Inter-station Impedance for Nearshore Seafloor Magnetotelluric

Y. Zhou[1], D. Yang[2]
[1] Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), Southern University of Science and Technology, China, zhouy@sustech.edu.cn
[2] Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), Southern University of Science and Technology, China, yangdikun@gmail.com

SUMMARY

Amphibious MT surveys involving land and seafloor stations require ocean-bottom EM (OBEM) instruments to be deployed in shallow waters. We present an economical replacement for the traditional OBEM by using the concept of inter-station impedance that measures the magnetic field on land near the coast and the electric field on the seafloor. There are difficulties in deploying magnetometers onto the seafloor with shallow waters as they are vulnerable without proper protection against water intrusion, and the seafloor magnetic field can be highly disturbed by seawater current and other electromagnetic (EM) interferences. This configuration can significantly simplify the instrumentation in water and allow a dense coverage of electric field data from the seafloor. We present the calculation of inter-station impedance for nearshore magnetotelluric (MT) surveys and apply it to the synthetic Littoral Fault Zone (LFZ) model inspired by the seismic model at the northern rim of the South China Sea. We conduct sensitivity analysis using the elementary effects (EE) method on the fault's resistivity and geometric parameters (depth, dipping angle, width) for both inter-station and regular impedance. The EE method quantifies the influence of each parameter with the sensitivity measures, mean, and standard deviation, and this information can indicate the influence type of each model parameter on the MT responses. The analysis shows that inter-station impedance produces similar influence patterns to regular impedance for most LFZ model parameters. Furthermore, we conduct synthetic LFZ model inversion using MARE2DEM code for both inter-station and regular impedance; the inversion models show that inter-station impedance can effectively recover the conductive fault zone. Our results suggest that inter-station impedance can be an alternative to the regular impedance for nearshore seafloor MT.

Keywords: Magnetotelluric, Inter-station impedance, Nearshore, Sensitivity analysis, Inversion