Hydrothermal circulation from the geochem-data of Ni & Co in ores and igneous host rocks of Ghuzayn massive sulfide deposit, Oman.

Toshio Mizuta[1]

[1] Earth Science, Akita Univ.

Volcanogenic massive sulfide deposits are mainly divided into Cyprus-, Besshi- and Kuroko-type deposits from their geological and geochemical characteristics of igneous activities. Cyprus- and Besshi-type deposits are closely associated with MORB or Backarc basaltic rocks, on the other hand, Kuroko-type deposits are related to acidic dominant bimodal volcanism.

Characteristics of ores from the Cyprus- and Besshi-type VMSDs are very similar with abundant Cu and Zn and scarcity of Pb, Au (0.01-8ppm) and Ag (2-100ppm). The ores are remarkably enriched in cobalt and their contents are 50-15,000ppm, and nickel content range 10 to 160ppm. The ores from the most Kuroko deposits are characterized by ploy-metallic features, and these ores are abundant in Cu, Zn, and Pb with considerable amounts of Sb, As, Au (0.1-50ppm) and Ag (2-8,000ppm). These ores are moderately enriched in Co of 5-200ppm and Ni contents ranging 0 to 120ppm. The hydrothermal circulating systems within host rocks should be responsible to those chemical variations of ores from those VMSDs and seafloor hydrothermal smokers. Origin of base metals, transition elements and precious metals (Au, Ag) should be generated by hydrothermal circulation from each underlying igneous rocks. The extraction of metals in magma-heated zone might be corresponding to the concentration of related igneous rocks. Basaltic rocks generally contain larger amounts of Ni than Co, however, are deficient in Pb and Ag.

The Ghuzayn deposit is one of the typical Cyprus-type VMSD, and embedded in basaltic rocks in Oman ophiolite suite. Three larege orebodies are found by the exploration of JICA-MMAJ (1996-1999). Oceanic crust and upper mantle structures are entirely preserved, so we are able to examine the extraction, transportation and concentration processes.

The Ghuzayn ores and the host rocks are peculiar to the enrichment of Ni and Co which are the constituent of rare metals. The concentrations of Ni and Co in some Ghuzayn ores are 1-200 ppm and 10 -5000 ppm, respectively. Pyrite in VMS ores is the most representative sulfide mineral which selectively contains some nickel (10-400 ppm) and cobalt (50-50,000 ppm).

Ni and Co in sheeted dikes, weakly altered basalt lavas and altered rocks just beneath the massive ores are also analyzed. Fresh basaltic host rocks contain 7 to 70 ppm cobalt and 40 to 250 ppm nickel. This reverse relations are strongly dependent to the footwall alteration porcesses. Assuming the equilibrium of distribution reactions of Co-Fe, distribution coefficient of cobalt between pyrite and/or chlorite and hydrothermal solution are employed to the Ghuzayn pyrite, chlorite in related igneous rocks at 300 degree. Concentration data of cobalt and nickel in ores and host rocks are indicating the circulation processes of hydrothermal solution passing through the oceanic crust.