Variations in the 143Nd/144Nd ratio of Early Pliocene to Late Miocene glacially derived sediments in Prydz Bay, East Antarctica

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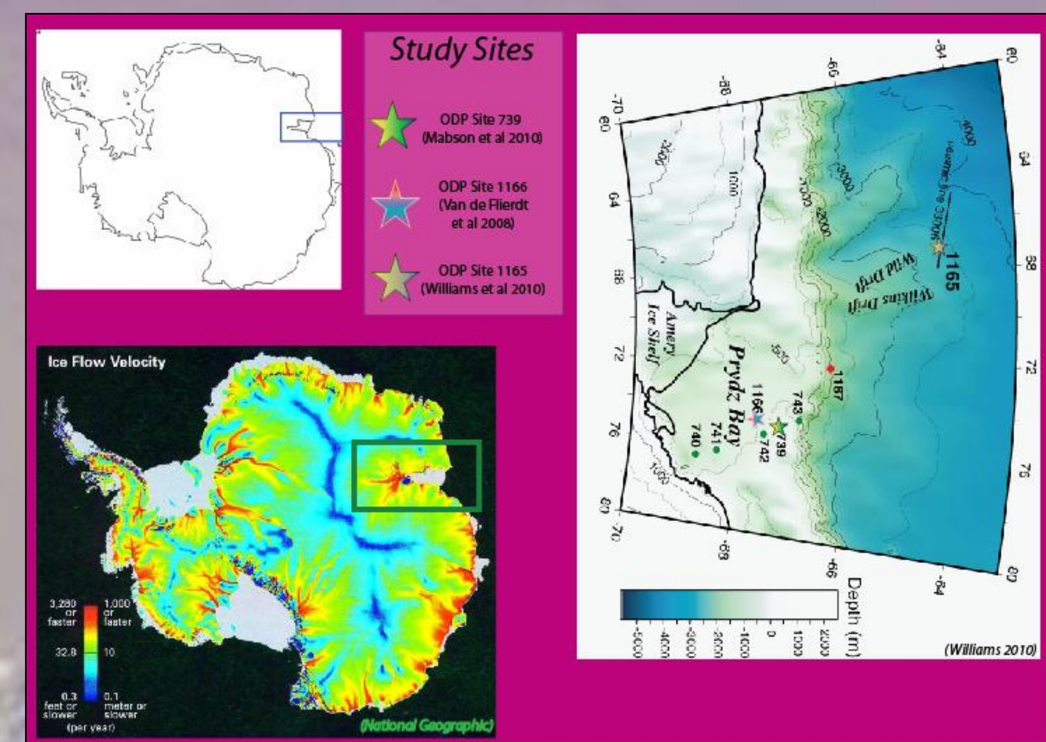
BACKGROUND AND MOTIVATION

The goal of this study is to trace terriginous sediment that has been deposited into the ocean back to its provenance source on land. This work is part of a larger study of East Antarctic Ice Sheet (EAIS) dynamics in the past, led by Trevor Williams at LDEO and by Tina van de Flierdt at Imperial College London. Recently Williams et al. (2010) published evidence for dramatic changes in the sources of glacially derived sediments in Ocean Drilling Program (ODP) core 1165 (see the maps). Their interpretation was based on the Ar-Ar ages of detrital hornblende grains, but a set of four samples across an event at 4.8 Ma showed an intriguing variation of the 143Nd/144Nd (Fig. 2). The older part of the event includes a significant fraction of exotic Ar-Ar ages, but εNd similar to the background values, while the younger part of the event shows a significant decrease in εNd but Ar-Ar of exclusively local origin. The specific goal of this study is to test the hypothesis that the shift to lower εNd in the 4.8 Ma ice rafting event is due to dynamical changes in the Prydz Bay sector of the East Antarctic ice sheet. There is evidence for a range of εNd in the terrains surrounding Prydz Bay (van de Flierdt et al., 2009). The core that was studied by van de Flierdt et al. (2008), ODP 1166 (see the map) has an unconformity that spans ~30-3 Ma. The down-core record we are investigating in this study is located off of Prydz Bay in East Antarctica at ODP site 739, located about 200 km from the coast line. Because of its location we can conclude that the sediment deposited into this area is derived from the Lambert Glacier. The stratigraphic range of sediments in site 739 is Quaternary to the late Eocene. Late Eocene is about the time of the inception of the EAIS (Zachos et al., 2001; Volpi et al. 2007).

Neodymium isotopes are commonly used as a provenance tracer for marine sediments. Previous studies around Antarctica have demonstrated the viability of the approach (Roy et al., 2007; Van de Flierdt et al., 2008; Williams et al., 2010).

