Combining Ge/Si, δ^{30}Si, and δ^{74}Ge to unravel controls on weathering and solute production in tropical catchments

J. J. BARONAS[1*], M. TORRES[1], A. J. WEST[1], D. E. HAMMOND[1], K. E. CLARK[2], S. OPFERGELT[3] AND K. W. BURTON[4]

[1]Department of Earth Sciences, University of Southern California, Los Angeles, CA 90089 USA
[*](baronas@usc.edu)
[2]Department of Earth and Environmental Science, University of Pennsylvania, USA
[3]Geological Sciences, Université catholique de Louvain, Belgium
[4]Department of Earth Sciences, Durham University, UK

We have found that river water dissolved Ge/Si, δ^{30}Si, and δ^{74}Ge signatures in two pristine catchments are highly sensitive to the prevaling weathering regime (kinetic- vs. supply-limited), which is governed by local geomorphology and hydrology. Our results point to the promise of these geochemical tools as proxies for weathering and solute fluxes, both in the present day and in the past.

We have measured Ge/Si, δ^{30}Si, δ^{74}Ge, and trace element concentrations in river water of catchments spanning geomorphic gradients in the Andes-Amazon (Madre de Dios, Peru) and a tropical rainforest (La Selva, Costa Rica). Results show that Ge/Si and δ^{30}Si in cation-depleted La Selva soil waters are controlled by secondary mineral dynamics, while vegetation plays a secondary role. In the Amazon foreland flood plain, Ge/Si responds strongly to runoff, implying sensitivity to either fluid transit times or dominant fluid flow paths in the catchments. In contrast, the Ge/Si ratio in the Andes is constant and runoff-independent, reflecting the high abundance of fresh bedrock. Preliminary δ^{74}Ge data indicates strong fractionation during secondary mineral formation. This suggests that δ^{74}Ge could be a useful proxy for resolving changes in weathering intensity in the past.

Overall, we show that combining multiple isotopic and geochemical proxies provides greater insight into weathering processes, solute production, and biogeochemical cycling than any single geochemical indicator on its own. Such a multi-proxy approach holds the possibility of disentangling the complexity of dependence of weathering on runoff, temperature, and erosion rates.