Weathering in deglaciated watersheds of western Greenland

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Weathering fluxes from Greenland are currently derived from subglacial, proglacial and deglaciated environments. As the Greenland Ice Sheet (GrIS) retreats in response to current warming, the proportions of weathered material sourced from each of these watersheds and delivered to the ocean will change. Currently there is little data on weathering in deglacial watersheds that are isolated from the GrIS and discharge annual precipitation and permafrost melt. We collected stream water and bedload samples from four deglacial watersheds in a 125 km transect from Sisimuit on the coast of western Greenland inland to Kangerlussuaq. The entire region is within the Nagssugtoqidian Mobile Belt, but the coastal sites sit on ~10 ky old moraines and experience a positive water balance while the inland sites sit on ~7.5 ky old moraines and experience a negative water balance. Analyses of waters indicate the dominant anion is HCO_3^- and the dominant cation is Ca^{2+} for all watersheds. The coastal sites record higher Na/Cl, SO_4/Cl, and Si/Ca ratios, lower Ca/Sr ratios, and are more undersaturated with respect to calcite compared to inland sites. These data indicate that carbonate weathering dominates the weathering fluxes in the inland sites and there is an increase in silicate and sulfide weathering toward the coast. Carbonate minerals weather more readily than silicates, thus this transition suggests the coastal region has experienced more extensive weathering than inland watersheds. This conclusion is supported by Sr isotopic analyses that record a smaller offset between water and bedload $^{87}Sr/^{86}Sr$ values in coastal watersheds (0.005) compared to inland water sheds (0.018). The difference in exposure age between these locations is small, thus differences in weathering are probably related to precipitation, which is influenced by proximity to the coast and GrIS. These results predict a greater contribution of silicate weathering as the arid landscape influenced by dry winds off the GrIS comprises a smaller proportion of the deglacial region. The evolution of weathering reactions in deglacial watersheds will ultimately impact the fluxes of solutes, nutrients and isotopes to the ocean.