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Experimental study of the effects of climate change (CO_2 and temperature) on trace metal fluxes to continental and oceanic environments

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Global climate change is driving fundamental shifts in geochemical and biogeochemical cycles through rising atmospheric CO_2 levels and increasing surface temperatures. One of the less understood yet critical consequences of these changes is the variation in metal fluxes from the continents to the oceans. Enhanced weathering, acidification, and hydrological changes are expected to increase the release of dissolved and particulate metals (Fe, Mn, Ni, Cu, Zn, Co, Pb, As, Cd) and nutrients (Si, P) into rivers and coastal waters. These fluxes have far-reaching implications for both environmental quality and the functioning of the global elemental cycles. In this study, we investigate how temperature and atmospheric CO_2 concentration (pCO_2) control the release, mobility, and speciation of metals during silicate weathering under conditions representative of continental environments.

The preliminary experimental results conducted at temperatures of 3, 22, and 40 °C, pH of 7-8.5, and initial CO_2 concentration of 20-30 ppm representative of shallow groundwater and rives in Iceland, show Si release rate similar those obtained in previous studies (log r of -10.4 mol/m^2/s). The lowest release rates among major basalt forming elements were found for Al and Fe with log r of -12.2 and -12.6 mol/m^2/s, respectively. The release rates of trace metals including Cr, Cu, As, Mo, W, and Li were 4 to 5 orders of magnitude lower compared to Si. On contrary, their relative mobilities normalized to Si were, however, high, substantially exceeding those predicted from stoichiometric basalt dissolution. Ongoing experiments will extend the investigation to other rock types and water compositions to better constrain the variability in chemical and physical conditions across continental and oceanic environments.