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Carbonate Chemistry and Carbon Cycling in Arctic Fjords : A Mucci-Inspired Study

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Fjords are critical components of the land–ocean continuum and serve as hotspots of carbon burial, linking terrestrial and marine carbon cycles. In the Arctic, climate-driven retreat of marine-terminating glaciers is transforming fjords, reshaping circulation, sedimentation, productivity, and modifying biogeochemical processes. Accelerated glacier melting dilutes coastal waters, lowers pH, reduces carbonate ion concentrations (CO_3^{2-}) and total alkalinity (TA), and decreases the aragonite saturation state (ΩAr). These changes heighten vulnerability to ocean acidification, impacting carbon cycling, sequestration, and the capacity of fjords to act as efficient carbon sinks.

The Canadian Arctic Archipelago is the fourth largest contributor of glacial ice and meltwater to the global ocean, yet its biogeochemical response to glacier retreat remains poorly understood. This study focuses on two Baffin Island fjords, Maktak and Coronation Fjords (Auyuittuq National Park, ᐊᐅᔪᐃᑦᑐᖅ, Nunavut). Both fjords share similar latitude, climate, and hydrographic conditions, are sill-less, and connected to the same shelf waters, but they differ in glacier termination type. This contrast makes them ideal natural analogues to investigate how glacier configuration regulates carbonate chemistry and carbon sequestration capacity.

During the *CCGS Amundsen* summer 2025 expedition, we sampled water columns and sediment porewaters and we conducted sediment incubations to study carbonate chemistry, including TA, DIC, and derived carbonate system parameters (HCO_3^-, CO_3^{2-}, ΩAr, ΩCa). These measurements allow quantification of carbon transfer to sediments and TA/DIC exchanges at the sediment–water interface, providing insight into benthic contributions to fjord carbon cycling. By combining water column and sedimentary processes, this study aims to improve understanding of how Arctic fjords respond to ongoing glacial retreat and their evolving role in regulating carbonate chemistry and carbon sequestration under a warming climate.