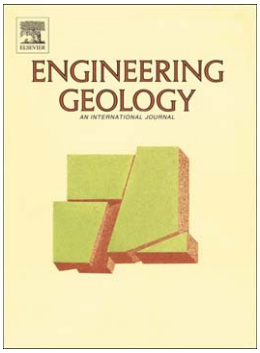

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Combined microgravity, electrical resistivity tomography and induced polarization to detect deeply buried caves: Algaidilla cave (Southern Spain)

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Abstract

The suitability of the combined microgravity and electrical tomography to detect and characterize caves deeply buried in limestones is tested. We have selected the buried Algaidilla cave, in the Estepa range (western Betic Cordillera), which is partially submerged below the water table and which was intersected between 26 and 66 m in depth by two boreholes. At that location, microgravity, electrical resistivity tomography (ERT) and induced polarization (IP) data was collected along four profiles. Algaidilla cave is associated with a -0.5 mGal residual gravity anomaly minimum. Microgravity models reveal an approximately horizontal N-S elongated shape with a maximum length of 150 m and a width of 40 m. Resistivity variations provide information on the cave sectors remaining above, as well as below the water table. Forward modeling and depth of investigation (DOI) support the suitability of ERT to constrain the cave geometry. The cave is identified as having an intermediate to low-resistivity feature, which approximately matches the 250 ohm·m contour line along its ceiling. In addition, induced polarization models show high chargeability anomalies probably associated with decalcification clays. The location and approximately geometry of Algaidilla cave estimated from geophysical modeling suggests that nearby overburden may develop cave-ins and collapse sinkholes. Microgravity is proved as a powerful tool to detect caves at this depth, but this method alone fails to estimate the geometry. ERT results delineate the cavity both above and below the water table. Although the deepest sectors of the models should be interpreted with caution since they are less constrained by the data, below the water table the cavity shows great resistivity contrast with regard to the background carbonate. In addition, this study points out the usefulness of the IP method for detecting decalcification clays, often present at the base of karstic caves.

Keywords: Microgravity, electrical resistivity tomography, induced polarization, deep-cave geometry, DOI index, forward modeling.