Physical property of rock cores of submarine hydrothermal deposits and its application to the geophysical joint inversion

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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. 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 inversion of gephysical data set. 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 result indicates a correlation between resistivity, NRM and concentration of metal. 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. Based on the laboratory measurements, we carried out the 3D joint inversion to estimate the reasonable geological structures. Two different physical parameters such as resistivity and magnetization can be modelled simultaneously with guide of known (initial) end-members of parameters. The joint inversion results show better accuracy and resolution than the individual inversions.