Submission code: 6A6WMNL7D0

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Clinoforms Classification in the Pelotas Basin: a Tool for Characterizing Depositional Environments of the Southern Brazilian Continental Shelf

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Introduction

Clinoforms are preserved depositional surfaces that reflect the past morphology of continental margins and are among the key building blocks of margin stratigraphy. Morphological analysis and quantification of clinoforms reveal past oceanographic and sedimentary conditions responsible for shelf formation. Different types of clinoforms (delta-scale, shelf-edge, or continental margin) form over varying temporal and spatial scales, which are related to factors such as sediment input intensity, sea-level changes, deltaic activity, and the action of waves and marine currents.

The rapid expansion of offshore wind farms has led to ongoing environmental licensing processes along the northeastern, southeastern, and southern continental shelves of Brazil. However, turbine installation in these areas is limited by factors such as gas reservoirs, beach rocks, unconsolidated sediments, and paleo-river channels. In the Pelotas Basin, located on the southern Brazilian margin, stratigraphic records indicate the influence of paleo-fluvial systems during the Neogene and Quaternary periods that correspond to typical turbine installation depths (100–200 m). Therefore, geological and oceanographic studies of this shelf are critical to the safe development of offshore wind infrastructure. In this context, the present study aims to quantify and classify Neogene-Quaternary clinoforms in the Pelotas Basin to determine whether the shelf was primarily shaped by deltaic systems or marine currents.

Method and/or Theory

To classify and quantify the Neogene and Quaternary clinoforms of the Pelotas Basin, 84 2D seismic sections provided by the Brazilian National Agency for Petroleum (ANP) were interpreted using IHS Kingdom and Paleoscan software. Stratigraphic clinoform patterns were identified, and measurements of foreset height, lateral extent, and slope were obtained. Additionally, paleocanyons, paleochannels, and delta lobes were mapped in plan view to assess possible associations with paleo-river systems and to determine the direction of clinoform progradation.

Results and Conclusions

Based on the distribution of clinothems, the Pelotas Basin was divided into three main regions: Area A (Florianópolis High platform), Area B (Rio Grande Terrace shelf), and Area C (Mostardas Low platform). Overall, the measured clinoforms exhibit a wide range of scales and morphologies. Foreset heights vary from 20.8 m to 549 m, foreset lengths range from 512 m to 28,297 m, and foreset dip angles range from 0.57° to 5.42°. Most clinoforms are oblique, though sigmoidal and complex oblique-sigmoidal geometries are also present.In Area A, during the Lower and Upper Miocene, dome-shaped reflectors are evident in strike sections. When observed in dip sections, the mounded reflectors appear as oblique clinoforms of the delta-scale or shelf-edge types, formed on the outer continental shelf. Additionally, in the Middle Miocene, plan-view analyses reveal lobate progradational patterns composed of oblique clinoforms, both delta-scale and shelf-edge types, often associated with paleo-channels identified in the northern part of Area A.In Area B, during the Miocene, delta-scale clinoforms are observed on the middle continental shelf, whereas shelf-edge clinoforms, oblique and sigmoidal, are predominant on the outer shelf.Finally, Area C presents less complexity, with oblique shelf-edge clinoforms clearly observed during the Upper Miocene.