Pb, Nd, Sr isotopic composition of the Mesoproterozoic mafic intrusions (Udzha paleorift, Northern Siberia)

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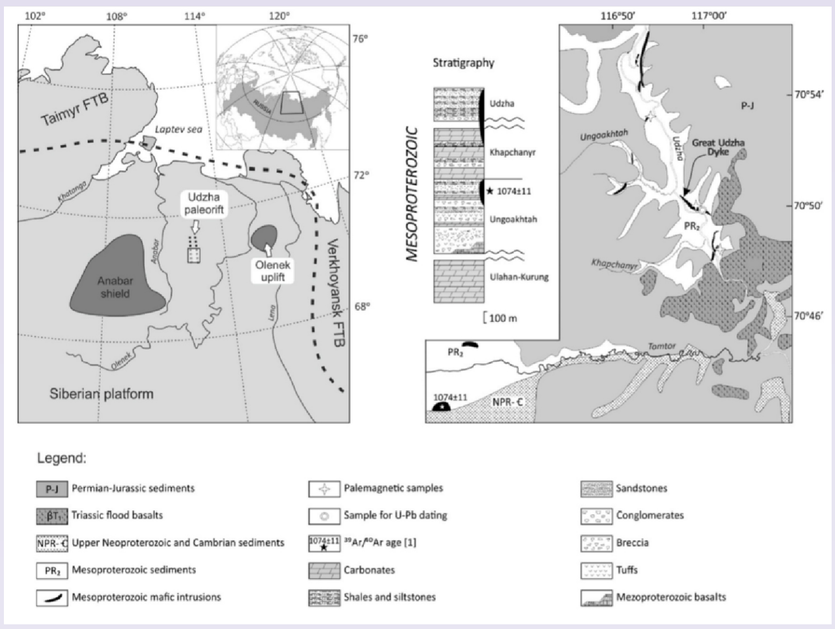
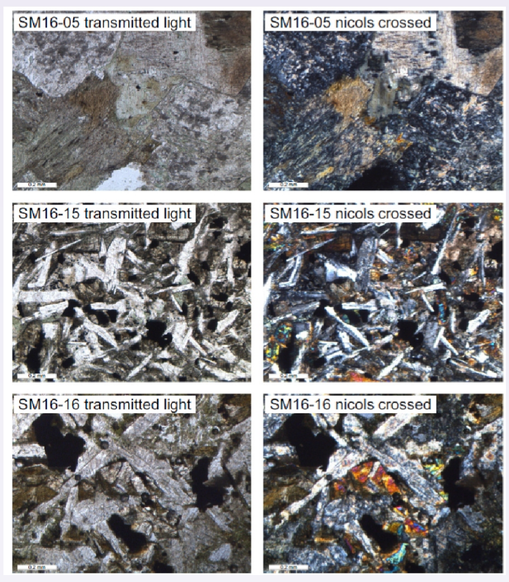
Geodynamic reconstructions are largely based on information contained in mafic igneous rocks, including dykes and sills. The age and isotope-geochemical characteristics of such rocks are inevitable for understanding of geodynamic history of the Proterozoic cratons. The regions in Siberian Craton, where Precambrian mafic dyke swarms are known are following: Anabar Shield and Olenek Uplifts, Aldan-Stanovoi Shield, SE area of Siberian Craton, and smaller Uplifts on the SW margin of Siberian Craton.



