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Assessing Seafloor Stability for Renewable Infrastructure in the Acaraú and Piauí-Camocim Sub-Basins, Equatorial Margin of Brazil

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Introduction

The expansion of offshore wind energy in Brazil, particularly along the Brazilian Equatorial Margin, necessitates a thorough assessment of geological hazards associated with the submarine environment, as these can compromise the stability and structural integrity of foundations that support offshore installations. The identification of geologically unstable areas is crucial for supporting the planning and safe deployment of offshore wind turbines, considering the occurrence of faults, gas seeps, mass-wasting events, and other forms of seabed instability. In this context, the present study aims to map and characterize seabed features potentially associated with geohazards on the continental shelf of the Piauí-Camocim and Acaraú sub-basins, located between the Barreirinhas Basin (to the west) and the Icaraí sub-basin (to the east).

Method and/or Theory

The adopted methodology is based on the interpretation of a robust dataset of 2D seismic sections provided by the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP). These seismic lines were acquired for hydrocarbon exploration purposes (with inadequate resolution for planning offshore wind). Still, they offer valuable surface and subsurface imaging of the continental shelf Piauí-Camocim and Acaraú Sub-basins. The data were imported and interpreted within the Petrel software environment, enabling the identification, mapping, and characterization of geological features potentially associated with submarine geohazards. The interpretation process involved horizon picking, fault mapping, and amplitude analysis to delineate key stratigraphic surfaces and structural discontinuities. Special attention was given to anomalous seismic facies, such as chaotic or discontinuous reflectors, acoustic blanking zones, and bright spots—indicators commonly linked to fluid escape or sediment deformation. Structural elements such as fault systems, (buried) channels, and slope breaks were also analyzed for their role in generating instability.

Results and Conclusions

Results from the seismic interpretation indicate the presence of various morphological and structural features associated with instability processes, including bedrock outcrops, incised valleys (e.g., Coreaú), buried valleys, mound-like structures, unstable zones, and the occurrence of submarine canyons and steep slopes. The identification of these features highlights the geological complexity of the area. It underscores the importance of detailed geological mapping in mitigating risks to offshore infrastructure in regions susceptible to geohazards. The integration of these seismic observations, although not the most suitable data, has enabled the classification of areas with greater susceptibility to geohazards, providing preliminary risk information for offshore infrastructure planning.