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Hydrogeological potential of Serra dos Martins sedimentar Formation, in the municipalities of Araruna and Cacimba de Dentro

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Introduction

This research presents a methodology to evaluate the water potential of the Serra dos Martins Sedimentary Formation, which is part of the Barreiras geological group, and has an important occurrence in the municipalities of Araruna and Cacimba de Dentro – Paraíba State, which constitutes a continental and marine terrigenous sedimentary cover (Arai, 2006) and is of Miocene to lower Pleistocene age (Suguio & Nogueira, 1999; Vilas Boas et al, 2001). The investigated area is part of the semiarid region of Northeast Brazil, which presents a water deficit, being this study important for the efficient planning of land use and occupation in areas that present social and economic vulnerability.

Metodology

The adopted method involves multidisciplinary integration: hydrogeophysical studies, near surface geophysical methods, petrophysical relationships used to link geophysical properties to hydrological properties and state variables, data inversion, and generation of three-dimensional models through spatial data interpolation methods. The proposed method can be replicated in the future in regions with similar geological formations. Initially, a georeferenced database was created, with cartographic bases of the entire study area referring to the sedimentary unit targeted by the project, including information on sedimentological, stratigraphic, and petrographic aspects of the lithotypes found in this unit. Rock samples were collected from outcrops and used to prepare petrographic thin sections and petrophysical analyses. The sampled lithotypes were determined and their textural aspects described. In the hydrogeological investigation stage, water samples were collected from wells already existing in the investigated region. Hydrochemical tests indicate that the groundwater in the investigated area can be classified as moderately brackish.

The geophysical method employed here was electrical resistivity in the ERT-SEV mode, with multilevel gradient array of electrodes. The parameters adopted for recording data in the field sought to reconcile the investigation depth with the resolution required in each line. The desired investigation depth was 100 meters. A maximum distance between current electrodes of 500 meters and a minimum separation of 20 meters between potential measurement electrodes were adopted, resulting in 144 measurements for each recorded geophysical line. Res2DInv software (Geotomo, 2003) was used for data processing. The geophysical lines location on the ground sought an areal distribution representative of the sedimentary body. The petrophysical tests consisted of measuring porosity and total and grain density. After constructing the spatial model of the investigated rock volume, by applying the inverse square interpolation technique, the Archie equation was applied to estimate the water-saturated pore volume. By integrating all the cells of the model, the groundwater reserve was estimated.

Results and conclusions

This work quantitatively (reserve assessment) and qualitatively characterized the groundwater of the investigated region. Considering that sandy-clayey sediments and sandstones occur in the region, when saturated with water, they present electric resistivity values between 40 ohm.m and 300 ohm.m. A 3D model of the investigated area was generated and the volume of rock saturated with water was calculated. By applying the regression function to the blocks of the model, a reserve of 85 million m³ of groundwater was estimated. The methodology here proposed can be applied in any region with similar geological characteristics.