3D inversion of Radio-magnetotelluric data for the investigation of a fault zone in Sub-Himalayan region (India)

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SUMMARY

We conducted radio-magnetotelluric (RMT) measurements to investigate the Himalayan frontal thrust fault (HFT) in the Sub-Himalayan region Uttarakhand in India in the framework of the Indo-German joint research collaboration (DST-DAAD). The overarching aim is the geo-electrical characterization of the fault zone, including the investigation of the fault inclination and orientation, as well as the determination of the sediment thickness in the survey area.

The data acquisition was carried out using the RMT SM-25 system, which consists of a receiver unit, two electrical antennas to observe the electric fields, and three magnetic coils to measure the magnetic fields. This enables the estimation of the full RMT impedance tensor and the transfer function for the vertical magnetic field. The RMT method utilizes frequencies between 10 kHz and 1 MHz and is therefore applicable for shallow subsurface investigations. We measured on eight parallel profiles with a profile separation and a station interval of 10m. In total data were acquired at 312 stations in an area of 500x70 square meters. The dense station distribution allows for a subsequent 3D inversion of the dataset. To account for a 3D conductivity distribution, we applied a full component tensor estimation of the impedances.

Here, we provide an overview over the data quality and the most crucial data processing steps. We present a comparison of the 3D model outcomes, derived from the scalar, tensor off-diagonal, full-impedance tensor, as well as a joint inversion with Tipper data. The derived 3D conductivity model shows a conductivity contrast zone, which correlates well with the outcrop of the HFT fault in the survey area and complementary geological information. In addition, the modelled geo-electrical characteristics within the area of investigation clearly exhibited the local sediment thickness as well as the fault inclination.

Keywords: Radiomagnetotellurics, HFT fault, ModEM, 3D Inversion, Sub-Himalayan