



Comparing the suitability of geophysical methods in the study of a cave in marbles: A case study of Gruta de las Maravillas (Aracena, Southwest Spain)

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Different geophysical methods have been applied to determine the geometry of caves, considering the host rock, depth, dimension, presence of water and other parameters. The Gruta de las Maravillas cave is located in marbles interlayered with gneiss, quartzite and granodiorite along the suture between South Portuguese and Ossa Morena zone. This cave is probably formed as a consequence of the presence of pyrite and iron oxides mineralization that interacted with the surrounding marble host rocks. In order to analyze the continuity of the Gruta de las Maravillas cave (Aracena, southwest Spain) geophysical methods has been used on the known cave in order to check their suitability. These results allow investigating the prolongation of the cave in surrounding areas, performing a comprehensive study of the Cerro del Castillo hill containing the cavity. Microtopography with differential GPS and cave topography with an accuracy of 0.01 m were measured. The first geophysical method employed were a regional microgravity, with and SCINTREX CG-5 gravimeter that reaches an accuracy up to 0.001 mGal. In the obtained residual anomaly map, negative values are associated with negative density contrast, which are related to the known cave position. In addition, residual gravity minima suggest the presence of other unknown cavities. The anomalies attributed to possible new shallow and deep caves have been studied in a second step with the application of other eight detailed geophysical methods along profiles to test the response of each of them to the presence of cavities: microgravity, magnetic, electrical resistivity tomography, induced polarization, seismic P-waves velocity tomography, ray tracing coverage, common offset and ground-penetrating radar. Moreover, the known cave has walls covered with iron oxides that determine magnetic anomaly minima and intermediate resistivity values (~ 2000 ohm.m) on the ERT profiles versus the host marble rocks (~ 45000 ohm.m). After a detailed comparison of each method, the best results are obtained by microgravity and ray tracing coverage. Other methods allow to support and precise the cave geometry obtained. The possible continuity of the known Gruta de las Maravillas cave is proposed after this detailed study, practically doubling the extent of present day known cave.