Potassium isotopic composition of the upper continental crust

TIAN-YI HUANG[1*], FANG-ZHEN TENG[1], ROBERTA L. RUDNICK[2], XIN-YANG CHEN[1], YAN HU[1], YONG-SHENG LIU[3] AND FU-YUAN WU[4]

[1] Isotope Laboratory, Department of Earth and Space Sciences, University of Washington, Seattle, WA 98195-1310, USA (*correspondence: tianyih@uw.edu)

[2] Department of Earth Science, University of California, Santa Barbara, CA 73106, USA

[3] State Key Laboratory of Geological Processes and Mineral Resources, School of Earth Sciences, China University of Geosciences, Wuhan 430074, China

[4] State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China

Potassium is the 8th most abundant element in the crust and is highly soluble. It participates in a number of surface processes, during which large K isotope fractionation is expected. However, thus far, little is known regarding the behavior of K isotopes during major geological processes, nor the K isotopic distribution in major reservoirs. Studies of K isotopic composition of the crust, especially the upper continental crust, can lay the foundation for tracing the interactions between the crust and the mantle, and shed light on K isotopic composition of the silicate Earth.

High-precision K isotopic data were obtained for a set of well-characterized upper crustal samples from around the world, including granites, loess, shales and upper continental crustal composites, measured by high-resolution MC-ICP-MS with dry and cold plasma. The K isotopic compositions are reported as $\delta^{41}K$ (‰) (defined as $\{(^{41}K/^{39}K)_{sample}/(^{41}K/^{39}K)_{standard} - 1\}\times 1000$, relative to NIST SRM 3141a). There is limited variability in the $\delta^{41}K$ values for most samples analyzed in this study except for shales, which have slightly lighter K isotopic compositions than other samples. When compared to their potential source rocks, S-type granites display different K isotopic composition. These findings suggest K isotope fractionation might be significant during chemical weathering and granite genesis. The upper continental crust overall has a heterogeneous and slightly lighter K isotopic composition than the mantle, mainly resulting from continental weathering and intra-crustal differentiation.