

Pacing of Northern Hemisphere Ice Sheet Growth and Retreat in the Early Pleistocene From Gardar Drift Site U1564

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The expansion and intensification of Northern Hemisphere glaciations occurred after 2.6 million years ago. During this late Pliocene/early Pleistocene period of Northern Hemisphere glaciations, globally integrated records of ice volume changes from the LR04 benthic oxygen isotope stack (Lisiecki and Raymo, 2005) suggest that there was a glaciation every 41 kyr. However, Raymo et al. (2006, *Science*) proposed that since ice sheet ablation is most sensitive to peak local summer insolation, which varies primarily on the precession (23 kyr) timescale and is anti-phased between hemispheres, that ablation would be out of phase between the hemispheres and this signal would cancel out in global ice volume records (e.g., leaving a $\delta^{18}\text{O}$ record dominated by obliquity). In fact, recent work by Barker et al. (2022, *Science*) shows that terminal ice-rafting events in the early Pleistocene North Atlantic Ocean were associated with minima in the precession index (Northern Hemisphere Summer insolation maxima). Here we constrain the timing and pacing of past ice sheet collapse by documenting iceberg rafting events in the recently recovered high-sedimentation rate Plio-Pleistocene section from IODP Site U1564. Site U1564 is located on the Gardar Drift, one of the major contourite drifts in the North Atlantic, which is bathed by the deep water flow coming over the Iceland-Faroe Ridge. To understand the timing and pacing of northern hemisphere glaciations in the early Pleistocene, we quantified the abundance of iceberg rafted debris (IRD) as well as planktonic foraminifera. High levels of IRD are typically associated with a major ice loss event (i.e. ice sheet collapse, sea level rise) as the continental materials trapped within the ice are released as the resulting icebergs melt. Consequently, by examining IRD abundance, we can evaluate when and how frequently these events occurred. In addition, we are building a $\delta^{18}\text{O}$ record using benthic foraminifera to refine the preliminary age model for Site U1564 and present a robustly dated record of ice sheet growth and retreat in the Gardar Drift, during the heart of the 41-kyr world.