Exploring of conductive black Shales using The RadiomagnEtotelluric Method

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Radiomagnetotellurics (RMT) is a relatively new electromagnetic method of applied geophysics which is extensively used in connection with near surface exploration in the last years. A RMT survey was carried out on four profiles to characterize near surface conductive black shales existing on the boundary between Lias and Dogger lithostratigraphic units at the research area Bramsche in Germany. The profiles are oriented perpendicular to the assumed strike direction of the black shale formation. Electric and magnetic fields of existing radio transmitters broadcasting in a frequency range between 10 kHz and 1 MHz were measured at 192 RMT stations on these four profiles. A five component RMT device was used in the survey. The distribution of radio transmitters in Europa is dense enough for using their plane waves to estimate RMT transfer functions. Time series of observed electric and magnetic field series are processed to derive the frequency-dependent apparent resistivity and the phases at each RMT station. In addition, we derived frequency-dependent transfer functions for the vertical magnetic field at each station in the RMT frequency range for the first time. They were also considered in the inversion procedure.

The observed apparent resistivity and the phase functions on each profile, which are associated with the TM mode, are jointly inverted with the transfer functions of the vertical magnetic field using the 2D inversion. A very good fitting between observed and calculated transfer functions is achieved.

The 2D conductivity models clearly show a 20 m wide conductivity zone at a depth of about 10 m which is clearly associated with the black shales in the subsurface. The derived results are compared with the existing DC-resistivity and induced polarization surveys of the same area. They show a very good agreement.