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Application of electric and electromagnetic prospection methods for the investigation of geological fault zones

G. Schaumann, T. Günther, P. Musmann, and M. Grinat
Leibniz Institute for Applied Geophysics, Hannover, Germany

Electric and electromagnetic prospection methods are applied in combination and investigated concerning their ability to image geological fault zones with depths up to a few km. Faults are prominent targets to explore because they bear possible flow paths for hydrothermal fluids. Therefore resistivity can become a valuable key parameter.
Within the German Research Association gebo (Geothermal Energy and High Performance Drilling, www.gebo-nds.de) the electric/electromagnetic methods are operated alongside with the seismic exploration method. While seismic investigations yield information about the subsurface structure, electric and electromagnetic methods supplement these results with their ability to provide information about the resistivity distribution. Commonly used survey setups are analysed with respect to their investigation depth. Non-standard large-scale DC resistivity measurements in a dipole-dipole configuration energized by a high current source were applied in the field. Furthermore, Transient electromagnetic (TEM) soundings with a high transmitter moment were carried out. The setup in the field was modified in order to reach greater investigation depths. The course of seismic reflectors was incorporated into the inversion of the DC resistivity data by structural constraints.
Especially thin low-resistive layers, detected by a 1D interpretation of the TEM data show a correlation to the seismic reflectors. While the 2D DC results give information about the resistivity structure of the fault zone, layers of low resistivity that are poorly determined with the DC measurements can be observed with an adapted TEM survey setup.
After an initial investigation of known shallow fault zones more emphasis will be attached to the exploration of deeper structures in the subsurface, significant for geothermal tasks. A concept for a suitable field survey design is under development, especially adapted to the specific geological features in the sedimentary basin of Lower Saxony. Overall aim is the application of a joint strategy for the investigation of fault zones by electric/electromagnetic measurements that are useful for geothermal application prior to or while drilling activities.