Changes in ore fluid composition with color of sphalerite from fluid inclusion and EPMA analyses at Toyoha polymetallic deposit

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Sphalerite (ZnS) is an ore mineral that often contains Fe with lesser amounts of various metals such as Cu, Mn, In, Ag, Sn and W (e.g., Ohta, 1991). This mineral is commonly associated with galena, pyrite and chalcopyrite at Toyoha, the largest polymetallic vein-type deposit in Japan. There, sphalerite occurs as euhedral-subhedral crystals or colloform aggregates, which contain well-developed growth bandings. The color in transmitted light varies from black (opaque) through brown and orange-red to yellow and colorless with numerous intermediate shades, in plate thickness of 120-320 micrometer.

Near-infrared and visible light microthermometry reveals the data of homogenization temperature and salinity in fluid inclusion from sphalerite from possible southeast extension of Toyoha (Shimizu et al., 2003); homogenization temperature does not show significant difference between dark-colored and light-colored sphalerites within the range of 182 to 290 degree centigrade, whereas salinity is variable in dark-colored (1.0-10.3 wt% NaCl equiv.), compared to 0.7-3.4wt% NaCl equiv. in light-colored.

EPMA (Electron probe microanalyzer) quantitative analysis in sphalerite shows that the variation in iron content is the major (but not sole) cause of the color variation; the overall FeS content of various colored sphalerite ranges from 0.70 and 24.47 mole %; the FeS content of dark-colored growth zones, where fluid inclusions for microthermometric measurements exist, is from 2.39 to 23.49 mole %. Small amounts of Ag (up to 0.23 atom %) and Tin (up to 0.07 atom %) are also detected from one of the dark-colored growth zones in a single crystal.

These fluid inclusion and EPMA data indicates that fluids salinity was a more critical factor responsible for transporting various metals (e.g., Zn, Fe, Ag, Sn) rather than temperature.

This study suggests that detailed correlation of growth zones of sphalerite with various color from one crystal to another in the same sample and eventually with other samples and other parts of the mine is essential to understanding many aspects of ore deposition, such as nature of trace element distribution, the chemistry of ore-forming fluid, and eventually cause of the ore deposition.

References

Ohta, E. (1991) Polymetallic mineralization at the Toyoha Mine, Hokkaido, Japan. Mining Geology, 41, 279-295.

Shimizu, T., Aoki, M. and Kabashima, T. (2003) Near-infrared and visible light microthermometry of fluid inclusions in sphalerite from a possible southeast extension of the Toyoha polymetallic deposit, Japan. Resource Geology, 53, 115-126.