Conjugate modeling of gravimetric and magnetotelluric data by Recôncavo Basin

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Abstract

The Recôncavo Basin (BR) is a prolific and mature oil producing basin, located east of Bahia, Brazil. The study area is surrounded by fault structures that generate preferential oil trends, the most important of which is the Mata-Catu fault system, responsible for the most important trend of hydrocarbons in the BR and oil fields in one of the most prolific regions of the basin, the Miranga Low. The determination of the area main faults, their trends, and understanding its depocenters are essentials steps for the investigation of the hydrocarbon formation and migration.This project by INCT-GP, aimed to characterize the structural geometry, investigate the morphology of the regional basement and possibly, influence the choices of exploration targets and production fields by generating of two geophysical-geological subsurface models. This processing and interpretation work used data collected by Petrobras's RIFT II project in a cross-section of the BR, which included magnetotelluric (MT) soundings and gravimetric surveys. The MT method used twenty-two stations in a transect of 84.8 km, with a spacing between stations of approximately 4 km, to collect data, including magnetotelluric and audio-magnetotelluric information. By the Gravimetric method, 43 points were collected along the same line of this transect, collecting a spacing of approximately 2 km, 13 wells were used as complementary information for generating direct modeling: 1. Processing, inverse modeling, and interpretation of MT data were performed, which was later used as an initial model for direct gravimetric modeling. We divide MT data processing into three stages: pre-processing, data analysis and advanced processing. Primarily, the data were placed in the frequency domain, performing data quality control, removing noisy data and obtaining the impedance and tipper using robust methods; 2. The dimensionality of the data was studied using two methodologies, WALDIM and SKEW, and the direction of the geoelectric strike. After this analysis, we determined that the 2D inversion of the data and a strike direction of 30^{O}NE were the most appropriate. In advanced processing, the data were then rotated to the geoelectric strike direction and resistivity and phase pseudosections were generated in TE and TM modes; 3. The MT inversion was generated using the OCCAM2D software, allowing the identification of faults, sediments, and interesting resistivity anomalies. The Mata-Catu fault was imaged at a depth of 6km, demarcating the depocenter of the basin. The post-rift and rift sediments showed a resistivity between 1 and 10^2 Ωm, and pre-rift sediments presented a resistivity between 10^2 and 5×10^2 Ωm. The basement was well demarcated by the resistivity transition, with a resistivity between 10^2 Ωm and 10^4 Ωm. Furthermore, two conductive anomalies stand out in the basement structure, with the highest conductivities from the model. For gravimetric modeling, only Bouguer anomaly data were used. The post-rift and rift sediments were assigned a density of 2.44 g/cm^3, the pre-rift sediments a density of 2.42 g/cm^3, and the basement values between 2.74 and 2.85 g/cm^3. Also, the two basement anomalies presented the highest densities of the model.