Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12412

Extensive crystal fractionation of high-silica magmas revealed by potassium isotopes

ZE-ZHOU WANG[1], FANG-ZHEN TENG[1], FU-YUAN WU[2], ZHI-CHAO LIU[3], XIAO-CHI LIU[2], SHENG-AO LIU[4] AND TIAN-YI HUANG[1]

[1]University of Washington

[2]Institute of Geology and Geophysics, Chinese Academy of Sciences

[3]Sun Yat-sen University

[4]China University of Geosciences, Beijing

Presenting Author: zzwang74@uw.edu

Fractional crystallization has been suggested to play the most important role in shifting the composition of Earth's continental crust from mafic to silicic. However, it remains controversial whether, and if so how, efficient segregation of crystals occurs in high-silica (SiO_2 > 70 wt.%) magmas owing to the lack of robust tool for discriminating differentiated melts and complementary silicic cumulates. Recent studies revealed that plagioclase is significantly enriched in heavy K isotopes compared to other coexisting rock-forming minerals (e.g., K-feldspar, biotite and muscovite). Therefore, discernible K isotope fractionation might be expected in melts that experience massive plagioclase crystallization.

Here we report high-precision K isotope data for high-silica and peraluminous leucogranites from the Himalayan orogen. The samples display a wide range of $\delta^{41}K$ from -0.72‰ to 0.35‰ and their $\delta^{41}K$ are well correlated with trace elemental indicators of feldspar crystallization (e.g., Ba, Sr and Eu/Eu*). Raleigh fractionation model suggests that up to ~70% fractional crystallization is required to account for the light K isotopic signatures of fractionated leucogranites, while plagioclase accumulation results in the extreme enrichment of heavy K isotopes in the leucogranites that have the least evolved compositions. Our findings provide strong evidence for the viability of extensive crystal fractionation of high-silica magmas and highlight the great potential of using K isotopes to study the magmatic differentiation of high-silica magmas.