

GEOCHEMICAL SIGNATURE OF MASSIVE SULFIDES FROM VMS DEPOSITS: IMPLICATIONS FOR PETROGENESIS AND EXPLORATION

Genna, D

CONSOREM-UQAC, 555, boul. de l'Université, G7H 2B1, Saguenay, QC Canada.

Volcanogenic Massive Sulfides (VMS) deposits and their modern equivalent Seafloor Massive Sulfides (SMS) are formed by the precipitation of metals at, or near, the seafloor when hot and acid hydrothermal fluids encounter cold and neutral seawater. They typically comprise a stratabound orebody (tabular or mound-shaped; typically Zn-rich) underlain by a discordant stockwork of sulfide veins (typically Cu-rich) hosted in a well-developed alteration halo. They are a major source of Zn, Cu, Pb, (\pm Ag, Au), but also a significant contribution of As, Co, Sn, Se, Mn, Cd, In, Sb, Bi, Te, Ga and Ge. The presence of a single element, or a combination of elements, could be indicative of a magmatic contribution but could also indicate specific capacity of transport by the fluids. For example, Tl has the same experimental behaviour under leaching, transport and precipitation conditions than Zn and could thus be used as a good proxy for Zn-rich VMS deposits.

This presentation will review the possible use and interpretation of in situ trace element composition (acquired by Laser Ablation-ICP-MS) and textures of sulfides (pyrite, pyrrhotite, sphalerite, chalcopyrite) and magnetite from VMS and SMS. Using the Matagami Mining Camp (Canada) as an example, pyrites from zinc-rich massive sulfides are relatively enriched in Sn, Sb and Tl, whereas those from copper-rich zones have a completely different signature, enriched in Cu, Co, As and Se (Genna and Gaboury, 2015). Idiomorphic pyrites, which commonly occurs at the district-scale, contain Co and As but are poor in most metals. They are interpreted to be formed during the regional greenschist-metamorphism. Thus, only Co, As, Se, Sn, Sb and Tl are useful to reconstruct the hydrothermal evolution of a VMS deposit. Thallium is particularly useful to differentiate pyrite in the zinc ore zone (>10 ppm) from those in barren rocks (<1 ppm).

Now that the distribution of trace elements at the mineral scale is better understood, the whole rock lithogeochemistry of massive sulfides could be reinterpreted to develop potential new tools for the discrimination of 1) the geodynamic setting and the composition of the leached rocks, 2) a magmatic contribution 3) the position within the deposit (i.e. mound vs. stockwork). Data from SMS worldwide (Hannington et al. 2004) and Canadian VMS (Flin-Flon, Jonasson et al. 2009) will be presented as examples to highlight the potential for exploration.

References

- Genna D., Gaboury D., 2015. Deciphering the hydrothermal evolution of a VMS system by LA-ICP-MS using trace elements in pyrite: an example from the Bracemac-McLeodd Deposits, Abitibi, Canada, and implications for exploration. Economic Geology, 110 2087–2108.*
- Hannington M.D., Petersen S., Herzig P.M., Jonasson I.R., 2004. A global database of seafloor hydrothermal systems, including a digital database of geochemical analyses of seafloor polymetallic sulfides. Geological Survey of Canada, Open File 4598, 1 CD-ROM.*
- Jonasson, I.R., Ames, D.E., and Galley, A.G., 2009. Sulphide ore geochemistry database for volcanogenic massive sulphide deposits of the Paleoproterozoic Flin Flon Belt and Sherridon area, Manitoba and Saskatchewan; Geological Survey of Canada, Open File 5432, 1 CD-ROM.*