A combined Nd-Sr-Cu-S isotope study of the Chernogorsk and Zub-Marksheider ore-bearing intrusions (Noril'sk Province, Russia)

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The world-class Ni-Cu-PGE sulfide deposits associated with the Noril'sk-1, Talnakh and Kharaelakh intrusions in the Noril'sk Province are considered to be sourced from the mantle plume-related magma with the addition of sulfur from the country rocks. However, why the Ni-Cu-PGE sulfide ores of the Noril'sk-type economic deposits contain isotopically heavy S isotopes has been hotly debated ([1] [2], among others).

This study assesses Nd-Sr-Cu-S isotope data for the same suite of lithologies and associated disseminated Ni-Cu-PGE sufide ores from the subeconomic Chernogorsk and Zub-Marksheider intrusions that contain small- to medium-sized Ni-Cu sulfide deposits, and medium- to large-sized PGE deposits. Studied intrusions have mineralogy, geochemistry and Nd-Sr isotope systematics broadly similar to that of the economic Noril'sk-1, Talnakh and Kharaelakh intrusions that show heterogeneous 'radiogenic' initial Sr ($^{87}Sr/^{86}Sr_i$ = 0.7055-0.7075) against rather constant εNd values of ~+1.

In terms of Cu-isotopes, the analyzed samples fall within a tight cluster (with a mean δ^{65}Cu of –0.03±0.06‰ at Chernogorsk and –0.10±0.15‰ at Zub-Marksheider, respectively) characteristic of the ores from the economic Ni-Cu-PGE deposits at Talnakh and Stillwater [1]. In contrast, the disseminated ores of the Chernogorsk and Zub-Marksheider intrusions show distinct S isotope signatures (δ^{34}S=10.9±0.4‰ and 0.4±1.6‰, respectively).

The determined δ^{65}Cu variability is interpreted to represent a primary signature of the ores. Finding of mantle-like δ^{34}S values in the subeconomic sulfide ore from the Zub-Marksheider intrusion hosted within sulphate-rich Devonian sediments suggests that the immediate country rocks may have little influence on the mineralization in igneous rocks challenging a model demanding assimilation of crustal S as a prerequisite to forming a magmatic deposit [2].

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[1] Malitch *et al*. (2014) *Lithos* **204**, 172-187. [2] Keays & Lightfoot (2010) *Mineralium Deposita* **45**, 241-257.