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Development of controlled-source EM survey using AUV and ROV

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The recent growth of world-wide requirement of metals demands advanced explorations for finding metal mine and deposits. Here we propose a new way for exploration of buried submarine massive sulphides with marine controlled-source electromagnetic technique, and magnetic survey. The result of latter suvey is introduced by Sanayagi et al. in this session. We demonstrated feasibility studies using various marine electromagnetic soundings: magnetometric resistivity (MMR) survey, CSEM survey and marine DC resistivity survey. As a result, we confirmed that the electromagnetic responses of each marine electromagnetic survey are very sensitive to the conductive layer simulating the submarine massive sulphide deposits, which is buried at the depth of several tens meters. For example, we demonstrated a CSEM survey with AUV-based source and OBEMs (ocean bottom electromagnetometers). A numerical simulation code for 2.5 dimensional electromagnetic field in the frequency domain is developed. The results shows high attenuation of received signal strength by OBEMs even with far source-receiver offset, when the source-AUV is arranged near the conductive seafloor. It implies a possibility of detection of horizontal extent of deep-sea mine. More quantitative modelling will allow the detailed sub-seafloor structure of deep-sea mine. On the basis of these numerical results, we newly developed our own controlled-source EM survey system for AUV and ROV. One of the instruments, the ROV-based marine DC resistivity survey system, was tested at a real deep-sea mine. The obtained data shows relatively conductive feature compared to the surrounding area. We confirmed a efficiency of our new CSEM survey system with ROV and AUV on imaging the distribution of exposed and buried deep-sea mine.

Keywords: deep-sea mine, controlled-source, EM survey, ROV, AUV