

Potassium isotope fractionation between K-salts and saturated aqueous solutions

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With recent progresses in multi-collector ICP mass spectrometry, it is possible to discern sub-per mil variability in ⁴¹K/³⁹K isotope ratios in natural samples. For example, $\delta^{41}\text{K}$ (relative to international standard K3141a) values of igneous rocks are about 0.5‰ lower than that of seawater [1,2], and over 1‰ variation in $\delta^{41}\text{K}$ has been measured in biological samples [2].

Isotopic fractionation factors between minerals and aqueous solutions are fundamental for interpreting observed isotopic data. We performed recrystallization experiments for six different K-salts and measured K isotope fractionation factors for the mineral-aqueous solution pairs. $\Delta^{39}\text{K}_{\text{min-aq}}$ fractionation factors varies from -0.5‰ for KI to +0.3‰ for K₂SO₄, suggesting strong crystalgraphic control on K isotope fractionation, that heavy K isotopes preferentially partition into minerals with shorter K-anion bonds.

Our results suggest that up to 0.8‰ inter-mineral fractionation of ⁴¹K/³⁹K ratio exists at low temperature conditions. Because K is a major element in Earth's crust and oceans, and K is an essential nutrient that plays a key role in a variety of metabolic and physiological processes in organisms, K isotope geochemistry is a promising tool for studying a variety of problems like continental weathering, global potassium cycling, and metabolism of potassium in organisms.

Reference:

[1] Morgan LE, Higgins J, Davidheiser-Kroll B, Lloyd NS, Faithfull J, Ellam RM, (2014) Goldschmidt Conference Abstract, 1731.

[2] Li W, Beard LB, Li S (2016) Precise Measurement of Stable Potassium Isotope Ratios Using A Single Focusing Collision Cell Multi-Collector ICP-MS. Journal of Analytical Atomic Spectrometry. Under review