Tracing varied fluid sources between VMS deposits by multiple sulfur isotope and trace element analysis

E.R. SHARMAN[1]*, B.A. WING[1], W.G. MINARIK[1], B.E. TAYLOR[2] AND B. DUBÉ[3]

[1]McGill University, 3450 University St., Montreal, QC, H3A 2A7, Canada (*correspondence: esharman@nrcan.gc.ca)
[2]Geological Survey of Canada, 601 Booth St., Ottawa, ON, K1A 0E8, Canada
[3]Geological Survey of Canada, 490 rue de la Couronne, Quebec, QC, G1K 9A9, Canada

Standard models for the formation of volcanogenic massive sulfide (VMS) deposits invoke sulfur contributions from reduction of seawater sulfate, remobilization of sedimentary sulfur, and volcanic sources (e.g. direct magmatic degassing or dissolution of sulfides from wall rocks). Multiple sulfur isotope analysis ($\delta^{33}S$, $\delta^{34}S$, and $\delta^{36}S$) has been previously been used to identify sulfur sources within the giant ~2.7 Ga Kidd Creek VMS deposit [1], and for modern hydrothermal vent sulfides [2]. This study aims to fingerprint sulfur and metal sources for VMS deposits in the Noranda district of the Abitibi Greenstone Belt, Canada, and identify the relative contribution of these sources to mineralization.

Multiple sulfur isotope analyses of sulfide mineral samples from major deposits within the Noranda district exhibit $\Delta^{33}S$ values ($\approx \delta^{33}S - 0.5\ \delta^{34}S$) from -0.22 to 0.09‰ V-CDT and $\delta^{34}S$ values all near zero. Consideration of the $\delta^{34}S$ values alone would suggest a purely volcanic S source to the VMS deposits of the Noranda district. In contrast, the $\Delta^{33}S$ measurements reveal a significant component of S that had cycled through the Archean surface environment prior to ore formation. In addition to an igneous S source, Noranda VMS deposits apparently also incorporated S likely from high-temperature reduction of aqueous sulfate.

In addition to sulfur isotope analyses, a large suite of trace element data, collected by both EPMA and ICP-MS methods, identifies the distinctive trace element character of the different sulphide populations. Principal component analysis of pyrite indicates deposits formed during the main ore-forming stage exhibit a strong positive correlation between seawater-derived Co and Ni. Combined high-precision trace element and S isotope analysis provides a powerful tool for source recognition in the 2.7Ga Noranda VMS deposits, and traces the evolution of a VMS district through each stage of its genesis.

[1] Jamison *et al*. (2006) *Econ. Geol*. **101**, 1055–1061.
[2] Ono *et al*. (2007) *GCA* **71**, 1170–1182.

Geochemical partitioning of trace metals in sediments of Nomi River, Tokyo, Japan

S. SHARMIN* AND N. SHIKAZONO

Laboratory of Geochemistry, School of Science for Open and Environmental Systems, Faculty of Science and Technology, Keio University, Hiyoshi 3-14-1, Yokohama 223-8522, Japan, Tel.: +81-045-566-1567, Fax: +81-045-566-1551 (*correspondence: shailasumi@gmail.com, Sikazono@applc.keio.ac.jp)

A fractionation study of Iron (Fe), Manganese (Mn), Copper (Cu), Chromium (Cr) and Nickel (Ni) in sediments at the 19 sampling sites of Nomi River, Ota Ward, one of the most industrial area of Tokyo, Japan has been carried out to examine the enrichment and partitioning of trace metal between five geochemical phases involving a five step sequential extraction procedure using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Atomic Absorption Spectroscopy (AAS) to understand enrichment and metal availability in five geochemical phases. Speciation data indicate significant exchangeable species of Fe (25-44.1%), Mn (11.8-76.7%), Cr (12.6-46.9%) and Ni (9.8-41.8%) were in residual phase and the maximum association of Cu was recorded with amorphous Fe Oxyhydroxide phase (24.7-51.3%). The order of potential trace metals mobility in the aquatic environment of Nomi River was Cu > Cr > Ni > Fe > Mn. According to the risk assessment code applied in the present study Cu, Ni and Cr were under medium and Fe and Mn were under low risk category. According to the risk assessment code applied in the present study Cu, Ni and Cr were under medium and Fe and Mn under low risk category. And considering the enrichment factors (EFc), most of the sites have highest EFc value indicating an anthropogenic source and pollution of his river by trace metal. The X-ray diffraction (XRD) study detected the presence of several clay minerals, those are likely to be the major host of trace metals in sediments. Further elevated levels of these metals in sediments suggest for the higher exposure risk to the benthic biota of the river. Finally the pollution of Nomi River could be linked to anthropogenic activities such as industrialization, urbanization, deposition of industrial waste and occasional flood.