SULPHUR ISOTOPE VARIATION OF SULFIDE ORES IN FUNCTION OF FOOTWALL-MAGMA CONTAMINATION WITHIN THE BATHTUB INTRUSION, DULUTH COMPLEX, USA

Benkó, Zs.[1], Molnár, F.[2], Mogessie, A.[1], Poulson, S.[3], Arehart, G.[3], Severson, M.[4], Hauck, S.[4] & Raič, S.[1]

[1]Karl-Franzens University Graz, Universitätsplatz 2, 8010 Graz, Austria
[2]Geological Survey of Finland, Betonimiehenkuja 4, 02151 Espoo, Finland
[3]University of Nevada, Reno, 1664 N Virginia St, 89557 NV, Reno, USA
[4]NRRI, University of Minnesota, 5013 Miller Trunk Highway, 55811 MN, Duluth, USA
e-mail: zsolt.benko@uni-graz.at

The 1.1 Ga old Duluth Complex (DC), is composed of multiple, discrete mafic intrusions. Intrusive rocks are emplaced between the Archean granitic and Paleoproterozoic metasedimentary footwall and co-genetic volcanic hanging wall rocks. The mineralized, troctolitic Bathtub Intrusion (BTI) contains particularly in the bottom part scattered bodies of hornfelsed metasedimentary footwall inclusions, granophyric textured felsic veins and hybrid rocks as a sign of the footwall-intrusion interaction. Mineralization is mainly disseminated but towards the intrusion-footwall contact locally semi-massive pods and veins also occur. Cubanite, chalcopyrite and pentlandite occur interstitially between cumulate phases, whereas a more fractionated sulfide melt composed of chalcopyrite and bornite form veins and disseminations within the silicate phases.

The average $\delta^{34}S$ values of sulfides in the troctolite are around +5 ‰. Irrespective of the stratigraphic height, melanocratic rocks have lower values (2.3-4.8 ‰), whereas samples of, or from the vicinity of metasedimentary footwall inclusions, quartz-bearing hybrid rocks, as well as felsic veins (all of them interpreted as derivate of the footwall) are enriched in heavy sulfur (8.6-16.7 ‰). With increasing contamination in the bottom 100 m thick part of the intrusion, sulfur isotope values increase abruptly towards the contact. Samples from the metasedimentary footwall have, however, slightly lower sulfur isotope signature (11.7-11.9 ‰) than samples in the lower, contaminated, inclusion-rich zone of the intrusion (11.0-16.7 ‰).

Although a large dataset is available for sulfur isotopes from the BTI (RIPLEY & ALAWI, 1986), our new data suggest that the grade of mineralization and the deviation of sulfur isotope value from the magmatic composition (~ 0 ‰) of a certain sample is exclusively the function of the distance of the sample from the metasedimentary footwall or from a footwall inclusion. Presence of mineralization along with heavy sulfur signatures at various levels, even at the top of the intrusion suggests that not only the bottom, but any part of the intrusion could be in direct contact with the heavy sulfur (0.2-25.8 ‰) bearing metasedimentary footwall rocks. In our model the BTI is composed of a series of horizontal sills that repeatedly intruded the metasedimentary footwall and the pre-existing sills. Therefore, contrary to other mineralized intrusions the metasedimentary rocks form not only the footwall but the hanging wall of the intrusion, as well.

RIPLEY, E. M., ALAWI, J. A. (1986): Canadian Mineralogist, 24, 347-368.