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Lithologic controls on solute flux responses to climate change:A field and laboratory experimental approach

John Dixon
University of Arkansas, Geosciences, Fayetteville, United States (jcdixon@uark.edu)

The impact of global warming is predicted to be greatest in Arctic and Alpine Environments. Increasing temperatures, and accompanying increasing precipitation, are likely to increase chemical erosion and solute fluxes in these environments. Field and laboratory experiments from Swedish Lapland demonstrate measurable responses to increasing temperature and precipitation over decadal scales. Additionally, CO_2 flow-through experiments demonstrate 2-3-fold increases in solute output in response to 1-3 fold increase in CO_2, the principal driver of global warming. Results of these experiments suggest considerable variability depending on lithologic setting. Sedimentary rocks demonstrate greater magnitudes of change than igneous and metamorphic lithologies.
Surface fragment and subsurface weathering disk field experiments in Lapland using three different lithologies over a decade-long duration demonstrate statistically significant differences in weathering rates between the first and second half-decade periods of the study. Mean annual temperature and precipitation of the second half decade are statistically significantly greater than those of the first half decade. Limestone and dolomite lithologies showed statistically greater mass loss in the second decade compared to the first. The granite lithology showed little difference.
Laboratory-based CO_2 flow-through experiments using carbonate, and schist lithologies from the same valley demonstrate a two to three-fold increase in potassium and nitrogen (ammonium) production accompanying a tripling of CO_2 through-flow. The strongest response in these experiments interestingly is from the schists compared to the carbonate.
The results of these experiments suggest that the response of solute fluxes to global warming and CO_2 driving in Arctic and Alpine environments may be strongly influenced by lithology. The solute flux response to changing environmental conditions may not be singularly uniform, but rather may exhibit considerable variability depending on the dominant lithology/ lithologies in a given environment.