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U-PB AND LU-HF ISOTOPIC SYSTEMS IN ZIRCONS AND HF-ND ISOTOPIC SYSTEMATIZATION OF THE KIMOZERO KIMBERLITES (KARELIA).

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The Kimozero kimberlite body is situated on the Onega structure of the Baltic shield. Kimberlite type rocks are intruding Paleoproterozoic volcanic and sedimentary rocks of the Ludikovy unit with the age 2040-1980 Ma. Geological, geochemical and petrographic data show that in Kimozero body can be found at least three generations of kimberlite rocks: kimberlites of the first generation (relics in breccias), the second generation (main part of breccias) and tuffs, so one can suggest multistage magmatic episodes of its formation (Dubovikova, Polekhovsky 2009). The existing isotopic data show evidence of Proterozoic age of some individual grains of zircons which are present in these rocks (Samsonov, e.a., 2009).

Isotopic investigation was carried out in Center of Isotopic Research (CIR) VSEGEI by methods of local isotopic analysis: at first was studied U-Pb isotopic system by SIMS SHRIMP II with spatial resolution beam diameter $d=15$ mkm and depth $h=2$ mkm, and then in the same locations by laser ablation LA-MCICPMS Finnigan Neptune/DUV-193 with $d=40$ mkm and $h=30-40$ mkm, following (Lokhov, e.a., 2009b). For isotopic Hf-Nd systematization the data on Sm-Nd isotopic system in kimberlites were also obtained in CIR VSEGEI.

In Kimozero kimberlites we have found a number of zircons with U-Pb age from 150 to 2545 Ma (SIMS SHRIMP II). According to low

uranium concentration (3-16 ppm) and morphology, only zircon grains with measured U-Pb age 1850-2070 Ma, can be considered as magmatic kimberlite. These zircons have concordant U-Pb ages, and for the array of U-Pb data can be obtained estimation of concordant age of kimberlite crystallization 2004 ± 41 Ma. From other side U-Pb dating by ID TIMS of individual grains of supposed magmatic kimberlite genesis gave estimation 1986 ± 4 Ma (Samsonov, e.a., 2009). Geochemical peculiarities of kimberlite zircons ($^{177}\text{Lu}/^{176}\text{Hf} < 0.0001$) (Nowell, e.a., 2004), give possibility of their robust determination, even in case of presence in kimberlite object as captured, so metamorphic zircon grains. Lu-Hf isotopic investigation of zircons from Kimozero kimberlites have shown, that only zircons with measured U-Pb age 1850-2070 Ma can be classified as magmatic kimberlite ones (fig.1).

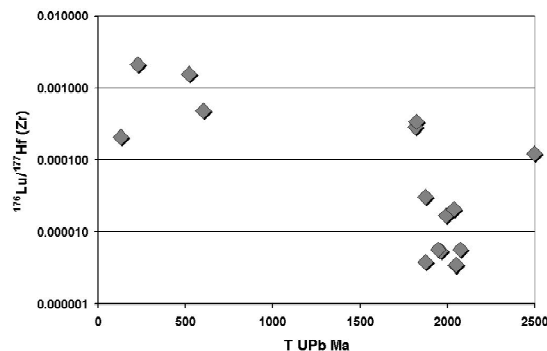


Fig.1. Values of Lu/Hf ratios in zircons from the Kimozero kimberlites.



