project title: Building a high-resolution paleogeographic reference frame

project subtitle: Paleomagnetic apparent polar wander paths based on magnetostratigraphic data

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Project description

Global paleogeography forms the basis for interpretation of paleoclimate, paleoenvironment, and paleobiology. It is quantified based on plate tectonic reconstructions that are then placed in a reference frame relative to the Earth's spin axis using paleomagnetic data. Currently, statistical procedures are crude, and paleogeographic reference frames average motions over 20 million year windows. Paleoclimate science, however, has identified fluctuations on shorter timescales, such as the Early Eocene Climate Optimum that lasted ~15 million years. We currently have no way of determining what the effect of paleogeographic change may have been, but one option is that Earth may undergo rapid phases of 'true polar wander' on these timescales. True polar wander is the rotation of the solid earth relative to its spin axis due to changes in its moment of inertia, which in turm may result from processes such as subduction initiation and slab break-off, which occurred regularly in the Cenozoic. It is thus necessary to drastically increase the resolution of paleomagnetic data behind paleogeography.

There is a way of doing this. Detailed climatic reconstructions are based on long sedimentary sections that are often dated with magnetostratigraphy. Those sections have thousands of paleomagnetic samples dated at high resolution, and available datasets, for instance from China, have the potential to increase paleomagnetic reference frames by two orders of magnitude. However, this requires programming a work flow in which data and their undertainties are first corrected for biases (magnetic overprints, inclination shallowing correction). Next, datapoints from different sections should be stacked on a per-sample level, as is common practice in the development of global climate curves.

The Bright Minds student will help develop and program the work flow and develop and apply a method to use existing magnetostratigraphic datasets to develop the first high-resolution paleomagnetic reference frame. The student will then test whether there are indications that paleogeographic fluctuations may underpin Cenozoic climate fluctuations.

Job requirements

The student is expected to have programming skills in Python, and be familiar with, or able to familiarize with, mathematics and statistics, especially bootstrapping methods for error propagation. Prior basic knowledge of stratigraphy, paleomagnetism, and paleogeography is a pre but is not required.