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SEASONAL EVOLUTION AND SPATIAL DISTRIBUTION OF WEATHERING IN WESTERN GREENLAND

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SEASONAL EVOLUTION AND SPATIAL DISTRIBUTION OF WEATHERING IN WESTERN GREENLAND

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Through physical weathering, the Greenland Ice Sheet (GIS) produces sediments which are subsequently chemically weathered in three types of watersheds: 1) deglacial watersheds that are physically disconnected from the GIS and drain local precipitation, 2) proglacial watersheds that are hydrologically connected to the GIS, and 3) subglacial watersheds that form beneath the GIS. Chemical weathering in the glacial foreland may be important to atmospheric CO_2 drawdown and oceanic fluxes of solutes, yet no holistic study exists that compares solute sources across all types of watersheds and through the melt season. Consequently, we investigated spatiotemporal changes in weathering through the 2013 ablation season from a transect of watersheds spanning the coast to the GIS in western Greenland. We sampled one proglacial (PG) watershed, from which we also assess subglacial (SG) weathering, one inland deglacial (IDG) and one coastal deglacial (CDG) watershed. A simple stoichiometric mass balance quantifies solute sources in each watershed. The principal solute source is trace carbonates in all watersheds; however, IDG has more carbonate (61 vs 36 mol%) and less silicate (3 vs 14 mol%) weathering than CDG. PG has similar carbonate (41 mol%) and silicate weathering (16 mol%) proportions to CDG, despite proximity to IDG. Weathering of biotite decreases from 12 mol% at PG to 3 mol% at CDG along an exposure age gradient, consistent with more radiogenic $^{87}Sr/^{86}Sr$ in waters at PG (0.73556) than DGC (0.71114). Carbonate weathering decreases and biotite + silicate weathering increases downstream through PG, reflecting increased weathering. Solute sources change little through time or space at IDG, but at PG, silicate weathering increases and carbonate weathering decreases as flow increases through the melt season, consistent with increased contributions of SG waters with long residence times in distributed channels. Thus, the evolution of SG through time and connections between subglacial reservoirs and main flow paths plays an important role in weathering at PG. As the GIS retreats, deglacial watersheds will constitute a greater fraction of the weathering flux and thus increased silicate weathering should alter solute fluxes to the oceans and increase atmospheric CO_2 drawdown.

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