Revealing 2.4 LIP in the Belomorian province, Fennoscandian Shield: U-Pb ID-TIMS studies of baddeleyite and baddeleyite-zircon aggregates

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Abstract

The Belomorian province, eastern Fennoscandian Shield, is an Archean crustal block that expired a tectono-metamorphic reworking in the Paleoproterozoic (1.8 – 1.9 Ga) being involved in Lapland-Kola collision orogeny (Balagansky et al., 2016). In the early and middle Paleoproterozoic Belomorian province was affected by several mantle plumes resulted in mafic intrusions and dykes of ages 2.5, 2.45, 2.4, 2.3, 2.2 and 2.12 Ga (Stepanova et al., 2022).

Olivine gabbronorites are widespread in the Belomorian province and often occur as tectonic fragments of larger intrusive bodies or dykes. Metamorphic alteration caused the formation of corona reaction rims around mafic minerals. These rocks also contain baddeleyite-zircon aggregates morphologically similar to corona reaction rims. The central part of the aggregates consists of igneous baddeleyite surrounded by a zircon rim that forms a parallel columnar aggregate. The rim contains fluid inclusions suggesting its metamorphic origin.

The Ambarny intrusion is characterized by a significantly lower degree of preservation of primary igneous minerals and corona reaction rims are developed everywhere. Unaltered baddeleyite is scarce in these rocks but baddeleyite-zircon aggregates are widespread. Structural relationships of baddeleyite-zircon aggregates and corona reaction rims indicate the synchronicity of zircon rims of corona mineral reaction rims. Zircon in aggregates forms 35-90% of the crystal volume, which has a significant impact on the baddeleyite U-Pb isotope system. Discrete chemical abrasion technique (modified M. Rioux's (2010) technique) was applied to separate both baddeleyite and zircon phases. The procedure consists of high temperature annealing, pre-treatment with HCl (baddeleyite dissolves) and final decomposition with HF (zircon dissolves) and separate ID TIMS analysis of each phase. The age of baddeleyite is 2411±6 Ma, the age of zircon is 1911±35 Ma. This allows us to yield the age of the Ambarny intrusion at 2.4 Ga and determine the age of the formation of corona reaction rims in olivine gabbronorites (Salnikova et al., 2022).

The Kamennoe intrusion is characterized by the best preservation. Here, coronas around olivine are poorly developed, and well-preserved igneous baddeleyite is recognized. U-Pb ID TIMS single grain geochronological studies of baddeleyite yield an emplacement age of 2404±11 Ma.

The Kondostrov dyke comprise well-preserved olivine gabbronorites. Metamorphic alteration here are confined to tectonic zones; primary igneous minerals are preserved in undeformed parts of the

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dyke. Baddeleyite here is also well-preserved with rare thin shells of zircon. However, the shells have little effect on the isotope system of baddeleyite, which made it possible to carry out geochronological studies using standard techniques. The age of baddeleyite is 2418±8 Ma.
These data indicate that ca. 2.4 Ga mafic igneous rocks in the Belomorian province belongs to a distinct igneous event and support the existence of ca. 2.4 Ga LIP.
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Keyword

U-Pb ID-TIMS, baddeleyite, Fennoscandian Shield, LIP

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