Using Geochemical Data to Constrain the Climatic and Ice-Cover History of Greenland

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Reconstructing the behaviour of the Greenland ice sheet (GIS) during the Pleistocene is critical for predicting its contribution to sea-level rise in a warming world. However, competing evidence for and against dramatic ice loss on Greenland during recent interglacial stages complicates our understanding of the longer-term history of the GIS. In addition, the lack of long, continuous temperature records from high northern latitudes has hindered our understanding of the cause and extent of past periods of ice loss in Greenland. Recent advancements in inferring the exposure history beneath the GISP2 ice core site [1], new proxy reconstructions of high-latitude Pliocene-Pleistocene climate change [2], and marine sediment records of ice-sheet erosion [3] are rapidly filling these gaps in our knowledge. Here, we simulate past instability of the Greenland ice sheet using coupled climate and ice-sheet models, and use the model output to predict bedrock exposure history, subglacial erosion history, and sediment delivery to the ice-sheet margin. We compare our simulations with recently published measurements of exposure history and erosion rates from beneath and around the ice sheet [1,3]. Our results allow us to infer the Plio-Pleistocene climatic history of the ice sheet most consistent with multiple geochemical datasets, and identify regions where additional data could further constrain the modelled ice-sheet and climate histories.

[1] Schaefer et al. (2016), *Nature* 540, 252-255. [2] Habicht, Castañeda et al. in prep. [3] Bierman et al. (2016), *Nature* 540, 256-260.