Organic matters and acid-sulfate alteration in Itomuka Mine, Hokkaido, Japan: implications for the transportation and deposition mechanisms of mercury

*Takuya Echigo[1], Mitsuyoshi Kimata[2], Masahiro Shimizu[2]

1. Graduate School of International Resource Sciences, Akita University, 2. Graduate School of Life and Environmental Sciences, University of Tsukuba

We investigated the ore and hydrothermal alteration minerals and solid organic matters from Itomuka mercury mine which is located in the eastern part of central Hokkaido to examine the transportation and deposition mechanisms of mercury. In addition to the ore minerals, native mercury and cinnabar, powder X-ray diffraction (XRD) analysis showed that the mercury ore consist of quartz, marcasite, alunite, kaolinite and minor amounts of pyrite and smectite. This mineral assemblage suggests that mercury deposition occurred with the advanced argillic alteration under low temperature and low pH condition. Two types of solid organic matter were recognized in quartz vein by yellow-green fluorescence under the ultraviolet radiation: (1) film-shaped organic matter occurring on the surface of quartz vein and (2) globule-shaped organic matter filling pores of quartz vein. Both of these organic matters occur with mercury minerals, cinnabar, native mercury and calomel (Hg_2Cl_2). These organic matters were analyzed with SEM-EDS, micro-X-ray diffraction and micro-FTIR. SEM-EDS analysis showed that film-shaped organic matter is closely associated with mercury and silica minerals though globule-shaped organic matter is not associated with such minerals. Micro-FTIR spectra of both organic matters are similar and suggested that these contain aromatic rings, carboxyl group (-COOH) and adamantine ($C_{16}H_{10}$). Micro-XRD showed that film-shaped organic matter consists quartz, opal- and adamantine crystals and globule-shaped organic matter consists of quartz and amorphous organic matter, respectively. The occurrence of these organic matters suggests that hydrothermal fluid which transported mercury was highly reduced. Because the solubility of Hg in acidic fluid is low, neutral to alkaline fluid seems to have leached mercury from the basement sedimentary rocks of Hidaka formation. The mercury-bearing fluid ascended along the faults in Itomuka formation and oxidized at near the surface. Reduced sulfur (HS^-) in the fluid oxidized into sulfate (SO_4^{2-}) and reduced pH, which resulted in mercury deposition and advanced argillic alteration. Probably, rapid oxidation of ore-forming fluid promoted the precipitation of marcasite, a metastable phase of iron sulfide. The dominance of native mercury over cinnabar indicates that mercury was transported by biphase (liquid+vapor) hydrothermal fluid.

Keywords: Mercury, Organic matter, Advanced argillic alteration

