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Geological Evaluation for CO2 Storage in the São Tomé Low, Campos Basin.

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Introduction

The urgent need to address climate change requires significant reductions in anthropogenic CO_2 emissions. Carbon Capture and Storage (CCS) technology is recognized as a viable solution that can be part of a comprehensive climate change mitigation strategy. This study provides a geological assessment of the São Tomé Structural Low, a key area in the Campos Basin along the Brazilian coast, which has potential for large-scale CO_2 storage. Its proximity to industrial sources of emissions and existing energy infrastructure enhances its suitability for developing a CCS hub. The investigation focuses on characterizing the saline aquifers of the Emborê Formation, utilizing integrated geological analysis and seismic interpretation to evaluate their capacity for safe and long-term CO_2 storage.

Method

This assessment utilizes geological and geophysical data, including time-domain 2D seismic surveys and well-log information (gamma-ray, sonic, and density) from the database managed by ANP. Drawing on literature about the tectonostratigraphic evolution of the Campos Basin, particularly concerning the Lower São Tomé Structural Sub-Basin, this study aims to understand the depositional environments of the Emborê Formation and its associated saline aquifer systems. We have identified the primary geological elements that influence potential CO_2 trapping mechanisms. The seismic interpretation includes mapping the critical horizons of the target reservoir, identifying the main fault systems, and analyzing seismic facies to delineate the reservoir geometry and assess its heterogeneity.

Conclusions

The tectonic and sedimentary history of the São Tomé Low has facilitated the formation of a promising reservoir. The São Tomé Member of the Emborê Formation is characterized as a thick (hundreds of meters), laterally extensive, and deep (with an average top at 1,630 m) sandy saline aquifer, which possesses favorable characteristics for CO_2 storage. Seismic interpretation has mapped the reservoir's geometry, revealing significant variations in thickness and structural controls influenced by regional fault systems. Distinct seismic facies patterns within the reservoir interval indicate internal heterogeneity, which can affect CO_2 migration and enhance residual trapping. Multiple CO_2 trapping mechanisms are expected, and the reservoir's depth is sufficient to ensure that CO_2 remains in a supercritical state. The integrated geological and seismic analysis strongly supports the significant potential of the Emborê Formation within the São Tomé Low as a promising target for large-scale geological CO_2 storage. Although initial volumetric assessments have high uncertainty, this evaluation underscores the geological potential and seismic evidence that affirms its suitability.