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Reconstructing southern Greenland Ice Sheet history during the intensification of Northern Hemisphere glaciation: Insights from IODP Site U1307

Keziah Blake-Mizen (1), Ian Bailey (1), Anders Carlson (2), Joe Stoner (2), Rob Hatfield (2), Chuang Xuan (3), and Kira Lawrence (4)

(1) University of Exeter, Camborne School of Mines, College of Engineering, Mathematics and Physical Sciences, Truro, United Kingdom (krb210@exeter.ac.uk), (2) College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, Oregon 97331, USA, (3) Ocean and Earth Science, National Oceanography Centre Southampton, University of Southampton Waterfront Campus, Southampton SO14 3ZH, UK, (4) Department of Geology and Environmental Geosciences, Lafayette College, Easton, Pennsylvania 18042, USA

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Keziah Blake-Mizen1, Ian Bailey1, Anders E. Carlson2, Joseph S. Stoner2, Robert G. Hatfield2, Chuang Xuan3 and Kira Lawrence4
1. Camborne School of Mines, University of Exeter Penryn Campus, Cornwall TR10 9FE, UK
2. College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, Oregon 97331, USA
3. Ocean and Earth Science, National Oceanography Centre Southampton, University of Southampton Waterfront Campus, Southampton SO14 3ZH, UK
4. Department of Geology and Environmental Geosciences, Lafayette College, Easton, Pennsylvania 18042, USA

Should it ever melt entirely, the Greenland Ice Sheet (GIS) would contribute to ∼7 metres of global sea-level rise. Understanding how the GIS might respond to anthropogenic-induced global warming over the coming century is therefore important. Central to this goal is constraining how this ice sheet has responded to radiative forcing during both warmer- and colder-than-present climate states in the geological past. Little is known in detail, however, about the GIS prior to the Late Pleistocene and large uncertainty exists in our understanding of its history across the last great climate transition during the Cenozoic, the intensification of Northern Hemisphere glaciation (iNHG; ∼3.6–2.4 Ma). This time encompasses two intervals of interest: (1) the mid-Piacenzian warm period (mPWP, ∼3.3–3 Ma), widely considered an analogue for a future equilibrium climate state when atmospheric CO_2 levels were comparable to modern (∼400 ppmv) and sea-level and global temperatures were elevated relative to today (by ∼25 metres and ∼2–3˚C) and, (2) a subsequent gradual deterioration in global climate and decline in atmospheric CO_2 that led to the development of Quaternary-magnitude glaciations from ∼2.5 Ma. Important unresolved questions include: to what extent did the southern GIS retreat during the mPWP, and when did a modern-day sized GIS first develop during iNHG? To tackle these issues our project focuses on the southern GIS history that can be extracted from Eirik Drift IODP Site U1307 between ∼3.3 and 2.2 Ma. To achieve this we are developing an independent orbital-resolution age model, one of the first for high-latitude marine sediments deposited during iNHG, by producing a relative paleointensity (RPI) record for Site U1307; and generating multi-proxy geochemical and sedimentological datasets that track the provenance of the sand and bulk terrigenous sediment fraction glacially eroded by the southern GIS and delivered to the study site by both ice-rafting and the Western Boundary Undercurrent at this time.