Ore formation processes in a submarine hydrothermal ore deposit in Izena Hole, Okinawa Trough: comparison with Kuroko deposits

*Tsubasa Otake[1], Takuro Ikeshima[1], Tsutomu Sato[1], Jun-ichiro Ishibashi[2], Tatsuo Nozaki[3], Hidenori Kumagai[3], Lena Maeda[3], CK16-05 Onboard members

1. Hokkaido University, 2. Kyushu University, 3. JAMSTEC

Construction of an appropriate ore deposit model is prerequisite for exploration and development of any type of ore deposit, including the submarine hydrothermal ore deposits found in Japanese economic excusive zones. However, their internal structures beneath the seafloor and evolution of ore mineralogy throughout hydrothermal activities have not been well understood. The CK16-05 cruise, operated from November to December, 2016 under SIP program, drilled through submarine hydrothermal ore deposits in the central part of Izena Hole, Okinawa Trough to investigate mineralogical, geochemical, and geophysical characteristics of both mound and lower sulfide deposits at the site. In this study, we are focused on C9027A and B cores, which drilled through a mound sulfide deposit to investigate mineralogical and geochemical changes in the sulfide ores with increasing depth from the seafloor and to compare the ore distribution and formation processes with Kuroko volcanogenic massive sulfide deposits, which were formed by ancient submarine hydrothermal ore deposits.
Results of microscopic observations with a reflecting light and SEM-EDS demonstrated that, samples at shallow depths are dominated by sphalerite and galena. In contrast, sample from the middle to deeper depths are more abundant in pyrite and chalcopyrite, and pyrite, respectively. The mineralogical change in the submarine hydrothermal ore deposit was comparable to that of some Kuroko deposits, such as Matumine deposit in the Hokuroku district. Our previous study using Fe isotope suggests that such a distinct ore zonation in Matsumine deposit is governed by replacement of sphalerite- and galena-rich ores by chalcopyrite- and pyrite- rich ores during long-term hydrothermal circulation. Based on the similarity in the ore distribution with depth, the mound sulfide deposit was also likely to be formed by the same processes. On the other hand, pyrrhotite and anglesite, which are rarely found in Kuroko deposits, are present in samples from the shallow part in the submarine hydrothermal ore deposit. Textural evidence indicates dissolution of pyrrhotite and replacement by pyrite or marcasite with increasing depth. Decrease in Fe content in sphalerite with increasing depth suggests that sulfur and oxygen fugacity in the hydrothermal fluid was higher in the depth. The formation of pyrrhotite and the subsequent transformation to pyrite or marcasite in the submarine hydrothermal ore deposit was likely caused by such change in the fluid chemistry.

Keywords: submarine hydrothermal ore deposit, SIP, Kuroko deposit, replacement reaction

