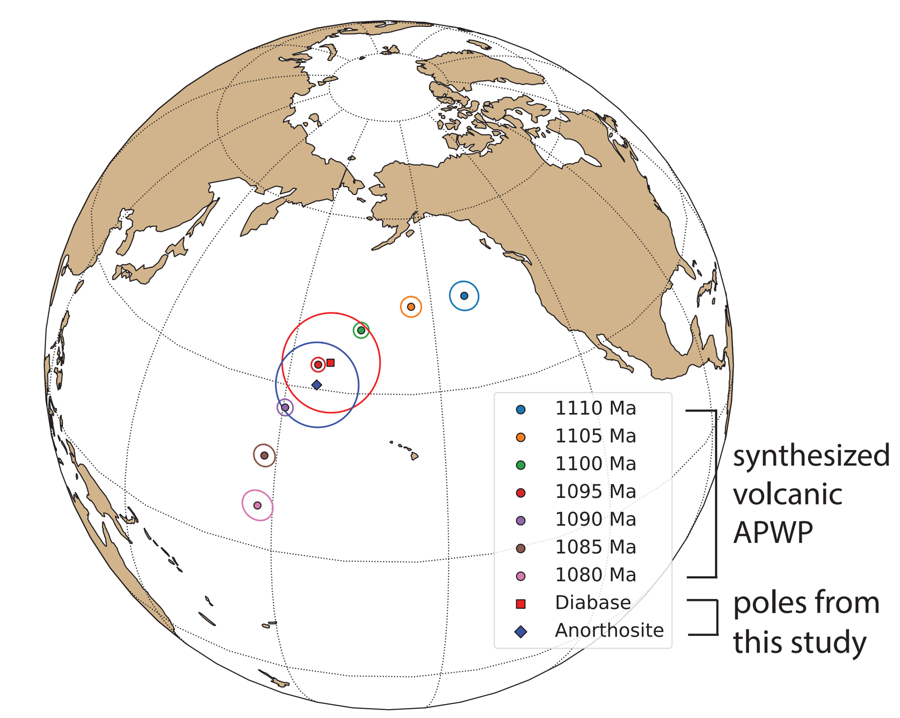


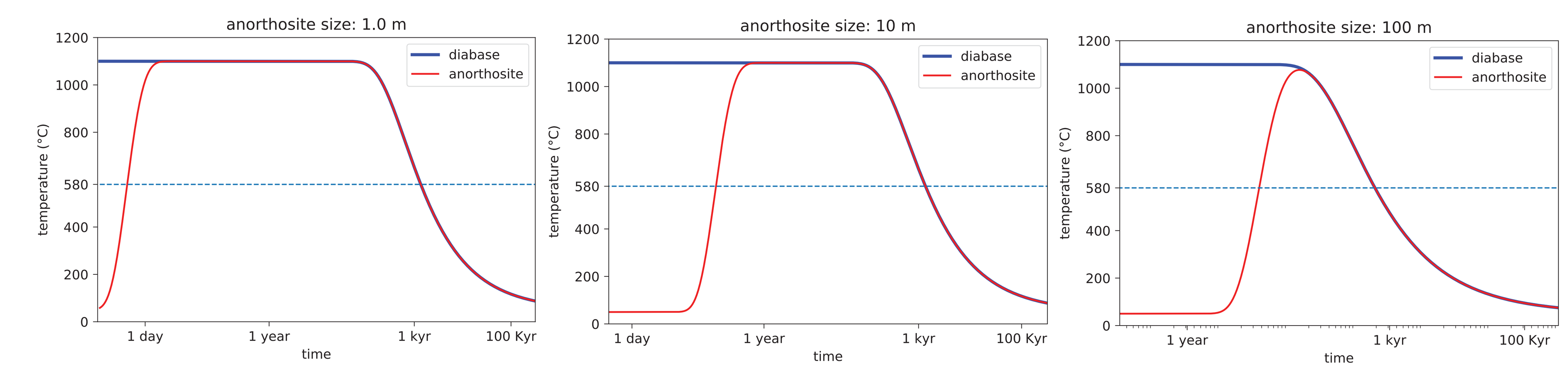
Paleomagnetic directional data from 16 anorthosite sites paired with directions of their diabase

Site Mean Directions



VGPs in Context of APWP from Volcanics





Cooling model for different sizes of anorthosite xenoliths embedded within the Beaver River diabase (modeled to be 200 meter thick. Anorthosites likely acquired full TRM within the dia-

Conclusion and Future Research

1. The anorthosite xenoliths acquired a thermal remanent magnetization within the diabase as it cooled.
2. Common mean tests indicate minimal remanence anisotropy of anorthosite relative to diabase.
3. Determining the remanence carriers in the anorthosite requires additional rock magnetic experiments and electron microscopy
4. Both whole rock anorthosite and single crystal plagioclase from the xenoliths are promising targets for

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Acknowledgement

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