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Olivines composition data to the origin of the Noril'sk deposits (Siberian trap province, Russia)

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Introduction. Siberian traps originated from the continental plume magmatism that occurred in the Siberian Platform. The basalts and underlying terrigenous sedimentary rocks are intruded by numerous igneous bodies, sometimes with unique Pt-Cu-Ni deposits, whose relations with the basalts are still poorly studied. Ore-bearing intrusions with high-Mg rocks were considered as the products of a specific picritic magma (Dyuzhikov, 1988) or as the tholeitiic magma feeders to the surface (Naldrett, 1996). The Gudchikhinsky and Tuklonsky picrites are usually considered as the parental melt products in these two hypotheses.

Results. To check these theories we have studied olivines by SIMS, LA ICP-MS, EPMA from ore-bearing intrusions (Talnakh, Kharaelakh and Noril'sk 1) and effusive high-Mg rocks mentioned above . The studied olivines vary in composition, including main, major and trace elements. Gudchikhinsky olivines are the most magnesium (up to Fo_{84} mol.%) and contain the highest NiO concentrations, reaching up 0.41 mas. %. They have very low trace-elements contents , exception Cu. However the patterns of rare elements from the rocks of the Gudchikhinsky formation are not similar to those from ore-bearing gabbro-dolerites. Thus these picrites can not be the parental magma for mineralized intrusions.

According to the second point of view, the Tyklonsky picrobasalts are the products of the parental magmas, which were contaminated by the deep crust matter and assimilated by host rocks in magmatic chambers. Thus the major formation factors of the unique Pt-Cu-Ni ores are (1) the duration of the interaction between melt and rock and (2) an enrichment grade of the host rocks in sulfates and carbonates. The result of this

interaction is the Nadezhdinsky formation with high-Mg rocks depleted in Cu.

This concept is based on the similar distribution of rare elements in effusive and intrusive rocks with Pt-Cu-Ni ores. However, olivines data from these objects do not support this hypothesis. The Fo content in the Tyklonsky olivines range from 70 up to 77, so they can be in equilibrium with basaltic melt, but not with picritic magma. Moreover, the olivines from the Tyklonsky and Nadezhdinsky formation differ strongly from the olivines of the Talnakh intrusion: they have very low NiO ($<$0,1 mas.%) and REE (Yb, Dy, Y) content comparing with very unusial olivines (0,23 mas.% NiO, and up to 9 ppm Y, respectively) from Taknakh .

This conclusion is also consistent with phase equilibria computed for the rocks of the Talnakh pluton .The calculated data indicate that at a T = 1200˚C the parental melt had the tholeiitic composition and it was slightly enriched in alkaline metals and magnesium (similar to the composition of the Mokulaevsky basalts) and contains Fo= 80 $\pm$ 1.5 mol %. According to the melt inclusions data, the olivine was formed at a T = 1210-1240˚C, i.e., at a much lower temperature than that of the picritic melt crystallization ($\geq$ 1300˚C). Our calculations performed on the rock composition with a 7 % of olivine fraction show that practically all this minerals are intratelluric phase (Fo_{77})

Conclusions. All studied olivines confirm that effusive high-magnesium rocks were not crystallized from the picrite magma and they do not responsible for the origin Pt-Cu-Ni ores.

References

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