Discontinuities detection using transmission electrical resistivity imaging

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The underground platform of Tournemire (Aveyron, France) presents the opportunity to perform in-situ experiments to evaluate the potential of geophysical methods to detect and characterize the presence of discontinuities in the sub-surface. In this work, we apply transmission electrical resistivity tomography to image the medium surrounding a regional fault. The studied Cernon fault presents a thickness of a ten of meters and drives water from an aquifer circulating at the top of a clay layer to the tunnel of Tournemire. A specific array of electrodes were set up, adapted for the characterisation of the fault. Electrodes were placed along the tunnel as well as at the surface above the tunnel on both sides of the fault. The objective of a such geometry is to acquire data in transmission across the massif in addition to classical protocol such as Schlumberger or dipole-dipole in order to better cover the sounded medium. 3D models considering the gallery geometry, the topography and the injection of current in transmission through the massif were developed for the analysis of such particular data sets. For the reconstruction of the medium electrical resistivity, the parametrization of the inverse problem was adapted to the geometry of the experience in a scope to reduce the inversion under-determination. The resulting image obtained with classical protocols and transmission current injection is compared to an image obtained using only classical protocols to better highlight the intersest of a transmission experiment in terms of resolution and penetration depth. The proposed configurationof electrical resistivity measurements in transmission is promising for hydrogeophysical studies, in particular for studies of karstic system where natural cavities could be used for electrodes deployment.