Preliminary study on gallium (Ga) isotopes as an effective proxy for weathering process

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Chemical weathering plays an important role in continental erosion, soil formation, plant nutrient release, the composition of dissolved elements in rivers and the oceans, and the control of atmospheric CO_2 concentration and climate. Recently, numberous stable isotope systems have been developed and proven to be useful for accessing weathering process, such as Sr, Li, Ca, Mg and Si isotopes. The weathering process such as adsorption, biological uptake dissolution and precipitation can cause significant isotope fractionation. As each isotope tracer used as weathering proxy has its limitation, multi-isotope approach is thus often employed for better constraining Earth surface processes.

Ga isotopes would be a good candidate for chemical weathering. Ga exists only in a trivalent state (Ga^{3+}) in nature, thus no influence of the redox process. Meanwhile, Ga is not a biologically essential element for most organisms, indicating less impact of biological absorption than many other elements (such as Zn, Cu, Fe, etc.). Interestingly, Ga has a chemical property very similar to Al which is of particular interest in weathering processes. But unlike Al which has only one naturally-occurring stable isotope (^{27}Al), Ga has two stable isotopes (^{69}Ga and ^{71}Ga). Therefore, Ga isotopes could be potentially used to trace the biogeochemical cycle of Ga and Al, and provide new and useful information for exploring the geochemical weathering processes. Using our newly develpoed method, Ga isotopes are measured for different samples including typical weathering profile. Our results show significant variation of Ga isotopes (e.g. $\delta^{71}Ga$ up to ~0.3‰ in a weathered profile), and that heavy Ga isotopes are preferentially leached out during weathering process, likely caused by a combination of mineral dissolution and adsorption/precipitation of secondary minerals such as Fe-Mn oxyhydroxides.

[1] Yuan et al. (2016) *Analytical Chemistry*, **88**(19), 9606-9613. [2] Yuan et al. (2018) *Geochimica et Cosmochimica Acta*, **223**, 350-383.