Large Fe isotope fractionations found in sulfide ores and ferruginous cherts in volcanogenic massive sulfide deposits

T. OTAKE[1*], S. NAKAMURA[1], R. YAMADA[2], K. SHIN[3], S. ONO[1], AND T. SATO[1]

[1] Division of Sustainable Resource Engineering, Faculty of Engineering, Hokkaido University, Sapporo, Japan
*correspondence: totake@eng.hokudai.ac.jp
[2]Department of Earth Science, Graduante School of Science, Tohoku Univeristy, Sendai, Japan
[3]Center for Research Promotion, Research Institute for Humanity and Nature, Kyoto, Japan

Volcanogenic massive sulfide (VMS) deposits were formed by ancient submarine hydrothermal activity. While redox environment on the seafloor during the formation of VMS deposits may play an important role in the preservation of the sulfide ores, factors controlling the size and grade for VMS deposits have not yet been well understood. Therefore, the objective of this study is to understand formation processes of a large and high-grade VMS deposit, primarily based on Fe isotope variations in the sulfide ores and ferruginous cherts. Study samples were obtained from several VMS deposits from the Hokuroku district, Japan, as well as Palmer deposit in Alaska, USA. Ferruginous cherts from all the studied deposits show large variations in the δ^{56}Fe values (-1.55–+2.04‰) with a positive Eu anomaly, suggesting that partial oxidation of dissolved ferrous iron (Fe^{2+}) from hydrothermal fluids occurred in an anoxic water column. Ferruginous cherts in VMS deposits that are enriched in Cu tend to shift to more negative δ^{56}Fe values than others, which may reflect the ore formation processes. Because δ^{56}Fe values in Cu-rich ores were not fractionated from Fe^{2+} in hydrothermal fluids (~-0.5‰) compared to those in Zn-rich ores (<-1.4‰), near equilibrium conditions in terms of Fe isotopes may have been expected between hydrothermal fluids and sulfide ores in a large and Cu-rich VMS deposit.