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Carbon and Strontium Isotope Insights on Bedrock Chemical Weathering: Implication for CO_2 Removal via Natural Water Alkalinization

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Chemical weathering is an important mechanism to remove CO_2 from the atmosphere.[1] To calculate the CO_2 removed through bedrock chemical weathering via river chemistry, it is crucial to estimate the contribution of alkalinity from carbonate and silicate rock weathering. In this study, we investigate the bedrock chemical weathering process in a headwater watershed in north-eastern Vermont U.S., with the bedrock of carbonaceous phyllites and limestones. We collected water samples from two stream outlets, three tile drains, and 12 groundwater wells over eight months and measured major cations, anions, alkalinity, trace metals, carbon isotopes (i.e., $\delta^{13}C$ and $\Delta^{14}C$) of dissolved inorganic carbon (DIC), and Sr isotopic composition (i.e., $^{87}Sr/^{86}Sr$ and $\delta^{88/86}Sr$). The chemical and isotopic signals indicated that the stream water chemistry is dominated by carbonate dissolution, while silicate weathering plays a secondary role. With the $\delta^{13}C$ and $\Delta^{14}C$ of DIC and Sr isotope data, we will quantify end-member mixing processes and estimate their relative contributions. Importantly, we render the estimated budgets of CO_2 consumption by carbonate and silicate weathering at the watershed scale. Our work on carbon isotopes of DIC and Sr isotopes, which serves as a powerful tool, can help elucidate the weathering process and its role in carbon sequestration.

References

[1] Gaillardet, Dupré, Louvat & Allegre (1999), *Chemical geology, 159* (1-4), 3-30.