GEOPHYSICAL ASSESSMENT OF DEEP KARST UNDER AN EMBANMENT DAM INF FLORIDA USING THE MULTI-ELECTRODE RESISTIVITY IMPLANT TECHNIQUE (MERIT)

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The use of geophysical assessment of dams in deep karst environments can yield valuable information for such complex geology. One of the most used methods in the assessment of dams over karst is electrical resistivity (ER). ER has progressed from 2D resistivity curves to inversion of complex array patterns that produce image. There are however limitations to the current data collection and inversion methodology that prevents higher resolution and higher quality images. These limitations are based on the geometry of array and data collection that results in trapezoidal-shaped inversion data set with decreasing data at depth.

As electrode spacing i.e. 1a, 2a, 3a, etc. increases, the number of measurements decreases for each progressively deeper data level. This is a fundamental limitation of the technique and this results with an inversion of progressively less data the deeper the survey, thus lower resolution images. The bottom third of the surface ER represents only 10.5% of the data for the inversion. The reduced data with depth results in a trapezoidal image that has approximately 40% blank space of the total rectangular area dir3ectly below the array. In practice this results in the inability of the ER image to collect information on the abutments of embankment dams and has low resolution at depth.

A unique technique called the Multi-Electrode Resistivity Implant Technique (MERIT) overcomes some of the fundamental limitations of surface ER. MERIT utilizes a combined surface array and array of small permanent implants driven to depths of up to 50 feet. The tomographic configuration of the surface and deep buried array results in overlapping field density that significant increases data acquisition of up to five times and can increase the depth by third to twice that typical surface ER array. At depth the overlapping fields of MERIT optimized data collection significantly increases the data points in the lower third of the inversion that results in higher resolution than surface ER. The MERIT image is a full rectangular image and as such can be used to evaluate the ends of the array such as at image abutments of an embankment dam.

A case study is presented an embankment of a dam in Florida where deep buried sinkhole features were identified over 250 feet deep. Due to the higher resolution of the MERIT images, the location and measurements of the sinkhole throats were possible and were encountered at depths of 100 feet. The permanent implants are being utilized to perform 3D surveys of the sinkhole features and are being incorporated into the long-term monitoring plan for the site.