Germanium stable isotopes (δ^{74}Ge) in weathering: Is there potential for paleo-weathering reconstruction?

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We have investigated the behavior of Germanium stable isotopes (δ^{74}Ge) during Critical Zone weathering processes. Dissolved δ^{74}Ge composition from a wide variety of global rivers falls in the range between 0.9 and 5.6 ‰, fractionated relative to source silicate rocks (0.5-0.8 ‰). The extent of fractionation at each site appears to be correlated with weathering intensity, i.e. the ratio of chemical weathering to physical erosion. Strongly weathered soils and clay separates are isotopically light (-0.1 to -0.3 ‰), supporting the notion that δ^{74}Ge fractionation occurs during Ge incorporation in secondary weathering products, in a fashion similar to δ^{30}Si and δ^{7}Li. However, fluids and solids in a Costa Rican waterhsed exhibit contrasting degrees of δ^{74}Ge and δ^{30}Si fractionation, highlighting the potential of a multi-proxy approach to trace the spatial and temporal separation of specific weathering reactions in the Critical Zone.

The global average riverine δ^{74}Ge input to the ocean is 2.6 ± 0.5 ‰, representing ~25% of global discharge and ~30% of total riverine Ge flux. The global ocean Ge isotope budget has been characterized, taking into account the most recent data on δ^{74}Ge composition of hydrothermal fluids, as well as preliminary data that suggests negligible δ^{74}Ge fractionation during opal and non-opal Ge burial in marine sediments. A simple global ocean box model was used to assess the sensitivity of seawater δ^{74}Ge recorded in opal to potential changes in the continental weathering δ^{74}Ge signature over glacial-interglacial and Cenozoic timescales.