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# Rubidium isotopes of highly evolved granites record the magmatic-fluid interaction process

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Magmatic-hydrothermal fluids play a significant role in the enrichment and mineralization of critical metal elements. Highly evolved granites are closely related to rare metal mineralization. However, it's difficult to directly trace the migration and enrichment of ore-forming elements using conventional geochemical methods. Rubidium is a fluid-mobile element, and studies have shown that Rb isotopes have great potential for tracing the evolution of magmatic-hydrothermal processes [1]. The Qitianling A-type granite batholith is one of the largest plutons in the Nanling Range, South China. Previous studies have shown that these granites have typical magmatic-hydrothermal evolution features, offering a good opportunity for using Rb isotopes to trace the magmatic-hydrothermal interaction process. There are three stages of granites in Qitianling, including medium- to coarse-grained porphyritic amphibole-biotite monzogranite, medium-grained porphyritic biotite granite, and fine-grained biotite granite. The whole-rock Rb isotopic composition of the three stages of Qitianling granite has no obvious change (1st stage, -0.34‰ – -0.11‰; 2nd stage, -0.26‰ – -0.03‰; 3rd stage, -0.19‰ – -0.03‰;), which is basically consistent with the upper continent crust (-0.14 ± 0.05‰). However, there is significant Rb isotope fractionation between different Rb-bearing minerals. In the first stage, biotite shows lower but more dispersed $\delta^{87}$Rb values (-0.55‰ – -0.28‰) than K-feldspar (-0.19‰ – -0.12‰). In the second stage, the $\delta^{87}$Rb of biotite increased obviously (0.21‰ – 0.39‰), while the $\delta^{87}$Rb of K-feldspar decreased (-0.43‰ – -0.26‰). Because Rb is a strongly incompatible element, fractional crystallization does not cause Rb isotope fractionation, thus the $\delta^{87}$Rb of the whole rock does not change significantly. Combined with petrographic observations and element contents, obvious magmatic-fluid interaction occurred in the second stage [2]. Therefore, magmatic-fluid interaction should be responsible for the large Rb isotopic fractionation of the Rb-bearing minerals. Fluid exsolution causes the enrichment of light Rb isotopes in the residual melt (K-feldspar), while fluid addition causes the enrichment of heavy Rb isotopes in biotite. Our study suggests that Rb isotopes of Rb-bearing minerals can reveal the behavior of elements in magmatic-hydrothermal processes.

[1] Hu et al, 2022, Geochim. Cosmochim. Acta, 336, 165-176.
[2] Deng et al., 2022, Earth Planet. Sci. Lett. 594, 117724.