



Assessment of probable contamination of Fortalezinha aquifers by coastal saline concentration using the correlation between Vertical Electrical Sounding and Electrical Imaging methods

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This paper was prepared for presentation during the 18th International Congress of the Brazilian Geophysical Society held in Rio de Janeiro, Brazil, 16-19 October 2023.

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Abstract

Coastal aquifers, vital sources of freshwater, are increasingly threatened by saltwater intrusion due to factors such as sea level rise, overexploitation and climate change. Accurately determining the saline concentration in these aquifers is crucial for the sustainable management of water resources and for ensuring the availability of fresh water for coastal communities. Vertical Electrical Sounding (VES) and Electrical Imaging (IE) techniques provide information on subsurface characteristics of coastal aquifers, particularly the distribution and extent of saline water intrusion. By measuring the electrical resistivity of subsurface materials, these methods allow the identification of contrasting geological formations and the differentiation between fresh and saline water zones. The vertical electrical sounding method, through its ability to provide depth-dependent resistivity profiles, facilitates the determination of depth and thickness of saline water intrusion. By measuring resistivity variations with depth, SEV allows estimating the transition zone between freshwater and saltwater, helping to delineate the interface and understand the hydrogeological processes that occur in the aquifer. Complementing SEV, electrical imaging techniques such as electrical resistivity tomography provide detailed spatial information on subsurface resistivity variations. IE uses an array of electrodes to measure resistivity at multiple locations, allowing you to create 2D or 3D resistivity models. By visualizing the subsurface resistivity distribution, the IE provides information on the lateral extent and spatial variability of saline water intrusion, allowing for more accurate mapping and monitoring of coastal aquifers. In the process of relating these methods, studies were carried out in the municipality of Maracanã on the island of Maiandeuá - Fortalezinha, Pará in the year 2022, in which results were obtained on lithology with geoelectrical analyzes generated by SEV and IE. The objective of this study was to identify whether there is a probability of contamination caused by the interaction of coastal waters and local aquifers in the region. After interpreting the data, results were observed with models of up to five layers, of which the top four are defined with resistivity and thickness. The fifth presents only the resistivity of a basal package, not defined geometrically – substrate. The depth of the investigation is, therefore, given by the base of the fourth layer, where in none of these there was any lithological or contamination alteration. In conclusion, we can say that the application of geophysical methods of vertical electrical sounding and electrical imaging, played a key role in the assessment and understanding of saline concentration in aquifers in the region of Fortalezinha. These techniques offer information on the extent, depth and spatial variability of saline water intrusion, allowing effective management of water resources and ensuring good acquisition, as well as generating long-term responses aimed at use for present and future generations.