The behavior of boron in hydrothermal alterations of granites

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Boron contents and B-isotopic compositions are measured on fresh and altered granite samples from the Qitianling granite and related hydrothermal tin deposit in South China. The fresh granite has the highest boron content (36.62ppm) and the highest $\delta^{11}B$ value (-10.9‰). The granites near the tin ore veins were slightly altered and have lower boron contents (12.12 to 24.77ppm) and lower isotopic compositions (-15.6 to -13.4‰). The completely chloritization granites sampled from the tin veins have the lowest boron isotopic compositions (-27.3 to -21.9%). B/Be and $\delta^{11}B$ values of granites decrease with increasing degrees of hydrothermal alteration. Boron isotopic variations are consisted with those of oxygen isotopes. The fresh granites have the highest oxygen isotopic composition ($\delta^{18}O$=10.5‰). The most altered granites have the lowest oxygen isotopic composition (5.4 to 6.6‰). The oxygen isotopic variations of granites are the result of fluid-rock interactions. The colinearity of isotope ratios of B amd O of granites indicated that the fractionation of boron isotope is also the result of fluid-rock interactions. These data indicate that the heavier isotope, ^{11}B is preferentially lost to hydrous fluids from altered granites during the fluid-rock interactions. It may be explained by coordination-dependent fractionation of trace B between tetrahedral sites in silicate and trigonal sites in hydrothermal fluids. This study identifies for the first time that boron isotope is an excellent tracer for hydrothermal alterations of granites and may be used as a useful exploration guide for mineralization. Future studies of the boron isotopic fractionations between main rock-forming minerals and hydrothermal fluids are needed in order to understand this tracer better.

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