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K isotopic fractionation in K-feldspar: Effects of mineral chemistry

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Abstract

Controlling factors of potassium (K) isotopic fractionation in K-feldspar remain poorly constrained. In this study, we analyzed the K isotopic compositions of 11 K-feldspar samples from diverse lithological compositions. The degree of Al/Si order ranged from 0.22 to 0.94 (1.0 = completely ordered). Analyzed samples are mixtures of K-feldspar (>70 wt%) and coexisting albite. The relative contribution of K_2O from the K-feldspar phase of the sample was over 98%, indicating that the K isotopic composition ($\delta^{41}K$) derives mainly from K-feldspar and hence reflects its behavior. The $\delta^{41}K$ values of these samples range from –0.710 to –0.075‰, which are slightly correlated with the degree of Al/Si order. The correlations of $\delta^{41}K$ with SiO_2 and Al_2O_3 contents and the corresponding Al/Si mole ratios reveal that Al and Si play a significant role in the K isotopic behavior of K-feldspar. The correlations of $\delta^{41}K$ with SiO_2 and Al_2O_3 contents are attributed to the difference in K-O bond strengths. Compared to K-feldspar, the K content could be a better proxy for constraining the $\delta^{41}K$ of plagioclase. Our results demonstrate that the $\delta^{41}K$ of K-feldspar is dependent on its mineral chemistry, and its K isotopic composition may be insensitive to other factors, such as the source heterogeneity. The inference is further confirmed by comparing the $\delta^{41}K$ values in this study with published $\delta^{41}K$ values of K-feldspar from different sources.

Keywords: K isotopes, K-feldspar, Al/Si order, bond length, Al/Si mole ratio