Collapse of the south Greenland ice-sheet during the Marine Isotope Stage 11 "super-interglacial"

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Marine Isotope Stage (MIS) 11 was an exceptionally long interglaciation ~400 ka with estimated global mean sea level of <6 m or up to 13 m above present, implying substantial mass loss from at least one of Earth's remaining ice sheets. However, there are no model simulations and only limited proxy data to constrain the magnitude of Greenland ice sheet (GrIS) response to climate change during this "super-interglacial". Even less is known about the Antarctic ice sheets (AIS). This lack of data confounds efforts to assess climate-ice-sheet threshold behavior and the magnitude and sources of interglacial sea-level rise. In the absence of direct geomorphic traces for ice-sheet retreat during past interglaciations, we turn to geochemical proxy evidence to assess the south GrIS retreat during MIS 11 and, in turn, estimate its contribution to MIS 11 sea level.

We use the Eirik Drift sedimentary record in core MD99-2227 to infer GrIS extent on south Greenland. The Eirik Drift receives terrigenous sediment sourced from erosion of south Greenland's Precambrian bedrock and from Paleogene volcanics in east Greenland and Iceland. Provenance of Eirik Drift sediments is determined using Sr-Nd-Pb isotope composition of the $CaCO_3$-free silt fraction, which tracks terrestrial silt sources because the unique isotope compositions of south Greenland's bedrock terranes reflect their differing ages and tectonometamorphic histories.

There is a major reduction of sediment input derived from south Greenland's Precambrian bedrock terrane during the peak of MIS 11, likely reflecting the absence of subglacial erosion and meltwater sediment transport as a result of near-complete deglaciation of south Greenland. Comparison with simulated ice-sheet configurations suggests that the GrIS lost ~4.5 to 6 m of sea-level-equivalent volume during MIS 11. We therefore provide a geologically recent example of GrIS collapse under an interglacial climate forcing within the range of projections for the end of this century.