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# Geochronological U-PB zircon dating of two ore-bearing magma pulses: stratifrom and non-stratiform ore bodies in the Fedorov deposit (Kola Peninsula)

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The Kola Peninsula is one of the unique geological provinces both in Russia and in the world, where platinum and palladium deposits have been discovered. The highest level of noble metal concentration has been found in the ore of the Fedorov-Pana massif. Presently, the several deposits within the Fedorov block contain first hundreds of tons of estimated platinum metal resources, allowing us to ascribe the intrusion to the class of large deposits (Mitrofanov, 2005).

The Fedorov-Pana massif is situated in the central part of the Kola Peninsula and is one of 14 major Early Proterozoic layered massifs of the Northern belt occurring at the border between Early Proterozoic volcano-sedimentary rift sequences and Achean basement gneisses (Zagorodny, Radchenko, 1983; Bayanova, 2004).

The isotope-geochronological data corroborate the geological-petrological conclusions made on the basis of prospecting works on the polyphase history of the Fedorov-Pana massif. At present, the following ages have been defined for the different stages of the massif evolution: 2526 – 2516 Ma (Nitkina, 2006) – pyroxenite and gabbro of the Fedorov magma chamber; 2501 – 2496– 2485 Ma (Bayanova, 2004; Nitkina, 2006) – gabbro-norite and gabbro of the main phase of the West-Pana block magma chamber and early disseminated platinum-metal mineralization and relatively rich Cu-Ni sulphide mineralization in the basal part of the massif; ca. 2470 Ma (Bayanova, 2004) – pegmatoid gabbro-anothosite and, probably, fluid-associated rich platinum-metal ores of the Lower Layered Horizon (Malaya Pana deposit); ca. 2450 Ma (Bayanova, 2004) – anorthositic injections and, probably, local lens-like rich Pt-Pd accumulations of the Upper layered Horizon.

The Fedorov deposit represents the western part of the massif with the exposed area of about 45 $km^2$ and occurs as a lopolith-like body (Shissel et al., 2002; Mitrofanov, 2005; Mitrofanov et al., 2005). The stratigraphy of the deposit consists of the following zones: 50-100-m-thick marginal zone composed of schists after mafic rocks; the zone of ore-bearing taxitic gabbronorite typical of the deposit and will be discussed below; 50-200-m-thick norite zone with norites and plagiopyroxenites; 200-800-m-thick gabbronorite zone, and the uppermost gabbro zone with the thickness of over 1000 m. The latter contains rare thin layers of leucocratic rock varieties and anorthosites (Shissel et al., 2002; Mitrofanov et al., 2005).

The Fedorov deposit is characterized by the presence of mineralized taxitic gabbronorite zone with the thickness of 150 – 300 m. The zone contains great amounts of orthopyroxenite and norite xenoliths (Shissel et al., 2002; Mitrofanov et al., 2005). Besides, the stratigraphy of the Fedorov deposit includes the second-phase rocks, gabbronorites cementing the xenoliths with sulphide mineralization (Shissel et al., 2002; Mitrofanov et al., 2005). This is the non-stratiform type of ore-bearing bodies, and the previously defined age for this ore-forming stage was 2485$\pm$9 Ma (Nitkina, 2006).

The basement of the Fedorov deposit, where sulphides (2-5 vol.%) are spread widely, but irregularly includes several low-sulphide PGE-bearing horizons occurring conformably to the massif layering. This is the stratiform type of ore-bearing bodies. The thickness of the sulphide mineralization interval varies from 10-20 to 100 m. This zone is divided into the lower and upper ore bodies with the total PGE content of about 1 ppm (Shissel et al., 2002; Mitrofanov et al., 2005; Mitrofanov, 2005).

The isotope U-Pb zircon dating was made on the core samples from the upper ore body (gabbro F10-C weighing 11 kg, and gabbro F10-B weighing 7,35 kg), and from the lower ore body (gabbro F10-A weighing 12 kg, and gabbro with olivine F10-D weighing 20,5 kg). Four zircon populations from gabbro F10-B were separated from electromagnetic and non-electromagnetic fractions for isotope U-Pb dating that yielded a preliminary age of 2.52 Ga. From gabbro F10-C, six zircon populations were dated using U-Pb method; the age of ore-bearing gabbro has been assumed to be 2.54 Ga. Five zircon populations were separated from gabbro F10-A for isotope U-Pb dating and gave the tentative age of 2.50 Ga. The isotope U-Pb dating of olivine gabbro F10-D was carried out on five zircon populations separated from fractions of different size; the age of the ore-bearing rocks has been estimated to be 2.51 Ga.

As a result, the isotope U-Pb dating of the upper and lower stratiform ore bodies yielded the following preliminary ages: 2518±8.8 Ma and 2515±12 Ma, respectively. The age of the non-stratiform ore body obtained earlier is 2485±9 Ma. The ages determined in this work confirm the concepts proposed by geologists about the presence of two ore-forming stages in the Fedorov block, i.e. stratiform or simultaneous to the formation of the overall layering.

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