

Geo-hydrological evaluation of Isla de la Pasión, Quintana Roo

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Abstract

The development of geophysical methodologies in conjunction with hydrological sampling will propose an interpretation for the geohydrological prospecting of Isla de la Pasión, *State of Quintana Roo, México*, and will provide us with the geometry of the aquifer as its main lithological and hydrogeochemical components, so that the necessary evidence will be collected for the Determination of the necessary conditions to characterize the investigated aquifer and whose purpose will be the usufruct and adequate exploitation for the hotel industrial development.

INTRODUCTION

The purpose of this research study is to explore the variables such as the physical and chemical properties contained in the subsoil rocks in the Passion Island, through geophysical detection studies and chemical sampling of the water.

The independent variable is defined as the water contained in the subsoil.

The dependent variables are:

- 1.- The chemical and physical constituents of the subsoil
- 2.- The quality of the chemical components of the water necessary for the optimum development of the locality.

OBJECTIVES OF THE STUDY

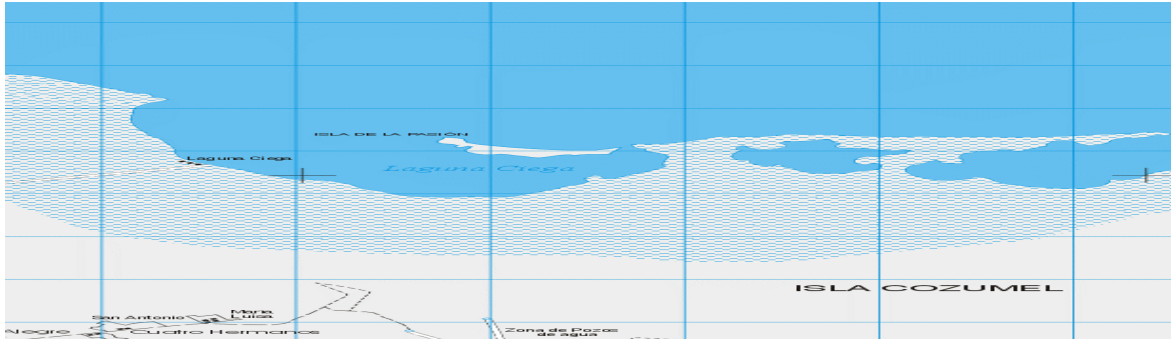
Based on the background described, the following objectives of the study are proposed:

1. Specify one or several sources of underground water supply with the quality and quantity necessary to supply drinking water to La Pasión Island.
2. Demonstrate the delimitation of the zone of saline intrusion with fresh water.
3. Examine the depth of saturated strata with fresh, brackish and salt water
4. Estimate the direction of intrusion and freshwater.

5. Determine the geological structures in the area that control the storage and flow of groundwater.

METHODOLOGY

Based on the following graphic representation, the steps to be followed for the development of the study aimed at pursuing the purposes set out in the objectives will be outlined.



UNIT A1

With resistivities of 54 to 300 ohm-meters, it describes the surface cover of drained, highly permeable beach sand. It was detected in boreholes 1, 3 and 4 with a minimum average thickness of 0.5 m and a maximum of 1.52 m.

UNIT A2

Made up of resistivities of 1 to 2 ohm-meters, which is associated with the surface cover of beach sand and caliche fragments with the presence of high permeability salts. In SEV's 2, 5, 6 and 7, an average thickness of 0.40 m was detected: this unit slows down the passage of surface water towards the subsoil, which intensifies evapotranspiration and decreases infiltration into the underlying strata, causing salt deposit.

UNIT B1

Determined with resistivity logs from 16 to 25 ohm-meters, it is associated with high-permeability sand deposits, saturated with fresh water. It was determined that in the SEV's 1, 3 and 4 boreholes, its minimum thickness is 1.2 m and the maximum is 2.4 m. Geohydrologically, this is the most important unit that meets the exploration expectations for the usufruct of water, since its geometry promises a considerable exploitation in terms of the amount of water.

UNIT B2

This geoelectric unit presents resistivities of 1 to 3 ohm-meters, describes highly permeable sand deposits, saturated with brackish water. They appeared in both geoelectric sections with minimum thicknesses of 2.5 m and maximum of 17 m.

