Quantifying Lateglacial and Holocene sediment provenance and transport pathways in southern Nares Strait

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Kane Basin and Smith Sound are part of the Nares Strait, a major northern outflow gateway connecting the Arctic Ocean with Baffin Bay (Figure 1). This region is strongly influenced by glacial discharge from outlet glaciers along eastern Ellesmere Island and the northwestern margin of Greenland (Jennings et al., 2011; 2019). Studying marine sedimentary sequences in these settings provides essential constraints on glacier dynamics beyond the instrumental era, offering valuable context for predicting their response to future climate change.

In this study, we analyzed the physical, sedimentological, mineralogical, and elemental geochemical properties of sediment cores collected in central Kane Basin (Caron et al., 2020), near Mittie Glacier (Bracquart et al., 2025), and in Cape Norton Shaw Inlet (Stevenard et al., 2021) (Figure 1). Our objective was to reconstruct glacial sediment discharge and evaluate how ice-ocean interactions influenced sediment dynamics and the opening of the southern Nares Strait since the last deglaciation.

Unmixing of sediment composition and detrital proxies (e.g., plagioclase + K-feldspar, biotite + chlorite, calcite + dolomite, and Ca/K) reveals that detrital sediments in the studied cores originate primarily from two source regions: (1) the Ellesmere-Inglefield Mobile Belt, characterized by plagioclase- and feldspar-rich sediments; and (2) eastern Ellesmere Island, where detrital carbonates (mainly calcite and dolomite) dominate (Figure 1).

Mineralogical and geochemical signatures show that variations in detrital sediment provenance and transport in southern Nares Strait were strongly linked to regional ice-stream dynamics, particularly during the early Holocene, when intense meltwater discharge from the Innuitian and Greenland ice sheets accompanied the final stages of deglaciation. During this interval, elevated detrital carbonate contents support the gradual opening of Kennedy Channel between ~8.8 and 8.2 cal ka BP.

With the onset of milder conditions during the mid-Holocene and reduced glacial activity as ice sheets retreated inland, sediment input delivered by ocean currents became increasingly dominant, and more open glacial marine conditions associated with seasonal sea-ice melting prevailed. The sortable-silt mean-size flow-speed proxy indicates an intensification of near-bottom currents at the beginning of the mid-Holocene, followed by a gradual weakening linked to declining meltwater inputs.

During the Neoglacial period, detrital proxies in cores from the Mittie and Cape Norton Shaw sites indicate intensified glacial erosion, likely driven by the long-term decline in boreal summer insolation. This phase of glacier expansion culminated in their maximum Holocene extent during the Little Ice Age.

Modern warming has translated into a sharp increase in sedimentation rates (160–220 cm/ka) since approximately 1900 AD near the Mittie and Cape Norton Shaw Glaciers, a trend unprecedented

throughout the Holocene. This increase is accompanied by elevated inputs of both coarse- and fine-grained sediments, indicating enhanced runoff from snowmelt and meltwater plumes during this exceptionally warm period.

Ongoing analyses (including Be-isotope measurements and radiocarbon dating of sedimentary organic compounds) on sediment cores collected on each side of the Kane Basin will further refine the deglacial history of the southern Nares Strait and enhance our understanding of sedimentary dynamics in this key region throughout the Holocene.

