tion of Riphean shale, in explosive activity and in the intrusion of the carbonatite melt. At the first stage of carbonate-alkaline fluid-explosive system of the Middle Timan formation, in the front of the Ca-Na fluid flow, on the Riphean shale substrate, metasomatites were formed, composed of calcite, albite and alkaline colored minerals. At the second stage, due to a sharp drop of pressure and decompression, an explosive release of gases occurred from the carbonatite source, hacking into the Riphean strata and their metasomatized areas. At the third stage, carbonatite melt was introduced into the gas-shattered horizon and caused phlogopitization of host rocks and xenoliths.

A similar evolutionary history also corresponds the fluid- explosive alkaline rocks dike complex. The solid-gas fluidized mantle material was introduced in the form of dikes into the previously meta-somatically altered zone and mixed with hacked fragments of metasomatites and Riphean metasedimentary rocks. Xenogenic mantle material in the form of mineral fragments (pyroxene, olivine, chromespinelide) and rocks (pyroxenite and hornblendite) was transported by fluid flow from relatively shallow mantle horizons. The clastic material in the explosive dikes was cemented by low-temperature metasomatic minerals. At the next stage, as well as in the carbonatite stock, the rare-earth and rare-metal mineralization was generated in the formed fluid-explosive ultramafic rocks due to the incoming alkaline-carbonate hydrothermal solution from the cooling down carbonatite source.

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GEOCHEMISTRY OF THE INTRUSIVE ROCKS OF THE SIBERIAN TRAP PROVINCE

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Introduction

The connection of ore deposits with Large Igneous Provinces (LIPs) is one of the most important problems of geology, since they contain many deposits of strategic metals (Dobretsov, 2005; Ernst, 2014).The world's largest continental Siberian trap province is an example of a combination of a huge volume of basic rocks and Pt-Cu-Ni ores that provide 90% of the platinum group metals (PGE) and Ni in Russia. This metallogenic province is located in the Arctic zone of the province and includes deposits of the South Taimyr and Noril'sk area (Dodin, 2011; Malitch et al. 2017). Its high economic value raises the question of the possibility of new deposits discovering in other parts of the Siberian province and around the world. Meanwhile, the causes of localization of deposits in the north part of the province are rarely considered in genetic models and are still controversial (Rad'ko, 2016; Krivolutskaya et al. 2018).

To solve this problem we tried to identify specific features of the tectonic structure and magmatism of the northern zone of the Siberian province in comparison with the other areas including the Norilsk, Maimecha-Kotuy areas, Tunguska basin, Angara and Kulyumber river valleys. The research included a geochemical study of both volcanic and intrusive rocks: major components (XRF), trace elements (ICP-MS) and radiogenic isotopes Sr-Nd-Pb (TIMS).

Results

In this study our special attention was paid to intrusive rocks of the key areas. Analytical data demonstrate that the maximum composition diversity is typical of the intrusions located in the northern part of the province, namely the Norilsk, Maimecha-Kotuy and Taimyr areas. These rocks range from ultrabasic, alkaline and subalkaline to tholeiitic rocks of normal alkalinity. They have both mantle and crustal characteristics. The first intrusive type includes the Dyumtaleysky massif and a series of ultrabasic dikes and irregular bodies in Taymyr. These rocks are characterized by trace element patterns without Ta-Nb and Pb anomalies, with ε_{Nd} ranging from +3 to +5, and $^{87}Sr/^{86}Sr$ from 0.703 to 0.704 (Fig.). The second intrusive type (including the Norilsk intrusive complex) contains massifs with distinct Ta-Nb and Pb anomalies, ε_{Nd} varies from -9to +2, $^{87}Sr/^{86}Sr$ changes from 0.705 to 0.711. Major components in both types change significantly (wt%), i.e. MgO = 3-35, TiO_2 = 0.7-4.6, K_2O = 0.2-1.8. In contrary, the intrusions of the southern part of the Siberian province (Tunguska basin; Angara and Kulyumber river valleys) represented by gabbro-dolerite sills (often with olivine) and combined in Katangsky, Kuzmovsky and Kurejsky intrusive complexes have a constant tholeiitic composition (wt%): 6-7 MgO, 1.6-1.8 TiO_2, 0.4-0.5 K_2O. Their isotope characteristics are following: ε_{Nd} = +1 to +2, $^{87}Sr/^{86}Sr$ =0.705-0.706. The composition of the intrusions from the southern part of the Siberian platform is close to the composition of the Norilsk intrusions excepting lower MgO and elevated TiO_2.

The difference in the rock compositions of northern and southern parts of the province could be explained by the difference in their tectonic position. According to geophysical data the northern part of the East Siberia is characterized by anomalous magnetic and gravitational

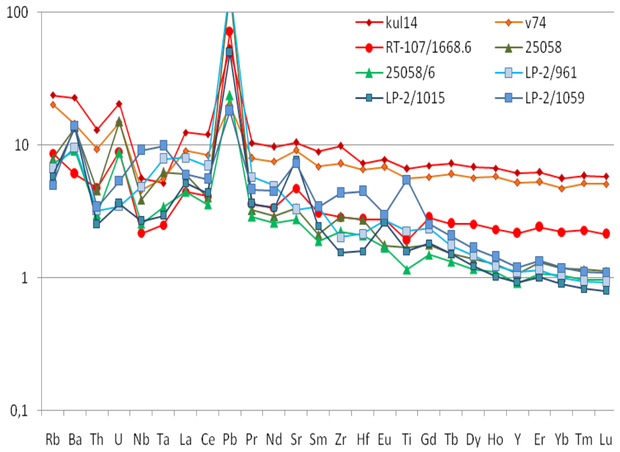

Figure. Spider-diagram for intrusive rocks of the Siberian trap province. Intrusions, lines colors: red – Kharaelakh, green – east Taimyr, blue-central Taimyr, brown – r. Kulyumber. Normalized after (Hofmann, 1989)

fields (Dolgal, 2012). It is suggested that these anomalies reflect the occurrence of large amount of basic-ultrabasic rocks within these blocks of crust and evidence of intense magmatic activity in this area in contrast to the southern part of the trap province. Thus, different tectonic regimes operated 251 Ma ago, rift and platform (Malitch.

The PGE-Cu-Ni deposits are concentrated only within zones where both regimes took place. These zones are paleorifts, the Yenisei-Khatanga and Norilsk-Igarka They are characterized by long-lasted development and their geological structure is a result of many geological processes.

Conclusions

Northern part of the Siberian trap province comprises many ultrabasic-basic intrusions varying in composition from peridotites to gabbro. This compositional diversity of this region is due to a specific tectonic development of this area in comparing with the southern part of the province

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