The Udzha paleo-rift is located in the northern Siberian Craton (left map). Distribution of the Mesoproterozoic dykes within the geological framework and the location of studied samples (right) are shown on the right map. The bold dotted curve outlines the boundary of the Siberian Craton.
(Malyshev et al., 2018)

The Udzha paleo-rift is associated with mafic dyke swarm. These dykes cross-cut the pre-Neoproterozoic sedimentary successions. The age of the largest dyke in Udzha paleo-rift (Great Udzha Dyke) presented by medium-grained dolerite was determined to be 1386 ± 30 Ma (Malyshev et al., 2018)



Transmitted (left) and polarized (right) light microscope images of thin sections of some of the studied samples

The studied samples are medium-grained dolerite with ophitic and coarse grain textures and are composed of plagioclase (60–65 vol. %), clinopyroxene (20–25 vol. %), quartz (~ 10 vol. %) and hornblende (5 vol. %). Secondary minerals, such as saussurite, sericite and chlorite are common, due to low temperature alteration. The chemical composition of these rocks corresponds to moderately alkaline basalts (SiO_2 = 46–52%; K_2O + Na_2O = 1.7–4.4%) (Malyshev et al., 2018).

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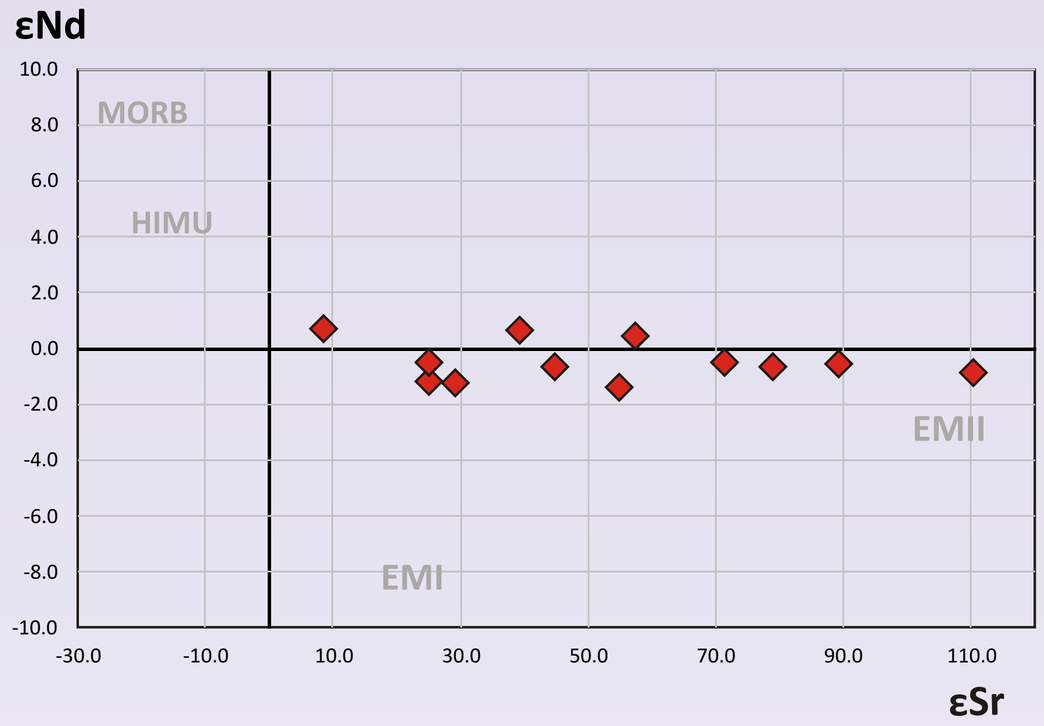
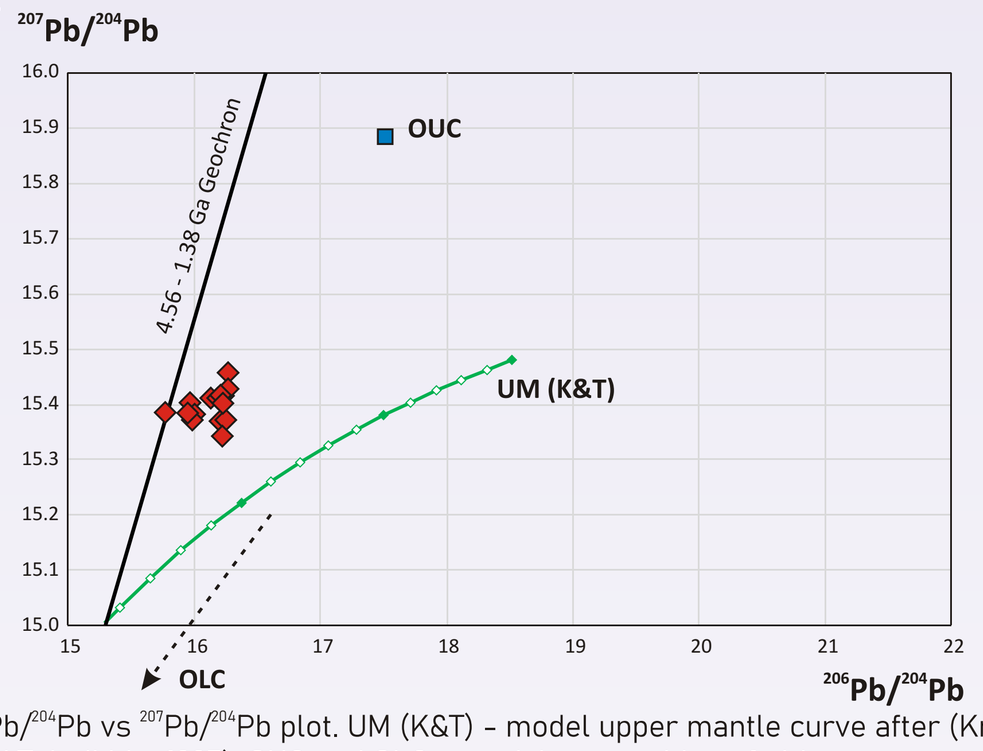
Previous investigations has included dating and determining of abundances of rare elements (Gladkovhub et al., 2009), but no isotopic data were published before. In our research, we present new data on the isotopic composition of Nd, Sr and Pb. Analyses were performed using a ThermoFisher Triton multi-collector TIMS at the Institute of Precambrian Geology and Geochronology RAS, St. Petersburg, Russia.



