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Geophysical Analysis of Saline Wedge Intrusion Using Electromagnetic (EM-34) and Geoelectrical (Electrical Resistivity) Methods at Cumbuco Beach, in the Municipality of Caucaia, State of Ceará

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Introduction

Water is a vital resource for survival. In semi-arid regions, where surface water resources are scarce, one solution is the use of groundwater, often exploited irregularly and excessively, leading to environmental problems such as aquifer depletion and contamination. The situation is no different in coastal areas, where similar uncontrolled exploitation occurs, resulting in water shortages or contamination due to saline intrusion, where potable groundwater is transformed into saline water.

Considering the issue at hand, the present study aims to identify areas potentially vulnerable to aquifer contamination due to saline intrusion, a consequence of the overexploitation of groundwater resources. To achieve this goal, well-established geophysical methods, widely recognized in scientific literature and commonly used in subterranean contamination investigations, were employed to map and compare anthropized and non-anthropized áreas.

Method and/or Theory

Two geophysical methods were employed for the study. The first, the magnetic method (EM-34), was applied along two 200-meter profiles, with a 10-meter spacing between the collection points. The second method, electrical resistivity (geoelectric), was used to complement the results obtained, with the geoelectric profiles also arranged along two 200-meter lines, both extending from the coastline inland. To enhance the interpretation of the data, the regional well database was consulted in order to identify the lithostratigraphic profile. The geophysical data processing was carried out using the RES2DINV software for the geoelectric data and the Surfer software for the electromagnetic data.

Results and Conclusions

It is concluded that the geophysical methods employed, both the electrical and the electromagnetic methods, proved to be suitable for the objectives of the study, efficiently fulfilling the role for which they were initially designed. The application of these methods resulted in the identification of areas affected by saline intrusion, allowing for the precise localization of the extent of the saline wedge in both analyzed zones. The presence of contamination was observed in all the target areas of the study, highlighting the urgent need for preventive measures and sustainable management to mitigate the advance of saline intrusion. This finding underscores the importance of continuous monitoring and the implementation of appropriate strategies to protect groundwater aquifers, considering the risks inherent in the excessive exploitation of water resources and its consequences for water quality.