Abstract

The growing interest in engineering and environmental problems demands increased subsurface geological information. Geophysical investigations provide valuable information for characterizing a variety of subsurface properties. The objectives of this thesis are to evaluate geophysical techniques in different near-surface applications. These include the following: 1) Detecting clay beneath sand using seven methods encompassing geoelectrical, ground-penetrating radar and seismic methods; 2) Comparing the resolution and depth penetration of ground-penetrating radar, using two field techniques, with those of the shear-wave reflection method; 3) Comparing the volumetric water contents obtained from resistivity with those from ground-penetrating radar, in combination with empirical relationships; 4) Comparing the results of compressional- and shear-wave refraction and surface wave data, analyzed using three processing techniques, followed by a comparison of shear moduli calculated from shear-wave velocities, with those determined from empirical relationships. Two test sites in southwestern Sweden were investigated, at Härryda and Veddige, where clay below sand is documented by drilling. The results show that (1), the resistivity method was best able to identify the clay layers, using other methods to constrain modelling and interpretation. The shear-wave reflection method gave information about both the upper and lower boundaries of clay, although a qualitative interpretation is difficult without complementary geological or geophysical information. It is shown that (2), the multi-offset ground-penetrating radar method gave better resolution and depth penetration in sand, but not in clay, compared to the conventional common-offset method, and that the shear-wave reflection method provides a viable alternative to radar in conductive materials, and increases the depth of investigation obtained by radar. The results obtained by resistivity and ground-penetrating radar (3), show very similar trends of water-content distribution in the unsaturated zone, although absolute values differ somewhat, and a good agreement between the methods is achieved in the saturated zone. Finally (4), the best method for processing seismic refraction data depends on geological conditions. Conventional methods are recommended if high-contrasting velocity layering is present, whereas if the subsurface is characterized by gradational velocity changes, the tomography method is better. The multichannel analysis of surface waves resolved low-velocity zones below high-velocity zones. The empirical relationship for sand gives higher values for shear moduli than those calculated from shear-wave velocities.

Keywords: Ground-penetrating radar; resistivity; seismic reflection; seismic refraction; surface waves; induced polarization; water content; porosity; shear modulus; clay; sand; southwestern Sweden.