Paleoclimate reconstruction of the Baffin Bay region, west Greenland

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Introduction:

As the Greenland Ice Sheet (GrIS) adjusts to rising temperatures across the Arctic, changes in ice sheet extent, velocity and mass will have an important influence on global sea level rise and more broadly the oceanography of the North Atlantic. Given that the GrIS has the potential to add up to ~7 m to global sea level if it were to fully melt, understanding the long-term history of the ice sheet is of global significance.

There is an increasing body of evidence investigating the Last Glacial Maximum (LGM) extent, retreat dynamics and Younger Dryas response of the GrIS, but this is extremely scattered. The collected data are also heavily skewed towards Disko Bugt because of concerns about the stability of Jakobshavn Isbræ, an ice stream draining ~7% of the contemporary GrIS. This means that outside this region there is a poor understanding of deglacial dynamics and even the validity of supposed ice sheet extent. The Melville Bugt region (north eastern Baffin Bay offshore Northwest Greenland), for instance, is poorly understood at a range of timescales; only recently has detailed seafloor mapping shown that ice extended as far as the shelf edge at the LGM - more extensive than the mid-shelf position that was previously inferred. Presently, the catchment area of ice flowing toward Melville Bugt is much larger than Jakobshavn Isbræ. Although the Melville Bugt Trough (MBT) covers a similar area to the Disko Trough in front of Jakobshavn Isbræ, water depths are deeper in the MBT. Therefore, if the MBT was fully-occupied by an ice stream at the LGM, it was likely draining more of the GrIS than Jakobshavn Isbræ, highlighting the need for a better understanding of its post-LGM evolution in this region.

Project Summary:

In this project the following research questions will be addressed:

- What mechanisms and processes drove ice sheet advance and retreat in the past, and across what time scales?
- Was the response linear and steady or non-linear and catastrophic?
- Is there evidence for climatic or glaciogenic thresholds or tipping points?
- Were changes in ice dynamics coupled with changes in ocean-atmosphere records of environmental change?
- What processes occurred at the base of the ice and can this be used to inform us about landform genesis and modern subglacial environments that we cannot investigate in such detail?

To address these questions shallow sedimentary cores from across Baffin Bay (including the Melville Bugt region), recently donated by the oil industry, will be analysed using a wide range of advanced techniques including (in)organic geochemical, (compound specific) isotope analyses and radiocarbon analyses (to be done at QUB). This offers an unique opportunity to reconstruct paleoclimates across this

part of the Arctic region and will provide insights into several key components of the global system that are currently poorly understood. In addition, by understanding how the GrIS evolved, we will gain a better insight into the future evolution of the Greenland and Antarctic Ice Sheets and their surrounding seas by placing recent observations of changes (including from satellite observations) into a longer-term perspective. Combined, this will provide greater observational evidence for constraining, testing and refining numerical Earth-system models, such that the consequences of anthropogenic climate change can be better mitigated against, rather than reacted to.

The student working on this cross-disciplinary project will gain a wide breadth of training in inorganic and organic (geo)chemistry, isotope geochemistry, sedimentology and paleoclimate reconstruction and would suit a student with a background in any of these fields. They will have access to world-class facilities in the Williamson Research Centre for Molecular Environmental Science (SEES) and the University of Manchester ITRAX facility (SEED), the analytical facilities at MMU and the new GIS suite at LJMU with industry standard software for satellite data processing. The techniques will provide a basis for a future career in environmental science, in the industrial, government or academic sectors, in a rapidly expanding research area of international importance.

Image 1– Greenland Ice sheet

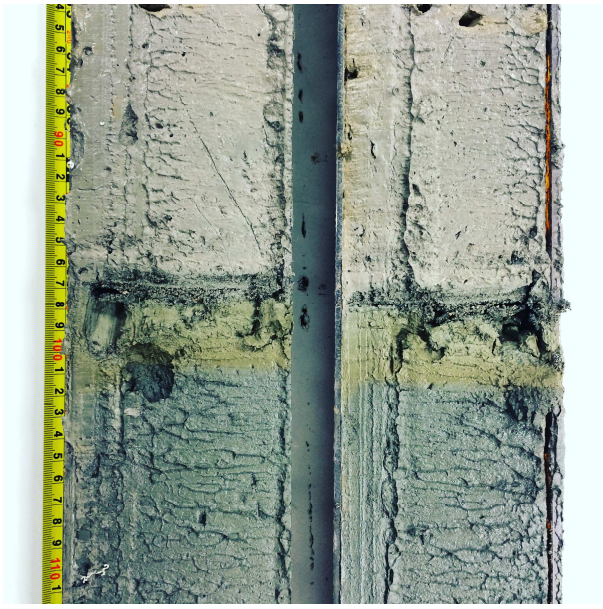

Image 2 – Core section from the Melville Bugt region indicating clear differences in sedimentology likely reflecting a major climate transition

References

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