SEISMIC FACIES CLASSIFICATION IN PRESALT CARBONATE RESERVOIRS OF THE BARRA VELHA FORMATION IN THE BÚZIOS FIELD, SANTOS BASIN

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For the last decades, the presalt carbonates have changed the oil and gas production scenario in Brazil and attracted worldwide interest as a consequence of its large hydrocarbon accumulations and elevated production. Although it has been explored since the early 2000s, the presalt reservoirs continue to represent a significant challenge in technical terms due to the high heterogeneity and complexity of the carbonate rocks. For this reason, reservoir characterization methods have become an essential step to provide geological information and evaluate the physical properties of these rocks. Thus, as part of reservoir characterization in the Búzios Field, we performed an unsupervised clustering neuronal technique classification, based on the Kohonen's Self-Organizing Map (SOM) algorithm (Kohonen, 1995), to classify and distribute the seismic facies in the Barra Velha Formation. To accomplish that, the implemented methodology consisted in: (1) data preconditioning, to attenuate background noise and enhance signal to noise ratio; (2) tectonic and stratigraphic interpretations, to generate the classification's interval; (3) seismic patterns definition based on seismic attributes analysis; (4) application of unsupervised neuronal technique for seismic facies classification and (5) correlation of seismic facies with seismic patterns. The data used was a 3D PSDM volume from the Búzios Field, second largest oil and gas producing field of Brazil, located at the Santos Basin. Its main reservoirs are composed by shrubs and spherulite deposits from Barra Velha Fm and coquinas from Itapema Fm. Our target, the Barra Velha Fm, is delimited at the base by the Pre-Alagoas unconformity and at the top by the Base of Salt (Figure 1a). The Figure 1a shows the identified seismic patterns: (1 and 3) carbonate build-ups, formed by build-up processes at border zones (large throw faults); (2) carbonate platforms, with parallel to sub-parallel sedimentation at the structural highs; and (4) debris flow, rock mass displacements located at the normal fault planes. The build-ups patterns have good porosity and permeability, characterizing the best reservoir in this formation (Ferreira et. al, 2021). Figure 1b shows the results of the unsupervised classification, where it is possible to identify two build-ups' patterns with different internal structures and classes associations. The first one (1) can be associated with class 9 (dark red) combined with classes 1 (purple), 2 (dark blue) and 3 (blue), while the second one (3) presents class 9 along with classes 3 and 4 (turquoise). This emphasizes how the local deposit environment conditions contribute to the expressive heterogeneity of the carbonate rocks, especially at the presence of structural factors. The carbonate platform presents an intercalation of classes sub-horizontally disposed, where higher contrasts can be related to class 9 and low amplitude reflectors, to class 1. Finally, the debris flow deposits can be associated to classes 4, 5 (green) and 6 (light green). The unsupervised classification proved to be efficient in improving the reservoir characterization, as it allowed associating the generated facies with the main seismic patterns identified in the seismic. With this, we obtained a three-dimensional view of the location and distribution of these facies within the Barra Velha Formation.
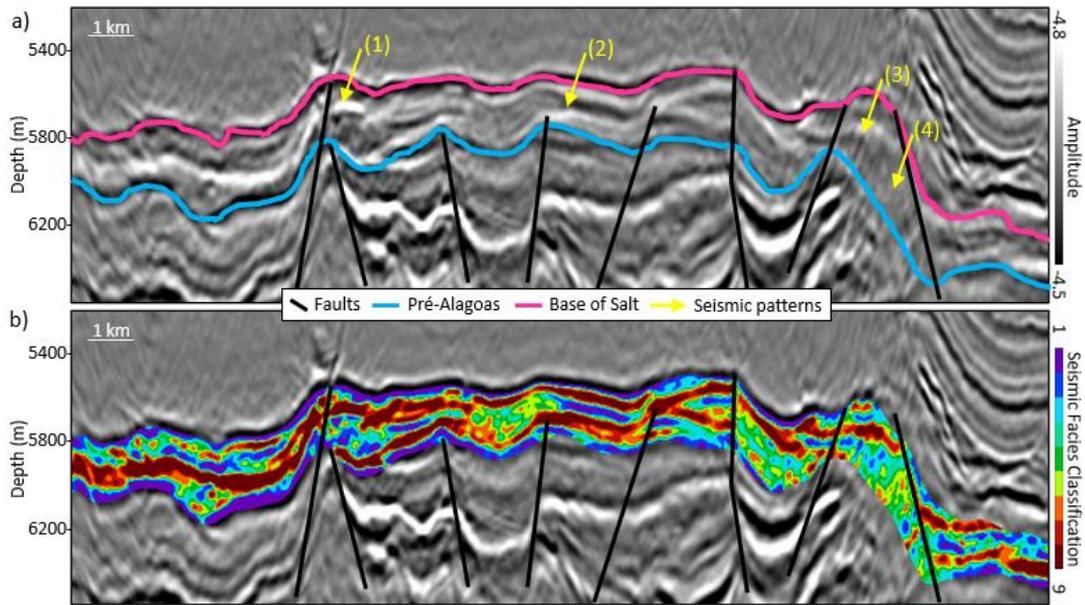
Figure 1: a) Preconditioned seismic amplitude section with seismic patterns indicated by yellow arrow: (1 and 3) carbonate build-ups, (2) carbonate platform and (4) debris flow deposits. Interpreted horizons: Pré-Alagoas (blue line) and Base of Salt (pink line). b) Unsupervised seismic facies classification results with 9 classes.

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Topics related: Reservoir Characterization, Seismic Facies.

References

Ferreira, D. J. A., Dias, R. M., Lupinacci, W.M., Seismic pattern classification integrated with permeability-porosity evaluation for reservoir characterization of presalt carbonates in the Buzios Field, Brazil, Journal of Petroleum Science and Engineering, v. 201, p. 108441, Elsevier, 2021.

Kohonen, T., Self-organizing maps, 2nd edition, 362 p., Springer-Verlag, 1995.