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Continuity among three-consecutive Brazilian caves established by a geophysical approach

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For seldom investigated Brazilian caves, detailed non-invasive mapping is crucial for environmental, ecological, and geological investigations. However, the Cerrado region of Brazil hosts covered karst (underlain by a thick clayey layer) which makes its non-invasive mapping difficult using the readily available tools. In this study, we applied a geophysical technique to establish the linkage (continuity) among the three caves named *Trimba, Pasto de Vaca I*, and *Pasto de Vaca II* in the environmentally protected area of River *Vermelho,* Goias, Brazil.

Our analysis started with the optimization of the electrode array geometry and its depth of penetration in the area. A forward model was chosen based on the site where the river enters the cave and soil-clay-carbonate lithological contacts are exposed on the surface. As there are well-developed drainage networks and cave development is attributed to fluvial influences that still have subsurface water flows in most of the places. Therefore, buried streams were also considered in the numeral approximation study. Findings from the numerical simulation indicated that the best results could be obtained using either the dipole-dipole, pole-dipole, or Wenner-Schlumberger array configurations, with an inter-electrode spacing of 2.5 meters.

Hence, a dipole-dipole array of electrodes was selected to acquire the DC electrical resistivity data. Considering the objective of the study, the measurements were carried out using 72 electrodes were spaced 2.5 m apart and arranged in seven electrical resistivity tomography (ERT) profiles perpendicular to the one end of *Trimba cave*, covering the entire length of *Pasto de Vaca I* and the beginning of *Pasto de Vaca II* cave marked on existent caves topography.

In the first stage of resistivity data processing, a manual inspection and consequent removal of bad data points to improve the inversion results were conducted seeking a possible reduction in root mean square error. The inversion models, represented through 2D sections, indicated anomalous resistivity areas, interpreted as regions of subsurface cavity. Additionally, a geomodeling approach was used for improving the presentation of the inversion results (resistivity variables) in 3D. The latter revealed anomalous zones present on all profiles, attributed to the presence of a subsurface cavity.

The geophysical results made it possible to detect the continuity of the same cave from north to south, contrary to the previously held assumption about the existence of three individual caves. Results encourage the integrated application of geophysical techniques for further detailed investigations.

Keywords: Cerrado; Electrical Resistivity; Array optimization, Geomodeling