Hf-Nd isotopic systematization give possibility for robust identification of genesis of individual zircon grains (Lokhov, e.a., 2009b) and exhibits, that zircons with age near 2500 Ma are captured, and zircons with age in the range 130 – 600 Ma are metamorphic (fig.2). Metamorphic zircons with the same range of Phanerozoic ages were found in majority of Paleoproterozoic rocks of the Onega depression (Goltsin, e.a., 2010). To magmatic zircons on this plot can be attributed only those, which are belonging to correlation for magmatic rocks – “terrestrial array”. Magmatic zircons can be subdivided into four groups with measured U-Pb age: 1815-1825, 1870-1875, 1920-1975 and 2000-2070 Ma. Each of these groups is characterized by specific and in series increasing parameter $\epsilon_{\text{Hf}}(T)$ (fig.2.). Zircons of the first group mainly have $^{177}\text{Lu}/^{176}\text{Hf} > 0.0001$ (fig.1), hence, are not kimberlitic. The zircons of last three groups cannot be correlated with any known group of kimberlites by Hf-Nd systematization in (Nowell, e.a., 2004) (fig.2). They are occupying some intermediate position, and are most close to the field of kimberlites of transitional type, which are considered to be generated by relatively enriched deep source. There is a clear regularity: as younger is the group

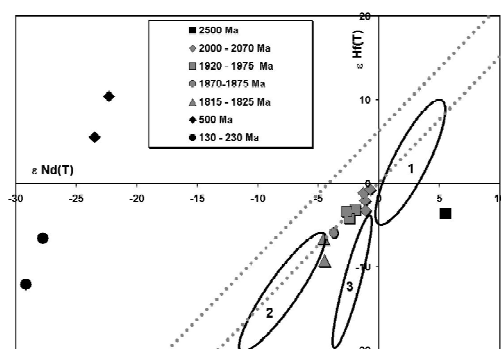


Fig.2. Isotopic Hf-Nd systematization of the Kimozero kimberlites. Gray dotted lines are marking correlation for magmatic rocks – “terrestrial array”, black ellipses – fields of known kimberlites by (Nowell, e.a., 2004): 1- first type, 2- second type, 3- transitional type.

of zircons, so them demonstrate lower values of $\epsilon_{\text{Hf}}(T)$ (fig.2.).

The source of captured zircon with age near 2500 Ma, according to negative $\epsilon_{\text{Hf}}(T)$ value, could be rocks of lower crust. Metamorphic zircons of Phanerozoic age range demonstrate clear excess of radiogenic hafnium, usual for analogous metamorphic zircons from sedimentary and volcanic Paleoproterozoic rocks of the Onega depression.

Geological, geochemical and petrographic data show that in Kimozero body can be found at least three generations of kimberlite rocks (Dubovikova, Polekhovsky 2009). Hence these three groups of zircons can be attributed to different generations of kimberlites. Calculation for these groups of U-Pb data gives estimations of concordant ages of zircon crystallization: 1893 ± 57 , 1975 ± 65 and 2048 ± 48 Ma. Obtained data demonstrate, that the magmatic source of kimberlites suffered evolution in the time span over 150 Ma at progressive increase of its enrichment from kimberlites of first type to transitional type ones. Effect of enrichment of the deep source in fact is virtual, and is related to evolution of isolated deep reservoir with model age relative to depleted mantle by hafnium near 2450 Ma (fig.3). Origin of this kimberlite deep source can be correlated with time of Early-proterozoic rifting event on the Baltic shield,

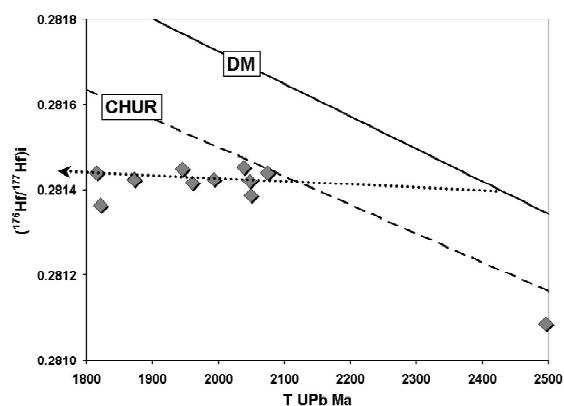


Fig.3. Evolution of Hf isotopic composition (by zircons) in the deep source of the Kimozero kimberlites.



which is marked by numerous layered mafic intrusions and high magnesium basaltic series with emplacement age near 2450 Ma.

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