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"Hydrogeological assessment of a spring area in sedimentary terrain using geoelectrical methods in the Itaí region, São Paulo, Brazil."

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Hydrogeological assessment of a spring area in sedimentary terrain using geoelectrical methods in the Itaí region, São Paulo, Brazil.

The municipality of Itaí is located in the Alto Paranapanema region, in the southwest of the state of São Paulo. Situated within the Paraná sedimentary basin, its geology comprises Paleozoic-age events, characterized by the deposition of the Tubarão and Passa Dois groups, formed by glacial, marine, and lacustrine sediments that caused basin subsidence, compacting the materials and resulting in lithologies less favorable for water storage. Additionally, the region features Botucatu Formation sandstones, Serra Geral basalt flows, and intrusions of dikes and sills. The spring studied in this research is located within the Passa Dois group, specifically in the Passa Dois aquiclude, where rock fractures allow for some water productivity, albeit with low supply capacity (Groundwater of the State of São Paulo, 2014). This study aims to characterize the hydrogeology of the spring using geoelectrical methods, as the region is experiencing a water crisis and is dominated by monoculture. The Electrical Resistivity (ER) and Frequency Domain Electromagnetic (FDEM) methods involve techniques capable of validating hydrogeological information regarding springs. For ER, resistivity (ρ) data were collected along three lines (CE-01, CE-02 and CE-03), each 200 meters long, using the electrical profiling (CE) technique with dipole-dipole and Schlumberger arrays. Ten investigation levels were used, with electrode spacing of 5 meters. The maximum theoretical investigation depth was 33.8 meters, allowing the identification of initial features related to potential geological units and fractures. Data processing was performed using the PROSYS III software, and inversion was carried out with RES2Dinv, generating interpretive profiles. For the FDEM method, data were collected using the EM-34 instrument along three lines (EM-00, EM-02 and EM-03), with transmitter receiver coil spacings of 10 and 20 meters and frequencies of 6.4 kHz and 1.6 kHz, respectively, with 10 meters station spacing. The maximum theoretical depth reached was 55 meters, allowing for the identification of similar geological units and fractures, albeit at greater depths compared to the ER method. The data were processed with SURFER 10, also producing interpretive site profiles. On line EM-00, results showed high conductivity around the 50 meters distance and 35 meters depth mark, near the spring area, suggesting the presence of water. On line CE-01, both dipole-dipole and Schlumberger arrays revealed low resistivity at the surface and high resistivity in the center, with low resistivity breaks (fractures) around 60 to 80 meters along the profile. Field observations also noted purplish soil coloration, likely related to magnetite, possibly from a fractured sill. The Schlumberger array allowed deeper data acquisition, revealing a long zone of low resistivity that may correspond to more saturated pelitic rocks between 28.7 and 33.8 meters deep. On line CE-02 (dipole-dipole array) and EM-02, profile integration showed consistency between resistivity and conductivity data. High resistivity at the beginning of the line likely corresponds to features observed in CE-01. However, around 90 meters along the profile, there is an abrupt topographic break and soil color change, suggesting a lithological transition toward lower resistivity, particularly near the spring. On line CE-03 (dipole-dipole array) and EM-03, integrated profiles showed low resistivity at the surface and, around 100 meters into the profile, increased resistivity, which may also relate to the sill identified in CE-01. Field evidence of magnetite was again present. Additionally, zones of low resistivity were found below 10 meters depth, indicating possible saturated areas. The geophysical methods identified anomalies related to fractures, topography, and rock types based on resistivity and conductivity. Less resistive and more conductive zones indicate moist or saturated areas, useful for water prospecting. These methods proved effective in spring studies and hold potential for similar applications.