Physical Properties of massive sulfide samples at the Iheya North Knoll Hydrothermal Area, Off-Okinawa, Japan

*Tada-nori Goto[1], Yusuke Ohta[1], Yosuke Teranishi[1], Weiren Lin[2,1], Takafumi Kasaya[2], Hideaki Machiyama[2], Toshiya Kanamatsu[2], Yukari Kido[2], Osamu Tadai[3]

1. Graduate School of Engineering, Kyoto University, 2. Japan Agency for Marine-Earth Science and Technology, 3. Marine Work Japan Ltd.

Seafloor massive sulphides (SMS) around seafloor hydrothermal active zone are attractive due to the general growth trend of global economical activities. Since the SMS is located below the deep seafloor, which restricts a number of boreholes for land-based mineral explorations, deep seafloor geophysical surveys (e.g., electromagnetic, magnetic, gravity and seismic surveys) are conducted to image the detailed distribution of SMS below seafloor. However, the complicated lithological structure around SMS interrupts the good interpretation of sub-seafloor structure by using sole geophysical technique. For example, low resistivity value is expected for SMS, but the evaluation of amount of metal deposits is not enough only from the resistivity structure.
In this study, we try to include the physical properties (and amount of metal deposits) obtained from laboratory experiment using rock core samples to add better constraint to the joint inversion, recently used for physical models based on the geophysical explorations. The rock samples of SMS were obtained by ROV and submersible exploration around the hydrothermal active areas in the Okinawa Trough, Japan. From 21 core samples, resistivity, density, porosity, natural remanent magnetization (NRM) are measured. The chemical components are obtained by X-ray fluorescence (XRF) analysis.
The measured result indicates a correlation between resistivity, NRM, density and concentration of metal. For example, the resistivity values measured in laboratory indicates pretty low features. The resistivity cannot be explained by the conventional Archie’ s law, and modified one (called as parallel circuit model). We newly develop a rock physics model of resistivity for massive sulphide in this study. In our model, a direct connection term between conductive solid and conductive liquid to the conventional model. As a result, our new model well explains the measured resistivity trend, especially samples including large amount of pyrite. The contribution of conductive material in rock sample indicates high correlation to the amount of Cu, Fe, Zn. We conclude that the higher conductivity of rock matrix and higher NRM are possibly relates to the high metal contents and can be a good index for mineral deposits.

Keywords: Hydrothermal Area, Massive Sulfide, Rock Physics

