Deep Sea Self Potential and (S)IP Measurements of Seafloor Massive Sulfides

K. Schwalenberg[1], H. Müller[1], and J. Börner[2]
[1]BGR- Federal Institute for Geosciences and Natural Resources, Hannover, Germany;
katrin.schwalenberg@bgr.de
[2]TU Bergakademie Freiberg, Institute of Geophysics and Geoinformatics, Freiberg, Germany

SUMMARY

GOLDEN EYE is a deep-sea multi-sensor platform to conduct CSEM, self potential (SP), along with spectral and time domain induced polarization ((S)IP) measurements. As part of the German activities for seafloor massive sulfide (SMS) exploration in the Indian Ocean, we have collected detailed data sets on several confirmed active and inactive SMS sites. A unique feature of our survey strategy is that we collect data from three electric field components using excitations from two horizontal source dipoles, and measure SP data both near seafloor as well as about 50m above seafloor. While we can clearly correlate anomalies in SP and (S)IP data with video observation of active and inactive sulfides at the seafloor, the source and mechanisms of the anomalies may not yet be fully understood. Strong (S)IP effects are known from sulfidic rocks caused by the dominating interfacial conductivity. SP effects may originate from the battery model of a conductive (sulfide) body connecting areas of different redox potential as proposed by Sato and Mooney, or to circulating hydrothermal fluids at and below the seafloor. Separating these effects by modeling is difficult and is complicated by the complex small-scale mid-ocean ridge bathymetry. We are currently analyzing systematic behaviors in both, SP and (S)IP data to prepare for higher-dimensional modeling of the underlying sulfide bodies, which is a prerequisite for possible future in-situ drilling and production tests.

Keywords: deep-sea self potential and (S)IP measurements, seafloor massive sulfide exploration

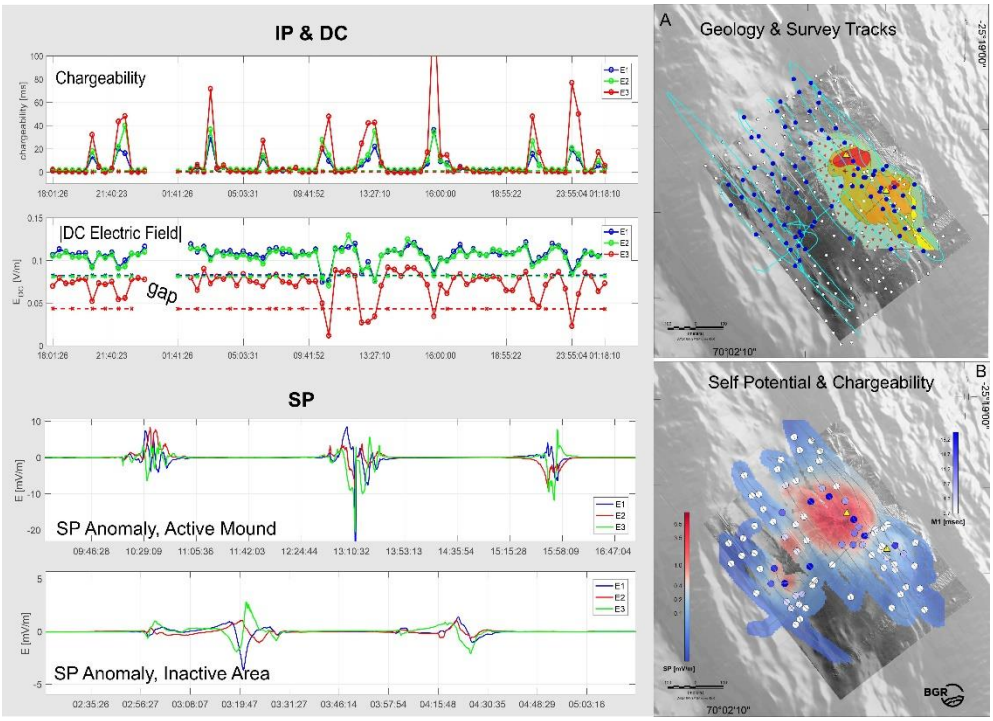

Figure 1: Geoelectrical (IP chargeability and DC electric field) profiles (top left), and SP profiles over active and inactive sites (bottom left) at the known KAIREI hydrothermal field at the southern central Indian Ridge. Right panels show the geological interpretation of the KAIREI double mound and Golden Eye tracks (top), and SP and IP intensities (bottom), which ae highest over the active mound.