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Petrochemistry and Rock-Forming Mineral Compositions of Mafic-Ultramafic Intrusions in the Norilsk Area, Siberia, Russia as Criteria for Pge-Cu-Ni Ores Prospecting

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The north of the Siberian craton is a unique PGE-Cu-Ni province. World-Class PGE-Cu-Ni deposits located in the Noril'sk area are related to mafic-ultramafic intrusions inside the largest trap province on the Earth. There are hundreds intrusive bodies in Siberian province but only some of them contain PGE-Cu-Ni ore. The problem of identification of ore-bearing massifs among many barren intrusions is under examination of geologists during 60 years.

New analytical methods help us to solve this problem more successively.

We have studied 33 intrusions in the Noril'sk area using XRF, ICP-MA, EPMA, SIMS and LA-ICP-MS methods. It was demonstrated that average composition of ore-bearing intrusions of the Noril'sk Intrusive Complex is characterized by elevated MgO (10-12 wt%) and low TiO_2 (<1wt%) in comparing with other intrusions. Nevertheless, it is not possible to distinguish massifs with rich ore from weakly mineralized.To solve this problem we have studied the compositions of rock-forming minerals from gabbro-dolerites of different horizons. The most important information was obtained from olivines as earliest liquidus phase of picritic gabbro-dolerites. The composition of olivine vary in range Fo_{78}-$Fo_{82.}$ Major components do not contain information on specific features of intrusions. Only rare elements in olivines allow us to distinguish ore-bearing and barren intrusions. We used 3,000,000 LA-ICP-MS data for olivines for comparing ore-bearing intrusions with rich PGE-Cu-Ni ore (Talnakh, Kharaelakh and Norilsk 1) and weakly mineralized (Low-Talnakh, Zelenaya Griva) massifs. The homogeneity of the data sets was checked with the help of the Statistica program and the VADIC (The Visual Analisis of Data, the Identification and Clasification The range of elements included SiO_2, FeO, MnO, MgO, CaO, NiO, Ti, V, Y, Li, Cr. For all elements, the coefficients of the discriminant function were obtained, as a result of which the canonical function acquired the following form: CF = -0.094SiO2 -1.34FeO + 0.20MnO -1.39MgO -1.21CaO + 0.83NiO +0.30 Ti -0, 15V + 0.27Y + 0.10Li + 0.18Cr.

The calculated values of the function for olivines from different intrusions generally reflect the degree of ore mineralization of the latter. Thus, for Kharayelakh massif, the value of the function is +0.79, for Talnakh - +0.61, for Norilsk 1 - + 0.16, for Norilsk 2 - -1.25, for Zelenogrivsky - 1.80 and for Low-Talnakh - -2.58. Thus, a preliminary evaluation of the ore content of newly discovered massifs can be carried out according to the composition of rock-forming minerals and, in particular, olivines.

Biography:

Dr. N. Krivolutskaya graduated from Moscow State University on specialty "Geology and prospecting of ore deposits" in 1976. After graduating MSU she has studied geology of deposits of different genetic types (Cu-sandstones, Au-quartz, Ti-Fe-V) in Transbaikalia. The main objects of research are PGE-Cu-Ni deposits of the Noril'sk area and Kola peninsula N. Krivolustkaya defended the candidate dissertation (PhD) on geology and genesis of Chineysky PGE-Cu-Ni deposit (Northern Transbaikalia) and doctorsky dissertation on Noril'sk PGE-Cu-Ni deposits. She has been studying Cu-Ni and PGE deposits around Russia (Noril'sk, Karelia-Kola and Eastern Sayan areas), volcanic rocks and deposits in Emeishan province (China). Results of the study were published in 200 articles and 5 books. The last results were published by Springer in book "Siberian Traps and PGE-Cu-Ni deposits of the Noril'sk area" in 2016 She was awarded by Smirnov Premium of Russian Academy of Sciences (2015) for the study of magmatic deposits of Eastern Siberia.