MATERIALS AND METHODS

- ❖The bulk sediment was wet-sieved and dried down, and the <63 µm fraction was used for analyses.
- ❖Twenty samples from ODP site 739C were allotted to conduct geochemical analysis.
- ❖Flux fusions were performed using 0.1000 ± 0.0005 g of sample mixed with 0.4000 ± 0.0020 g of lithium metaborate.
- ❖REE were co-precipitated with iron oxide and aluminum oxide using Ammonium hydroxide.
- ❖Neodymium (Nd) was isolated through a two-step column chemistry procedure:
  - ❖First, the REE were separated from the precipitated matrix using cation exchange.
  - ❖Secondly, the samples were passed through columns using Eichrom Ln-Spec resin to separate the Nd from the other REE.
- ❖Six samples were chosen for isotopic analysis which was performed on the Triton Thermal Ionization Mass Spectrometer.



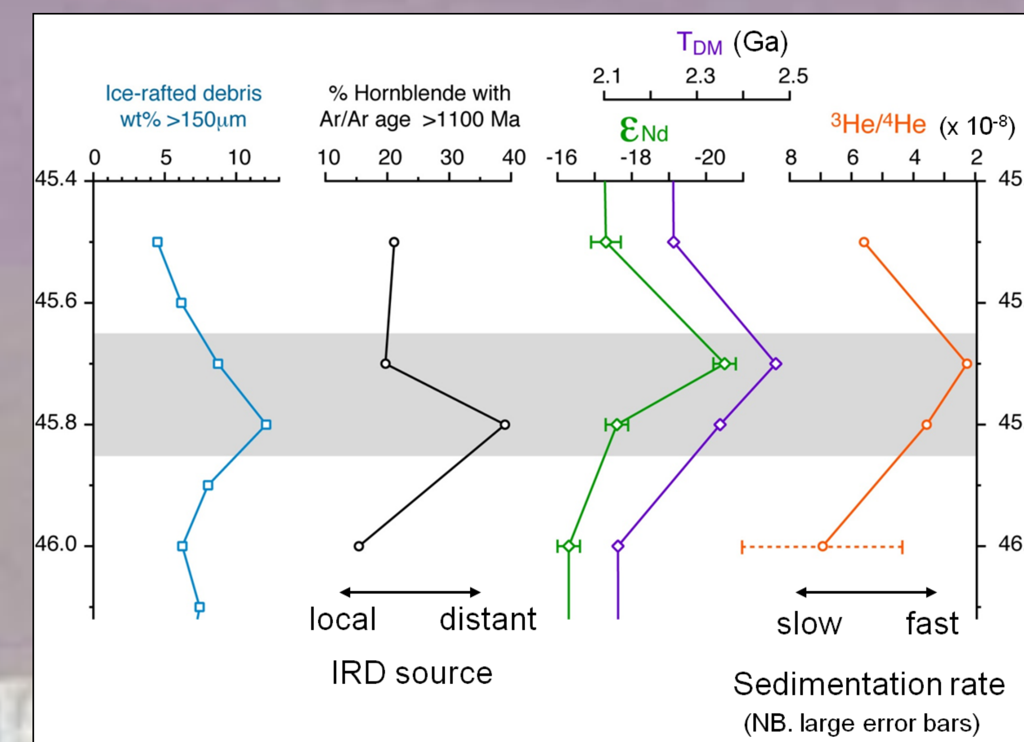


Figure 1: The picture in the top left is an outline of Antarctica with a box indicating the location of Prydz Bay. Just below this picture is a diagram depicting the ice flow velocity around Antarctica with a specific indicator on Prydz Bay. The last picture is showing a zoom in of Prydz Bay where sites 739, 1166, and 1165 are highlighted.

Figure 2: This figure indicates an event that occurred at the 4.8 Ma ice rafting occurrence when different isotopic tracers are applied.

