geoconvention
Calgary • Canada • May 12-14 2025

Multi-seismic attribute geomorphological Characterization using unsupervised machine learning techniques

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Summary

Accurately determining the facies beneath the surface is essential for successful geological modeling in the oil and gas sector. Therefore, this study attempts to explore the efficacy of unsupervised machine learning in understanding the pattern of seismic reflections and analyze their implications for revealing the subsurface tectono-depositional environment prevailing within the Woolaston and Johnson formation, Poseidon, Browse Basin. Several seismic attributes including geometrical, spectral, amplitude, and GLCM-textures are extracted using high-resolution three-dimensional seismic data acquired from the Poseidon Field. Numerous techniques, such as k-means clustering, self-organizing maps (SOM), Density-based spatial (DBscan), Hierarchical Density-Based Spatial (HDBscan), Gaussian mixture models (GMMs), and Auto-Encoders, have been effectively employed to identify significant geological features within seismic data. While extensively discussed in research, the terminology and intricate nature of these algorithms can be challenging for typical seismic interpreters to grasp. Furthermore, few studies have directly compared the performance of these methods using the same dataset. This study examines these six widely utilized algorithms. This method reveals various geomorphic features such as distributary channel, coastal plain, and pro-delta. Gaussian mixture model reveals the most features in comparison to other techniques. For unsupervised machine learning approaches to be as effective as possible, we believe that geologically significant sets of seismic qualities should be employed as inputs. This will allow seismic interpreters to successfully find patterns or relationships in the data. This study's methodology can be used to support subsurface interpretation in comparable geologic contexts.