Exploring the Rate of East Antarctic Ice Retreat during the Pliocene using Geochemical Provenance Analysis

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Approximately one third of the East Antarctic Ice Sheet (EAIS) (~19m global sea level equivalent) is situated in marine-based sections. Models and data have indicated that such regions, including the Wilkes Subglacial Basin (WSB), may be prone to instability under warmer temperatures. Past ice sheet instabilities can be studied by investigating marine sediment cores in proximal locations to the ice sheet. Of particular relevance is the Pliocene epoch (~2.6 to 5.3Ma), as it was a time with global temperatures similar to those predicted for the end of this century.

Here we present new results on Pliocene aged marine sediments recovered during IODP Expedition 318 (Site U1361) on the continental rise offshore the WSB. Previous studies at this location have shown that the radiogenic isotope compositions (Nd and Sr) of detrital sediments can provide insights into sediment provenance and, by inference, ice dynamics.

Our new study covers four high resolution intervals, which span from early to late Pliocene in age, at a resolution of a few thousands year (84 samples in total). Results show that the provenance of sediments varies between two continental lithologies (average ε_{Nd} value of -13.6, $^{87}Sr/^{86}Sr$ of 0.733940 and average ε_{Nd} value of -10.0, $^{87}Sr/^{86}Sr$ of 0.719794), of which one is exposed locally at the continental margin, whereas the other is mainly situated within the WSB. We hence interpret the latter to be associate with significant ice retreat.

We here show for the first time that provenance transitions into and out of individual warm phases in the Pliocene do not occur very abruptly. Instead they occur gradually, over time scales of at least a few millennia, in parallel to changes in ocean productivity. These findings corroborate recent modelling work where East Antarctic ice retreat, on the order of ~17 m global sea level equivalent, could be achieved within a few thousand years under Pliocene boundary conditions.