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Extreme fractionation from zircon to hafnon in the Koktokay No. 1 granitic pegmatite, Altai, northwestern China

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Abstract

The Koktokay No. 1 pegmatite is a Li–Cs–Ta-rich granitic pegmatite located in Altai, northwestern China. Zircon is present in most textural zones of this pegmatite and in its contact zone with surrounding metagabbro. Here we describe the detailed associations of zircon with other minerals, and the internal textures and chemistry of the zircons. Most zircon grains from the contact zone have relatively low HfO_2 (<9.4 wt%), whereas the bright rim of one such grain has high HfO_2 (18.0–18.7 wt%). Zircon grains from the aplite zone contain <9.6 wt% HfO_2, although their thin and bright rims have higher HfO_2 (10.8–13.0 wt%). Most zircon grains from the quartz–muscovite zone have complex internal textures and have HfO_2 contents of <13.0 wt%. However, zircon grains from localized, nest-like, muscovite aggregates are highly enriched in HfO_2 (up to 36.1 wt%). Zircon (*sl*) from the cleavelandite–quartz–spodumene zone can be divided into two types based on petrography and chemistry. One group of zircons appears to be typical magmatic zircon and are greater than 100 μm in size, closely associated with albite, and have HfO_2 contents of 13.0–19.5 wt%. The second group of zircons is typically associated with muscovite and/or spodumene, is small in size (down to a few micrometers), and may exhibit zoning or alteration textures. The HfO_2 contents of this second zircon group are 19.8–58.9 wt%, indicating the presence of hafnian zircon to zirconian hafnon. Large HfO_2 content variations of up to 34.8 wt% were also observed within single zoned crystals. We suggest that the increase of HfO_2 in the magmatic zircon from 9.4 wt% in the contact zone to 19.5 wt% in the cleavelandite–quartz–spodumene zone mainly reflects fractional crystallization of pegmatite magma. However, the occurrence of hafnian zircon and hafnon in the cleavelandite–quartz–spodumene zone is likely related to coupled Li-F fluxing effects in the pegmatite magma.

Keywords: Zr-Hf fractionation, zircon, hafnon, granitic pegmatite, Altai