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S isotopic characteristics of PGE-Cu-Ni ores from the Noril'sk-Talnakh area (Russia): new data

O.V. Petrov, K.N. Malitch, V.O. Khalenev, E.V. Tuganova
All-Russia Geological Research Institute, St. Petersburg, Russia

This study presents the extensive data on S isotopic composition of platinum-group element (PGE)-Cu-Ni sulphide ores and occurrences from the Noril'sk-Talnakh area, which is located in the northwestern corner of the Siberian craton, Russia. The ores are hosted within intra-continental palaeorift-related mafic-ultramafic intrusions that range up to 360 m in thickness and up to 25 km in length.

A suite of 165 samples from drill cores MN-2 (Noril'sk-1), OUG-2 (Talnakh), KZ-844 and KZ-963 (Kharaelakh), MP-27 (Zub-Marksheider), MP-2b (Chernogorsk), OV-29 (Pyasino-Vologochan), MD-48 (Mikchangda), TG-31 (Nizhny Talnakh) characterize three different types of PGE-Cu-Ni ores. Type 1 ore is massive in nature and is situated close to the bottom contact of economic ore-bearing intrusions (Talnakh and Kharaelakh). Type 2 ore is disseminated ore and occurs in both the ultramafic and the lower "taxitic" parts of intrusion. Type 3 ore is from the upper low sulphide zone, which is enriched in PGE. Pyrrhotite, chalcopyrite and pentlandite are predominant minerals in the ores. A set of 170 measurements has been performed on three ore types (type 1 ore – 53 analyses, type 2 ore – 111 analyses, type 3 ore – 6 analyses).

The economic PGE-Cu-Ni Talnakh (+11.0 $\pm$ 0.4‰, δ^{34}S) and Kharaelakh (+12.9 $\pm$ 0.5 ‰, δ^{34}S) deposits are the most homogeneous with respect to **sulfur** isotopic compositions. They show similar S isotopic signatures for massive and disseminated ores that differs from type 3 ore (δ^{34}S = + 6.5 - + 8.3). This feature allow us to compare disseminated ores that occur in various ultramafic-mafic intrusions that have different metallogenic potential at Noril'sk-Talnakh area. According to increase of δ^{34}S in type 2 ore, intrusions order looks as follows: Zub-Marksheider, Pyasino-Vologochan, Nizhny Talnakh, Noril'sk-1, Chernogorsk, Talnakh, Kharaelakh and Mikchangda. It is important to note that at Zub-Marksheider, which contain sub-economic type 2 ore,

the latter is characterized by very low S isotopic composition of sulphide (δ^{34}S = -0.4 - +0.2). So called crustal component is almost absent here, thus indicating mantle S isotopic signature and mantle origin for disseminated sulphide ore. In contrast, disseminated sulphide occurrence at Mikchangda (12.8-14.0) almost indistinguishable from type 1 and type 2 ores at Kharaelakh. The proof for their identity, however, requires further detailed geochemical and isotopic assessment.

Frequently, “crustal” (sulfate) isotopic composition of sulfur is postulated as evidence for high productivity of the ultramafic-mafic intrusion. Indeed, for many intrusions such pattern does exist. At Zub-Marksheider and several other occurrences, which are hosted by sulfate-rich Devonian rocks, however, no increased S isotopic signatures were determined. This feature allowed Kuz’min and Tuganova (1977) to question the use of heavy isotopic composition of sulfur as criterion for crustal isotopic source of S. It is likely that “isotopically-heavy” sulfur in sulphides from PGE-Cu-Ni ores at Noril’sk-Talnakh area show evidence for processes of sulfur fractionation that took place at deeper levels of tectonosphere, presumably close to the mantle-crust boundary, rather than at shallow levels when magmatic melt could have been enriched by heavy sulfur contained in the crust.

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References:

Kuz’min, V.K. & Tuganova, E.V. (1977) Geology and Geophysics **25**, 122-125.