Advances in Marine Electromagnetic Instruments and Data Processing Techniques

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In this presentation, we will report on advances in marine electromagnetic data acquisition system and data processing techniques at the EM laboratory of Ocean University of China (OUC). A new type of broadband Ocean-Bottom ElectroMagnetic (OBEM) receiver has been recently developed at OUC. The OBEM receiver collects three components of the electrical field and two horizontal components of the magnetic field. Our receiver is capable of resisting water pressure to depth of 6000 meters. We have seen more than 100 deployments with 100% recovery rate. We also have developed a new transmitter for the marine CSEM sounding. The transmitter can deliver up to 1500A currents into a neutrally buoyant antenna of 200m long. It was deep-towed at the end of a cable containing three optical fibers that is used to power the transmitter and for telemetry between the deep-towed transmitter and the shipboard control console. The transmitter has been successfully tested in the Yellow Sea and in the Southern China Sea. 3D modeling of electromagnetic fields is of vital importance for interpreting EM data collected in complex geologic settings. We developed two numerical algorithms for modeling 3D marine CSEM fields. One is the goal-oriented adaptive edge-based finite element (FE) algorithm, which can simulate marine CSEM responses in 3D arbitrarily anisotropic conductive media. The other is the high-order finite difference time domain algorithm for modelling marine CSEM responses in both the fictitious time domain and the diffusive frequency domain, which facilitates the full exploration of EM diffusive properties in the fictitious wave domain. Concepts, such as reflection, refraction, diffraction and transmission, can be adopted for interpreting marine CSEM data.

Keywords: Electromagnetic Instruments, Data Processing, 3D Moddeling