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CSEM Interpretation workflow in different life stages of a Hydrocarbon Reservoir. Phase I - Preliminary results

Guilherme Zequini, Paulo de Tarso Luiz Menezes, Tiziano Labruzzo, Andrea Zerilli, André Luis Albuquerque Reis

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Introduction

The exploration of hydrocarbon reservoirs involves geological and geophysical research across four main stages: reconnaissance, lead, discovery, and appraisal. A specific goal and amount of available data characterize each one.

In the reconnaissance or regional stage, the primary goal is to select targets (leads) for further detailed study. The available geophysical dataset typically includes 2D seismic, gravity, magnetic, and, more recently, controlled-source electromagnetic (CSEM) data. Among these geophysical tools, CSEM can provide valuable insights into fluid variations and help identify source rocks and migration pathways, complementing the information obtained from seismic data. Recent advancements, such as the Marlim R3D model, serve as a reference for investigating turbidite reservoirs located along the Brazilian continental margin.

Method and/or Theory

In this paper, we present preliminary results from implementing a CSEM interpretation workflow for all phases of exploring a hydrocarbon field. To that end, we use a subset of the MR3D data. In this subset, receivers are spaced 2km apart to match actual CSEM surveys in frontier areas. Our workflow is based on the 1D CMP inversion of each receiver, followed by a 2D pixel-based inversion.

Results and Conclusions

The CMP inversion serves as a quick evaluation tool, providing low computational costs and short processing times. While the results showed limited accuracy in the vertical positioning of the anomaly, they indicated good horizontal positioning. The subsequent 2.5D pixel-based inversion confirmed the resistivity anomaly. This anomaly, when integrated with existing seismic data, revealed a significant correlation to the presence of an interpreted turbidite body.

Hence, during the reconnaissance stage, the proposed workflow provides valuable information that aids in decision-making regarding the identification of potential leads and supports the transition to the next phase of detailed studies on identified targets.