Reassessing the post-Last Glacial Maximum retreat history from the Southwest Ross Sea

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Abstract

Constraining the timing of the retreat of the Last Glacial Maximum (LGM) Antarctic Ice Sheet in the Ross Sea provides insights into the processes controlling marine-based ice sheet retreat. The over-deepened Ross Sea continental shelf is an ideal configuration for marine ice-sheet instability, and this region was thought to be one of the largest Antarctic contributors to post-LGM sea level rise. However, the chronology and pattern of retreat of the LGM ice sheet in the Ross Sea is largely constrained by coastal records along the Transantarctic Mountain front in the Western Ross Sea. Although these offer more reliable dating techniques than marine sediment cores, they may be influenced by local glaciers derived from East Antarctic outlet glaciers. Consequently, these coastal records may be ambiguous in the broader context of retreat in the central regions of the Ross Sea. However, previous studies have inferred that records in this region retreated in a north to south pattern, and was fed by ice sourced from the central Ross Sea – with the implication that broader ice sheet retreat in the central Ross Sea occurred as late as the mid Holocene.

We present two lines of evidence that counter this established interpretation of the pattern of retreat in the Ross Sea: 1) a sedimentary facies succession and foraminifera-based radiocarbon chronology from within the Ross Sea embayment that indicates glacial retreat and open marine conditions to the east of Ross Island was already in place before 8.6 cal ka BP, at least 1 kyr earlier than indicated by terrestrial records in McMurdo Sound; and 2) a new multibeam swath bathymetry data that identifies well-preserved glacial features indicating thick (>700m) marine-based ice derived from the East Antarctic Ice Sheet (EAIS) coastal outlet glaciers dominated the ice sheet input into the southwestern Ross Sea during the last phases of glaciation – and thus may have acted independent of any ice in the central Ross Sea embayment. Comparing these data to new modelling experiments, we hypothesize that marine-based ice sheet retreat was triggered by oceanic forcings along most of the Pacific Ocean coastline of Antarctica, but continued early Holocene retreat into the inner shelf region of the Ross Sea occurred primarily as a consequence of marine ice sheet instability.

Keywords: Ross Sea, deglaciation, Last Glacial Maximum, Holocene