Pleistocene WAIS history from marine sediment cores

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The ANDRILL McMurdo Ice Shelf core made abundantly clear that the WAIS had a complex history characterized by repeated cycles of advance and collapse throughout the Pliocene. Interglacials dominated, and most of these were notably or significantly warmer than present. During Pliocene interglacials the Ross Embayment was characterized by notably warmer than present conditions with little sea ice, based on interpretation of diatom assemblages that define pelagic-dominated water masses.

The Pleistocene history of the WAIS is less well defined and probably more complex. It is now clear that the WAIS collapsed during the early Pleistocene interglacial Marine Isotope 31, with response of the ice sheet directly in phase with precession-paced insolation changes. A relatively brief interval of extremely high insolation at 1.08 Ma ago would have directly affected summer sea ice and year-round sea surface temperatures. Modeling of MIS-31 by DeConto & Pollard successfully reproduces the WAIS response inferred from high resolution sediment records, including collapse in phase with precession-paced insolation changes. Ross Ice Shelf collapse and subsequent WAIS retreat were triggered from ice shelf thinning from below. Their model does not show significant circumantarctic continental surface melt, but seasonal melt pond formation on the ice shelf surface is possible, which might have offered the potential for the melt-pond formation $\rightarrow$ draining $\rightarrow$ freezing $\rightarrow$ crack propagation mechanism that ultimately triggered the catastrophic collapse of the Larsen-B ice shelf in 2002. The DeConto & Pollard model included late Pleistocene collapse events as well (e.g., MIS-7), but these events are not as well documented in sediment core records or sea level proxies.

So, did the WAIS collapse multiple times through the Pleistocene? The recalculation of WAIS sea level equivalent by Bamber et al. (2009) (3.3 M as opposed to the frequently quoted 5-6m) makes it clear that it may be extremely difficult to identify all past WAIS collapse events by interpretation of sea level proxies. Proximal sedimentary records that reflect continuous sedimentation through the Pleistocene remain the best way to interpret past WAIS behavior for the last 1 Ma. Such records have been elusive, but some new cores have been recovered that are promising, and future Antarctic drilling may fill in the gaps.