Holocene ice-ocean interactions: Køge Bugt, southeast Greenland

Laurence M. Dyke[a,*], Camilla S. Andresen[a], Anna L.C. Hughes[b], Marit-Solveig Seidenkrantz[c], John F. Hiemstra[d], Tavi Murray[d], David A. Sutherland[e], Anders A. Bjørk[f], Longbin Sha[c,g], Hui Jiang[g]

[a] *Geological Survey of Denmark and Greenland, Department of Marine Geology and Glaciology, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark.*
[b] *Department of Earth Science, University of Bergen and Bjerknes Centre for Climate Research, Allégaten 41, N-5007 Bergen, Norway.*
[c] *Centre for Past Climate Studies, Department of Geoscience, Aarhus University, Høegh-Guldsbergs Gade 2, Aarhus C DK-8000, Denmark*
[d] *Glaciology Group, Swansea University, Singleton Park, Swansea, SA2 8PP, UK.*
[e] *Department of Geological Sciences, 1272 University of Oregon, Eugene, OR 97403-1272, USA.*
[f] *Centre for GeoGenetics, Natural History Museum of Denmark, University of Copenhagen, Øster Voldgade 5–7, DK-1350 Copenhagen K, Denmark.*
[g] *Key Laboratory of Geographic Information Science and State Key Laboratory of Estuarine and Coastal Research, East China Normal University, 200062 Shanghai, China.*

Abstract

We present results from a 174 cm marine sediment core collected from the previously uninvestigated Køge Bugt (Ikeq) in central southeast (SE) Greenland. Radiocarbon dates and lead-210 (^{210}Pb) measurements demonstrate that the core covers the last ∼9.1 cal. ka. Oceanographic changes are reconstructed from benthic foraminifera assemblage data and sortable silt mean ($\overline{SS}$) measurements. $\overline{SS}$ data provide a valuable proxy for reconstructing palaeo current vigour, even in marine environments dominated by ice-rafted debris (IRD) sedimentation. Holocene oceanic conditions in Køge Bugt are characterised by a tripartite history. Warm oceanic conditions occurred in the early-Holocene, this is accompanied by evidence for enhanced current sorting during this interval; we attribute this to circulation of the core waters of the Irminger Current (IC) in Køge Bugt. This was followed by a period of cooling during the mid-Holocene and the establishment of cold, Polar oceanic conditions in the late-Holocene. Holocene glacier activity in Køge Bugt is reconstructed from IRD abundance. We argue that IRD at the core site is exclusively derived from icebergs calved from local outlet glaciers. Consequently, continuous IRD sedimentation demonstrates that glaciers in the bay remained in tidewater settings throughout the last 9.1 ka. Bed topography data show that below sea-level troughs inland of the present-day ice margin are small (≤5 km). Glaciers cannot have retreated more than 5 km at any point in the record, despite climatic and oceanographic conditions warmer than at present during the Holocene Thermal Maximum (HTM). This behaviour is attributed to the specific geometry of the area — the bed topography slopes steeply inland of the present-day ice margin, this allows the glaciers to stabilise quickly during phases of retreat. Finally, we suggest that this will allow the large outlet glaciers within Køge Bugt to remain in tidewater settings, at least in the short-term, despite predicted climatic and oceanic warming scenarios.

*Corresponding author.
Email address: lad@geus.dk (Laurence M. Dyke)