UNIT B3

512,000m. E.512,000m. E.2,268,000m. N.2,275,000m. N.517,000m. E.2,268,000m. N.2,275,000m. N.517,000m. E. STUDY AREAS I M B O L O G I A STUDY AREA STUDY AREA RIVERS BOUNDED LEVEL CURVE IN METERS TERRACTERROAD TO PAVED ROADPAVED ROADFORESTS AGRICULTUREDENSE FORESTS OR JUNGLE, AGRICULTUREPOPULATED AREAPOPULATED AREAISOLATED HOUSEA ISOLATED HOUSES ISOLATED HOUSES Í A ISOLATED HOUSES

The resistivities of less than 1 ohm-meter in the SEV-2 indicate the presence of sand strata, saturated with salt water, of high permeability with an average thickness of 3 m.

UNIT C1

It presents resistivities of 2 to 6 ohm-meters, it is related to calcareous rock (saskab) or limestone, of medium permeability and saturated with brackish water.

UNIT C2

It presents resistivities of less than 1 ohm-meter, which corresponds to limestone and/or calcareous rock (saskab), saturated with salt water and with medium permeability.

SUMMARY OF GEOELECTRIC UNITS

Summarizes the global information of the geoelectric units, thicknesses and geohydrological characteristics.

CONCLUSIONS AND RECOMMENDATIONS

The study area is located 14 km north of the Municipality of Cozumel, State of Quintana Roo, in a place called Isla Pasión. Geographically it is limited by the UTM coordinates with the WGS84 DATUM: 2,271,900 to 2,272,300 North and 513,750 to 514,750 East; Zone 16.

The main objective of the study is to determine the geo-hydrological units of the subsoil, direction of underground flow, contact of fresh, brackish and saline water, depth of saturated strata, bodies of water that generate, store and transmit fresh, brackish and salt water. ; in order to determine the optimal drilling area for one or more water extraction wells to meet the needs of the project to be carried out on Isla Pasión.

To meet the objectives of the study, a geological verification, a hydrological-geohydrological analysis, in-situ physicochemical sampling and a geoelectric-type geophysical survey were carried out with the Vertical Electric Sounding technique.

Geologically, there are no rocky outcrops on Isla Pasión, the depth of these outcrops can be inferred from geophysical data. The regional geomorphology indicates that this area is one of marine accumulation, which is why there are mainly unconsolidated materials the size of sands with a high content of carbonates (limestone fragments, corals, remains of organisms, etc.) leading to a certain compaction of the sand in some areas.

Unconsolidated sandy materials are of great importance. Unconsolidated sands are characterized by their high permeability, water of meteoric origin infiltrates and accumulates in the subsoil, forming a lens of thin fresh water that floats on a denser mass of saline water, whose origin is natural

marine intrusion. . The contact between both masses of water, fresh and marine, forms a mixing zone or halocline that together make up an important geological component of the aquifer.

In terms of climatology, in the area the average annual rainfall is 1,441 mm, almost double what it rains in Mexico City, and from May to December it exceeds 100 mm in height. The monthly average temperature is 25.17°C and the runoff is negligible, due to a large amount of sand in the study site and all the water is filtered avoiding surface runoff. The average annual evapotranspiration is greater than 120 mm from June to September.

Hydrogeochemically, the water samples from PCA-1 and PCA-3, according to the Alekin classification, are calcium bicarbonated water type I, which is why they are considered to be waters of recent infiltration of meteoric origin, stored in the sandy stratum. unconsolidated, in these cases it corresponds to fresh water with 397.46 ppm and 408.24 ppm of Total Dissolved Solids (TDS) respectively.

The water sample from the PCA-2 well, according to Alekin's classification, is also a type II sodium chloride water, therefore, they are marine intrusion waters from the Caribbean Sea. It should be noted that PCA-2 is found near the coast, unlike PCA-1 and PCA-3, which are located in the middle of the island.

As can be seen in the hydrogeochemical maps, the small aquifer of La Pasión Island is very narrow and extends along the island, having a small thickness and width (of a few meters), the high rainfall favors the constant recharge of fresh water, however high temperatures increase the loss by evaporation of water in the aquifer. The vulnerability of the aquifer to marine intrusion by anthropogenic activities is latent if it is not treated sustainably

For the study area, a geophysical study of the geoelectric type was carried out, made up of seven Vertical Electrical Soundings, obtaining as a result seven geoelectric units, which are described in the following paragraph.