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Seismic expression of silicified carbonate mounds on the Pre-Salt of Campos Basin

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Introduction

Seismic facies and geometry characterization of seismic features is a primary step in seismic interpretation, allowing the comprehension of the scale and architecture of geological features. In the lacustrine carbonate setting, it is extremely important, since there are a variety of possible geometries and a few examples around the globe. In the distal portion of the Campos Basin, there are lower Cretaceous lacustrine pre-salt carbonates up to 200 m thick, which were affected by intense silicification. They form a significant oil and gas reservoir and have a very well-marked geometry in seismic data. The main goal of this work is to characterize the geometry and seismic response of these carbonate mounds and link them with the geological structures, such as regional faults.

Method

In this study, a PSDM high-density-high-resolution multiazimuth 3D seismic dataset comprising about 1500 km² and seven wells were used to depict the mounds features presented in the Sag Sequence of the Pre-Salt of Campos Basin. Horizons from the top and bottom of the mound features were interpreted in seismic data and correlated with the response of the synthetic seismic trace. Internal seismic facies were mapped and correlated with well data.

Results and Conclusions

Well data, such as ECS well log and thin sections, show that the carbonate mounds are intensely affected by silicification. The top of these carbonate mounds in seismic is marked by a peak indicating an increase in acoustic impedance, which is associated with the transition from the upper fine-grained rocks (seal) and the lower silicified carbonate interval (reservoir). This event can be linked to two different mounds presented in different structural highs. Also, deep detachment normal faults were recognized, which border some mounds in the Sag units and are linked to the basement in the deep basin.

Three different settings are found: 1 – The mound appears in plan view with a circular shape geometry. Any clinoform is observed, and it has a low thickness compared with other mound successions. Geometry and relation with faults suggest that this mound was formed without structural control; 2 –. Clinoforms are formed in diverse directions, but with a slight asymmetry being thicker and wider in the hanging wall on the southeast side of the mound (NE-SW direction) and on the northeast side of the mound (NW-SE direction), which suggests structural control. 3 - The mound is formed by different clinoforms that prograde in various directions from the structural high. For some of them, a relation with faults is recognized. Internally, those features are marked by reflection-free seismic facies.

Throughout this study, it was possible to depict a different scenario regarding pre-salt reservoirs, showing that the geometry of the silicified carbonates reservoirs is complex and associated with the reactivation of detachment faults.