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Growth of hydrothermal baddeleyite and zircon in different stages of skarnization

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Abstract

Both prograde and retrograde skarns from the Tengtie iron deposit, South China, contain rounded, euhedral, and anhedral zircon grains. Rounded grains were originally derived from detritus in carbonate rocks and were incorporated into the skarns. Euhedral and anhedral crystals are intergrown with various skarn minerals and are clearly hydrothermal in origin. These hydrothermal grains have low $(Sm/La)_N$ ratios and high La contents relative to typical magmatic ones and display flat LREE and subdued flattening of HREE chondrite-normalized patterns, similar to those of zircon crystallized from Zr-saturated fluids. Prograde skarns also contain baddeleyite rimed by zircon, which record a period of low Si activity during prograde skarnization relative to original magmatic-hydrothermal fluids. Hydrothermal zircon grains from Tengtie have variable Eu anomalies and slightly positive Ce anomalies, indicating that they may have crystallized from highly heterogeneous, but generally reducing fluids. They have low $\delta^{18}O$ values (–5.1 to –2.7 ‰), suggesting the involvement of meteoric fluids. Fluorine-rich fluids played an important role in remobilizing and transporting some high field strength elements (HFSE), including Zr, from the host granites into the skarn system. Reaction between HFSE-bearing fluids and carbonate rocks at the prograde stage decomposed F complexes to deposit HFSE-rich skarn minerals and baddeleyite. At the retrograde stage, alteration of the HFSE-rich skarn minerals released HFSE, including Zr and Sn, consequently producing a mineral assemblage of zircon, cassiterite, and retrograde skarn minerals. Dating results of zircons from the Tengtie skarn system by SIMS indicates roughly less than several million years duration for skarnization. Our study indicates that Zr was not only mobile locally under favorable conditions, but was also readily transported and deposited in different stages of skarnization.

Keywords: Baddeleyite, zircon, oxygen isotope, U-Pb geochronology, skarnization, HFSE