East Antarctic ice sheet dynamics during the mid-Miocene climate transition

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The Mid-Miocene Climate Transition (MMCT, ~14 Ma) saw a marked decrease in global temperatures and sea level, corresponding to an increase in global ice volume. Here we present direct evidence of East Antarctic ice sheet (EAIS) dynamics during the MMCT from sediment in deep ocean cores on the Antarctic continental margin. Between 14.2 and 13.8 Ma, coeval with the MMCT, unusually high concentrations of dropstones are found at IODP Site U1356, Wilkes Land, and ODP Site 1165, Prydz Bay. We interpret the ice-rafted detritus (IRD)-rich layers to be caused by repeated, massive pulses of debris-laden icebergs. Taken together with evidence for global ice volume oscillations from benthic oxygen isotope records, our new MMCT records suggest that at least two major ice sectors around East Antarctica featured repeated substantial growth and collapse before the EAIS reached a relatively more stable state.

Further constraints are made through isotopic provenance studies on the coarse ($^{40}Ar/^{39}Ar$ hornblende and biotite ages) and fine (ε_{Nd}) fractions of IRD layers. Site 1356 data indicate the ice margin likely sat along the extension of the Mertz Shear Zone at the western edge of the Wilkes Subglacial Basin, while variations in ε_{Nd} require sourcing from the interior of the Wilkes Basin and/or the Transantarctic Mountains. Site 1165 IRD shows a mixture of local (Prydz Bay) and far-traveled (>1000 km, Wilkes Land) material.