RESULTS

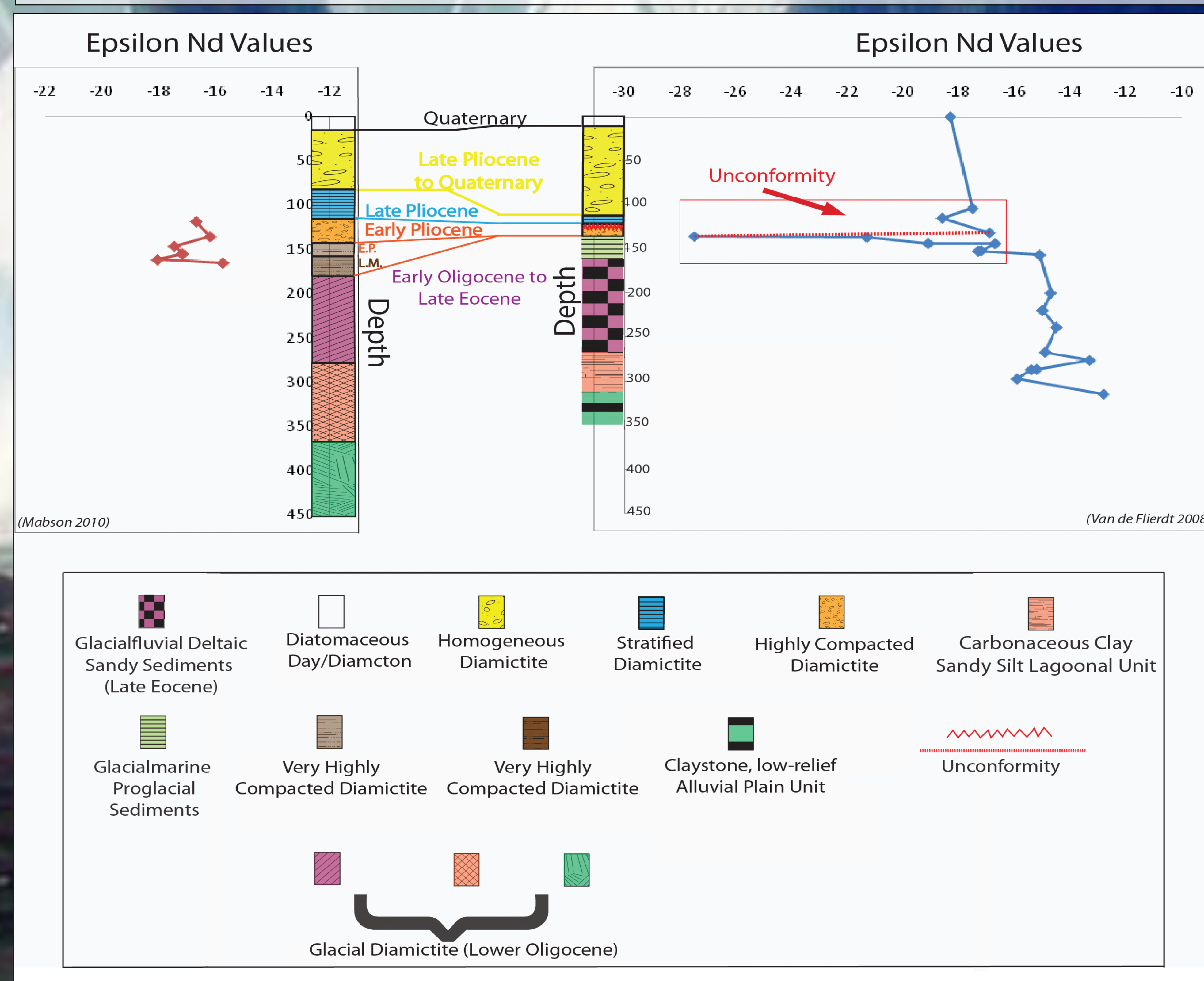


Figure 3: Comparison of εNd values from this study and Van de Flierdt et al. 2008.

DISCUSSION AND FUTURE WORK

Our reason for selecting the six samples is that they are close in time to the event studied by Williams et al. (Fig. 2.) Although there is a large gap in the stratigraphy of 1166 (Fig. 3.), just below the unconformity, van de Flierdt et al. (2008) documented two samples with significantly lower eNd. A likely explanation for this unconformity found in 1166 (Fig. 3. Volpi et al., 2007) is erosion caused by the Lambert Glacier. Site 739 is close to site 1166, but may have been located near the edges of the bases, thus avoided erosion and produced a more complete core (Fig. 3. Volpi et al. 2007). The data from site 739 do not show the low eNd found by van de Flierdt. It could be that higher resolution sampling across the ca. 4.8 Ma interval in 739 as well as other ODP cores in Prydz Bay will allow us to document the source of anomalous eNd found by Williams in site 1165.

Fourteen other samples from site 739, spanning the entire stratigraphic interval, have been prepared. There was not enough time to make the isotopic analyses, but in the future, these samples will be analyzed. It is expected that the epsilon Nd values will correspond closely with those found in similar stratigraphic horizons in ODP site 1166. There should be a change in Nd values when moving down the core and through different time periods.

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