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Why is amazonitic K-feldspar an earmark of NYF-type granitic pegmatites? Clues from hybrid pegmatites in Madagascar

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Abstract

The presence of amazonitic K-rich feldspar is considered an earmark of evolved granitic pegmatites of NYF type. Elements of an explanation of the "NYF pegmatite-amazonite" connection emerged in a study of the classic Anjanabonoina "hybrid" granitic pegmatite in Madagascar. The NYF assemblages there and at the Sakavalana and Anjahamiary pegmatites contain magmatic U- and Th-rich accessory phases and an amazonitic microcline perthite in miarolitic cavities. The early miarolitic minerals are overgrown by a Li- and Cs-enriched assemblage, depleted in HFSE, containing pale-gray microcline perthite. The amazonitic microcline perthite at Anjanabonoina has a $\delta^{18}O$ value above 15‰, and that at Sakavalana, close to 13‰, indicative of formation of the NYF-pegmatite-forming magma by the melting of crustal rocks. Locally, the source rocks had become slightly alkaline and enriched in HFSE during periods of metasomatism of the hot granulitic crust accompanying episodes of distension over the course of the protracted Pan-African orogeny. The fertilized crust underwent local anatexis after the culmination of Gondwana re-assembly. The proximity of pyrochlore and other U- and Th-bearing accessory phases in the NYF assemblage provided the ionizing radiation required to interact with H_2O trapped in the vacancy next to the Pb ions in the structure. The presence of an amazonitic K-feldspar ultimately signals net additions of Pb, U, Th, and the alkalis to the source prior to anatexis during a period of distension after a major orogenic disturbance. Plumbian K-feldspar also occurs in granitic pegmatite bodies formed by anatexis in the vicinity of a galena-bearing orebody (e.g., at Broken Hill, Australia); in this case, the resulting granitic pegmatite is neither of NYF type nor enriched in rare elements, however.

Keywords: Amazonitic microcline perthite, NYF-type pegmatite, metasomatism, anatexis, oxygen-isotope geochemistry, trace elements, Anjanabonoina, Sakavalana, Madagascar