

The paradox of a long grounding during West Antarctic Ice Sheet retreat in Ross Sea

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Abstract

Marine geological data show that the West Antarctic Ice Sheet (WAIS) advanced to the eastern Ross Sea shelf edge during the Last Glacial Maximum (LGM) and eventually retreated ~1000 km to the current grounding-line position on the inner shelf. During the early deglacial, the WAIS deposited a voluminous stack of overlapping grounding zone wedges (GZWs) on the outer shelf of the Whales Deep Basin. The large sediment volume of the GZW cluster suggests that the grounding-line position of the paleo-Bindschadler Ice Stream was relatively stationary for a significant time interval. We used an upper bound estimate of paleo-sediment flux to investigate the lower bound duration over which the ice stream would have deposited sediment to account for the GZW volume. Our calculations show that the cluster represents more than three millennia of ice-stream sedimentation. This long duration grounding was probably facilitated by rapid GZW growth. The subsequent punctuated large-distance (~200 km) grounding-line retreat may have been a highly non-linear ice sheet response to relatively continuous external forcing such as gradual climate warming or sea-level rise. These findings indicate that reliable predictions of future WAIS retreat may require incorporation of realistic calculations of sediment erosion, transport and deposition.

Keywords: Last Glacial Maximum, grounding zone wedges