Ca isotope study of hyaloclastite weathering in the Icelandic highlands

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High HCO_3^- concentrations in rivers draining basalt are widely interpreted as support for the hypothesis that basalt weathers significantly faster than granite. A broader interpretation of the 'relative mineral weathering stability paradigm' [1] predicts that rivers draining limestone should have among the highest HCO_3^- concentrations of all rivers given that carbonate minerals are exceedingly soluble and dissolve rapidly compared to both mafic and felsic silicate minerals. However, because rivers draining basalt and limestone have similar HCO_3^- concentrations at comparable runoff, an interesting paradox emerges: Either basalt and limestone weather at similar rates, or carbonate weathering pervasively occurs in basaltic watersheds, despite absence of sedimentary carbonate rocks. To address this problem, we studied the Ca isotope ($\delta^{44/40}Ca$) and major ion geochemistry of rivers draining the Icelandic highlands, where subglacial basaltic eruptions generate hyaloclastites breccias bearing crystalline clasts and highly reactive glass. The rocks also contain carbonates produced syn-eruptively or soon thereafter. Rivers display high $\delta^{44/40}Ca$ values supporting carbonate weathering control [2] but low Ca/Na ratios supporting silicate weathering control. The region is devoid of soils and plants. Formation of clays and secondary calcite may fractionate Ca isotopes. We also expect the palagonitization of glass to preferentially releases Na^+. Data will be presented for bulk rocks and leachates to further test these and other hypotheses.

[1] Goldich (1938), [2] Jacobson et al. (2015)