E(Nd)-ε(Sr) diagram. E parameter is recalculated on age 1380 Ma

11 whole rock analyses were performed to determine the isotopic composition of Sr and Nd. The Sr isotopic composition of the dykes demonstrates substantial variation: εSr varies from 8.4 to 110.4. Nd isotopic composition does not vary significantly (εNd varies from -1.4 to 0.7), thus we don't consider variety of Sr composition as a result of crust contamination. Obtained results indicate that initial for the Udzha paleo-rift dykes melts were generated from mantle reservoirs enriched in radiogenic Sr, that can be caused by high Rb/Sr ratio.



$^{206}Pb/^{204}Pb$ vs $^{207}Pb/^{204}Pb$ plot. UM (K&T) - model upper mantle curve after (Kramers and Tolstikhin, 1997); OUC and OLC – model composition of old upper crust and old lower crust at 1.38 Ga after (Kramers and Tolstikhin, 1997)

15 whole rock analyses were performed to determine isotopic composition of Pb. The initial isotopic composition of Pb in the dykes was obtained using the leaching method by Savatenkov et al., 2019. The initial Pb isotopic composition of the dykes is much closer to model old upper crust Pb composition (after Kramers and Tolstikhin, 1997; $^{206}Pb/^{204}Pb$ varies from 16.133 to 16.266, $^{207}Pb/^{204}Pb$ varies from 15.343 to 15.458). Therefore, we believe that enriched upper crust material participated in melt generation, perhaps, through subduction mechanism.

Both Sr and Pb isotope composition of Udzha paleo-rift dykes indicate presence of enriched component in melt generation process, while Nd isotope composition doesn't show significant crust contamination. Therefore, presence of enriched component is likely associated with lithospheric mantle, metasomatized by fluids, derived from ancient subducted oceanic crust (that causes high Rb/Sr ratio and enrichment in radiogenic Pb).