Hydrogeophysical Characterization of Anisotropy in the Biscayne Aquifer using Multi-Electrode Resistivity Imaging System

The use of geophysical method to characterize hydrogeologic parameter such as anisotropy and hydraulic conductivity is one of the fundamental objectives of hydrogeophysics investigation in the subsurface. Electrical anisotropy plays a crucial role in estimating the orientation of porosity and fluid flow in porous media.

Anisotropy is often measured by deploying a linear DC resistivity array along a range of directions and plotting the measured apparent resistivity as a function of azimuth to define the anisotropy eclipse. The alternative to the cross-over linear array is the square array where the current and potential electrodes are deployed on opposite sides or on diagonal vertices of a square. The square array has several advantages over the linear array, including faster set up time, smaller area requirement and greater sensitivity to anisotropy.

In this study, a 28-electrode resistivity imaging system was used to investigate anisotropy in the Biscayne aquifer using both Wenner cross-over linear array and square array. In the square array the electrodes were placed at equal distance on a circle forming 7 separate square array configurations at 12.86° interval. The radius of the circular array was expanded from 4m to 32m in order to investigate the variation of anisotropy with depth. Measurement at all radii resolved a well defined anisotropy eclipse with a co-efficient of anisotropy around 1.1 and a direction of maximum apparent resistivity around 60° NE-SW direction.

This anisotropy might be due to enhanced secondary porosity perpendicular to the maximum apparent resistivity. This study demonstrates that even small values of anisotropy may be effectively and efficiently measured with a multi-electrode resistivity system.