Potassium isotope fractionation during chemical weathering of basalts

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Non-traditional stable isotopes are increasingly used as tracers of chemical weathering (*e.g.* Li and Mg) [1-2]; however, the behavior of potassium (K) isotopes during weathering has not been systematically studied due to analytical difficulties. Potassium is water-soluble and is transported from the continental crust into the oceans via chemical weathering and river transport. A recent high-precision study found that K isotopes in the river waters are greatly fractionated from the Bulk Silicate Earth (BSE) value [3], indicating they are influenced by chemical weathering. The K isotope fractionation during chemical weathering is likely one of several key processes leading to ~0.6‰ difference of $\delta^{41}K$ between the BSE and modern seawater [4].

In order to determine the direction and controlling factors of K isotope fractionation during basalt weathering, especially under intense weathering conditions, we measured K isotope compositions in two sets of bauxite developed on the Columbia River basalts, together with fresh parental basalts and two eolian deposit samples using a Neptune Plus MC-ICP-MS [5]. Results show that K isotopic variations among fresh basalts and two eolian dust are very limited, close to the BSE value, indicating insignificant K isotope fractionation during magmatic processes. Extreme K depletion (>99%) and K isotopic fractionation ($\delta^{41}K$ up to 1‰) are observed in drill core bauxites due to intense chemical weathering of basalts. The top of the weathering profiles shows less depleted in K abundances and the $\delta^{41}K$ values are closer to the fresh basalts and eolian, which is likely due to the deposition of eolian dust at the tops of the profiles. The $\delta^{41}K$ in bauxites displays a positive correlation with $\delta^{7}Li$, indicating the behaviors of K and Li isotopes are comparable during chemical weathering. This study shows that K concentrations and its isotopic compositions are promising tracers of chemical weathering.

[1] Liu et al. (2013) *Geochim. Cosmochim. Acta* 115, 73-95. [2] Liu et al. (2014) *Geochim. Cosmochim. Acta* 135, 336-349. [3] Lee et al. (2018) *Goldschmidt Conference abstract*. [4] Wang and Jacobsen (2016) *Geochim. Cosmochim. Acta* 178, 223-232. [5] Chen et al. (2018) *Geostand. Geoanalytical Res.* in review.