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Reconstructing Changes in Catchment-scale Chemical Weathering in Response to Climatic and Geomorphic Controls from Sedimentary Records of Glacial and Non-Glacial Lakes in Iceland

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Chemical weathering of silicate minerals is the primary geologic sink for CO_2 in the ocean-atmosphere system. Accurately quantifying the changes in chemical weathering fluxes over time is therefore important for our understanding of the carbon cycle and planetary habitability. While marine sedimentary archives may help reconstruct variations in chemical weathering fluxes integrated over the global scale, these inferences cannot be directly compared to modern estimates of weathering fluxes from river chemistry as they integrate weathering processes over different spatial scales. Further, comparison between these two integration scales is complicated by the heterogeneity of land surfaces and their different weathering responses to climatic change. Instead, it may be possible to use lake sediments to infer paleo-weathering fluxes at the same spatial scale as modern riverine observations and better understand how chemical weathering respond to climatic and geomorphic controls.

In this study, we constrain changes in chemical weathering fluxes from the Efri Haukadalsá and Hvítá catchments in Iceland with sediment cores collected from the lakes they drain into, Haukadalsvatn and Hvítárvatn, respectively. In the modern rivers that feed these lakes, a strong correlation was observed between germanium to silicon elemental ratios (Ge/Si) and silicon isotope ratios (δ^{30}Si) that tracks chemical weathering intensity. This correlation enables the construction of a novel multi-proxy system to constrain chemical weathering fluxes in the past. This approach uses biogenic silica preserved in lake sediments, which records Ge/Si and δ^{30}Si of the lake with fractionations that indicate the degree of dissolved Si utilization. Preliminary data show an increase in chemical weathering fluxes in the Hvítá catchment during the last 10ka, coinciding with growth of the Langjökull glacier. Meanwhile, unvarying burial fluxes of biogenic silica and its Ge/Si and δ^{30}Si signatures in the non-glacial Efri Haukadalsá catchment evidence relatively constant weathering fluxes through the last 10ka. Further statistical analyses and modeling will be conducted to address potential complications from diagenetic alteration and biased preservation of time in sedimentary records (i.e. the Sadler effect), allowing for better constraints on the (in)variance of these weathering fluxes.