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海底熱水鉱床周辺における AUV を用いた電磁探査
Electromagnetic survey around the seafloor massive sulfide using autonomous underwater vehicle

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The recent growth of world-wide requirement of metals demands advanced explorations for finding metal mine and deposits. The feasibility studies demonstrated that the electromagnetic responses are very sensitive to the conductive layer simulating the submarine massive sulfide (SMS) deposits, which is buried at the depth of several tens meters. On the basis of the results, we developed instruments for the marine controlled-source electromagnetic (CSEM) survey with autonomous underwater vehicle (AUV), on which a transmitter was attached. For the real field test, R/V Yokosuka and AUV Urashima were used. The target region is a real deep-sea mine in a caldera structure called Bayonnaise, located in the Izu-Bonin island arc, south of Japan. We succeeded in the test experiment along four survey lines with current shooting from AUV. Six ocean-bottom receivers (OBEM) simultaneously recorded those signals. The maximum source-receiver distance, in which we can detect the artificial current signals, exceeds to about 500m. Therefore, the inferred maximum sounding depth will be 150m or more below the seafloor. For evaluating the anomalous attenuation or amplification of received electric field at OBEMs, the three-dimensional forward modeling including the real bathymetry and a simple subsurface structure having an uniform resistivity (1 Ohm-m) was employed. Comparison between the observed and synthesized received field gives us a three-dimensional pseudo-section of anomalous received field, which can visualize heterogeneity of sub seafloor structure qualitatively. On the basis of the preliminary result of our AUV-CSEM survey around the SMS, high conductive features are observed not only in the SMS exposed area, but also the surrounding area of SMS. It would reflect both the mineral deposits in and around the SMS and highly conductive pore water below the surface due to warm temperature by hydrothermal activities below the SMS. We conclude that our new technology imaging the near sub-seafloor structures will be useful for discussion about the geological background of SMS, and also be a powerful tool for the SMS detection and developments.

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