

Potassium isotopic composition of low-temperature altered oceanic crust and its impact on the global K cycle

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To constrain the behavior of K isotopes during low-temperature alteration of oceanic crust and reveal its impact on the global K cycle, we measured K isotopic compositions of 49 basalts recovered at Integrated Ocean Drilling Program (IODP) Sites U1365 (~100 Ma) and U1368 (~13.5 Ma) in the South Pacific, with different low-temperature alteration styles and intensities. The fresh basalts from both Sites in general show similar K isotopic compositions to the fresh mid-ocean ridge basalts (MORB), with $\delta^{41}\text{K}$ values ranging from -0.55‰ to -0.23‰ (average $-0.39 \pm 0.18\%$, 2sd). In contrast, the measured $\delta^{41}\text{K}$ values of the altered basalts vary within a larger range (-0.76‰ to -0.17‰, average $-0.44 \pm 0.33\%$, 2sd). Moreover, a positive correlation between $\delta^{41}\text{K}$ values and K_2O contents (also K/Nb ratios) of the altered basalts was observed in Site U1365 (~100 Ma), which is consistent with isotopically heavy K from seawater being absorbed into authigenic clays during low-temperature alteration. In addition, the general correlation between $\delta^{41}\text{K}$ values and alteration intensity (i.e., degrees of K enrichment) rather than with the alteration type (i.e., dominant alteration minerals) indicates that the scale of K isotope fractionation is largely controlled by the alteration intensity. Collectively, a weighted average $\delta^{41}\text{K}$ value of $-0.40 \pm 0.33\%$, (2sd) is given for the low-temperature altered oceanic crust (AOC) at Sites U1365 and U1368, which is indistinguishable from the MORB value. However, the heterogeneous K isotopic compositions of the low-temperature AOC, together with large fractionation scale during the subsequent subduction dehydration, further highlights the utility of K isotope systems to trace subducted crustal materials.