Abstract

The present thesis deals with estimation of soil/rock properties (cohesion, plastic index, moisture content, and angle of friction) in lateritic terrain and coal mining areas using 2D and quasi-3D Electrical Resistivity Tomography (ERT). Quasi-3D ERT subsurface structures are delineated by inverting collated parallel 2D ERT profiles. An electrical resistivity survey effectively demarcates the aquifer zone, subsurface cavities, and coal seams. The efficacy of the 2D and quasi-3D ERT was initially investigated by considering several theoretical models. Subsurface structures were obtained after the inversion of Wenner, Wenner-Schlumberger, and Dipole-dipole array data sets to examine conventional anomalies with varying complex geological conditions. Suitable electrode configurations were used in the study area by considering the forward modeling' and inversion results initially. According to the study in the lateritic area (Kharagpur, West Bengal, India), Wenner and Wenner-Schlumberger array yield better results than the Dipole-dipole array for detecting the aquifer zone. In contrast, quasi-3D ERT with a Dipole-dipole array is ideal for delineating subsurface cavities and high-resistive geological layers, such as coal seams in mining areas (Salanpur, West Bengal, India). Subsurface cavities were responsible for ground subsidence in the local area. The study demonstrates the sensitivity analysis of ERT arrays to choose the best electrode configuration for acquired real-field data. Subsequently, results from combining data sets of Wenner with the Gradient array and Dipole-dipole array were analyzed to improve the resulting models. Conversion of resistivity measurements into geotechnical parameters by established mathematical relationships is used to understand the subsurface structures compressively in the areas of interest. Cohesion, plastic index, moisture content, and angle of friction provide insight into soil behavior, while resistivity values provide information about materials' electrical properties. Compared with traditional laboratory analysis of borehole samples, the ERT method proved cost-effective and efficient in determining soil properties over a large area. Quasi-3D ERT overcomes the challenges of 2D ERT by evaluating the horizontal depth slices in three dimensions. Such studies are valuable for deciphering potential groundwater zones, coal seams, subsurface cavities, resource exploration, and mine planning purposes.

Key Words: 2D and quasi-3D ERT, inversion, laterite, aquifer, subsidence, coal, geotechnical parameters