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Baddeleyite in Archean to Paleozoic mafic and carbonatite deposits from the Arctic region of the Fennoscandian Shield: U-Pb (ID-TIMS) and LA-ICP-MS data

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In the north-eastern part of the Fennoscandian Shield of the Arctic region there are many mafic and alkaline igneous rocks including carbonatites ranging in age from Archean to Paleozoic. The oldest U-Pb (ID-TIMS) ages on baddeleyite (2738±6 Ma) have been obtained from dyke complexes which cut the Olenegorsk ore zone that includes the largest Kirovogorsk banded iron formation (BIF) deposits in the Central Kola megablock. The age of the Neoarchaean Tsaga mafic (titanium-chromite-magnetite) deposits in the Keivy terrane have been analyzed on zircon-baddeleyite from monzogabbro, anorthosite and gabbronorite, giving dates of 2653±3Ma, 2660±10Ma and 2668±10 Ma respectively [1]. Similar U-Pb ages have been determined in zircon-baddeleyite from the Siilinijarvi (REE, apatite, zirconium) carbonatites with 2613±13 Ma. A compilation of Nd, Sr and He isotope data for Neoarchean anorogenic intraplate mafic magmatism and sanukitoids (2.74-2.61 Ga [2]) indicates the presence of EMII-type enriched mantle plume reservoirs. Emplacement of these magmas was associated with the origin and break-up of the Kenorland Supercontinent [3].

The Paleoproterozoic mafic-ultramafic layered intrusions with strategic deposits of Co-Cu-Ni, Pt-Pd and Cr-Ti-V-Fe (Monchepluton, Fedorova-Pansky Tundra, Imandra lopolith, etc) belong to the Central Kola megablock. Based on numerous U-Pb ages for zircon-baddeleyite and Sm-Nd on rock-forming minerals and sulphides, prolonged multistage magmatic activity from 2.53 to 2.40 Ga is responsible for the formation of these deposits. Isotope geochemistry (ε_{Nd}, I_{Sr}) data suggest that primary enriched mantle reservoirs (EM-1) and dyke complexes were derived from N-MORB, E-MORB and OIB mantle sources [4].

The Paleoproterozoic Pechenga Cu-Ni deposits and carbonatites of Tiksheozero have similar U-Pb ages on baddeleyite of 1982±8 Ma and 1990±2 Ma respectively [5]. The Paleozoic large (Kovdor, Sebjavr, etc) and super large (Khibina and Lovozero) multimetal deposits in alkaline rocks and carbonatites lie in the north-east part of the Fennoscandian Shield in the Arctic region. Systematic isotope data (ε_{Nd}, I_{Sr}, REE, $^3He/^4He$, etc) reflect a plume mantle reservoir and U-Pb zircon-baddeleyite geochronology indicate emplacement between 450 Ma (from kimberlite pipes) to 346±7.9 Ma (LA-ICP-MS) (personal communication from E. Belousova, Macquarie University, Australia). All the isotope geochemistry data for Paleozoic mafic alkaline and carbonatite deposits suggest an origin related to the break-up of the Pangea Supercontinent.

Thus, the U-Pb (ID-TIMS) and LA-ICP-MS data on baddeleyite from mafic rocks and carbonatites indicate an origin during a period of about 2.4 Ga, from 2.74 Ga to 345 Ma. The data indicate that the baddeleyite in this region is of primary magmatic origin and may be a useful indicator of plume activity permitting reconstructions of the break-up of the oldest supercontinents.

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