References:
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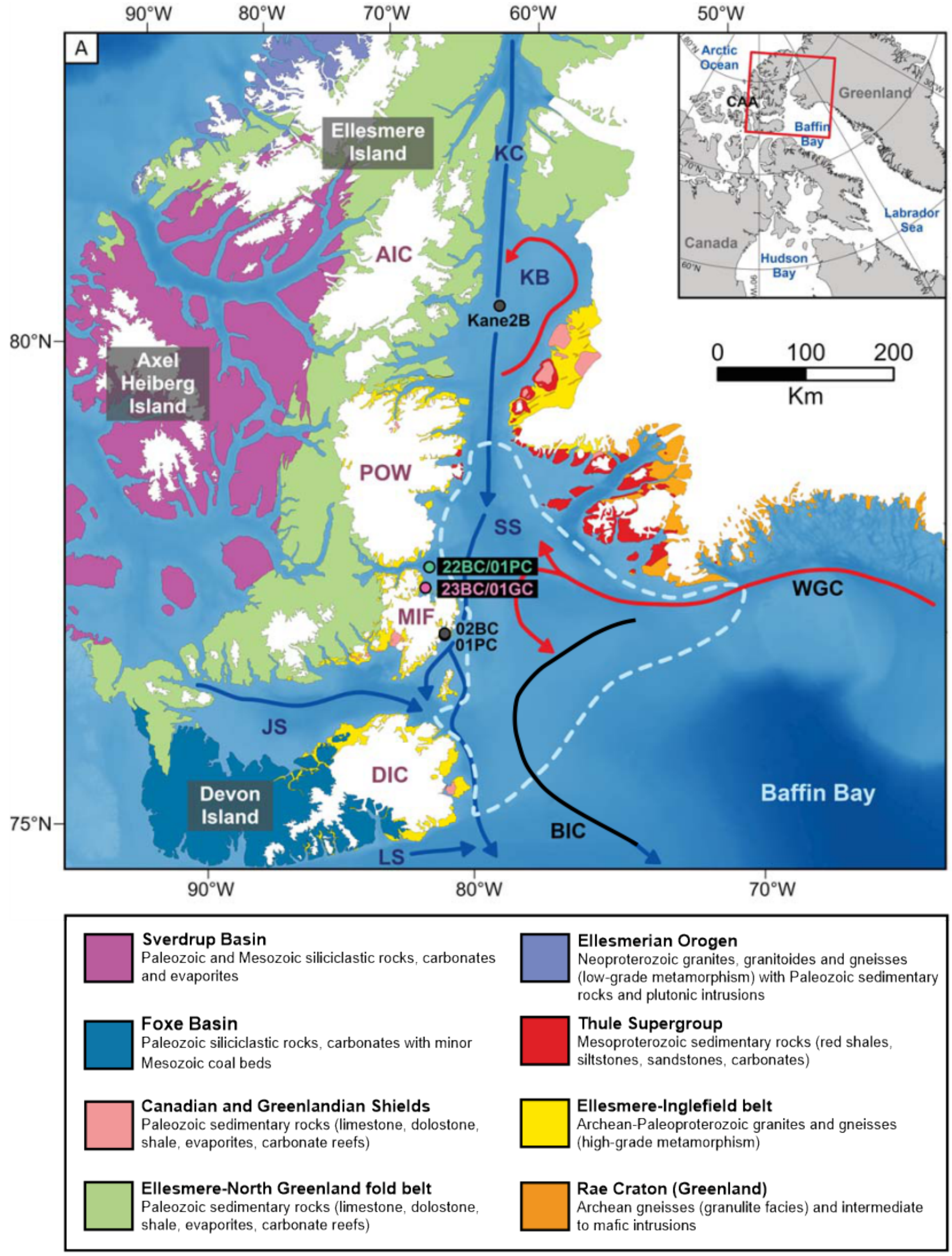

Figure 1. Maps of study area. Geological map of northern Baffin Bay with major surface currents. Red arrows represent warm surface currents (>2°C), and blue arrows represent cold Arctic Surface Water (ASW) (<−1°C). The blue dashed line represents the NOW (North Water Polynya) area. WGC = West Greenland Current; BIC = Baffin Island Current; LS = Lancaster Sound; JS = Jones Sound; SS = Smith Sound; KB = Kane Basin; KC = Kennedy Channel; MIF = Manson Icefield; POW= Prince of Wales Icefield; DIC =Devon Ice Cap; AIC = Agassiz Ice Cap. Cores studied are marked by circles: pink for 23BC =AMD2103-23BC and AMD2103-01GC (Bracquart et al., 2025), gray for 02BC =AMD1803-02BC and AMD1803-01PC (Stevenard et al., 2022) and Kane2B =AMD14-Kane2B (Caron et al., 2020).