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Integrated Machine Learning Unsupervised Log Facies and Seismic Facies Workflows to delineate stratigraphic traps for field developments

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Machine Learning techniques in subsurface exploration have been employed for over twenty years to interrogate large, varied, datasets through use of various data conditioning processes, data manipulation techniques and Clustering algorithms. One Machine Learning technique, Unsupervised learning, is used to generalize the structure of subsurface data where no prediction is required. The relationships and trends can be further utilized for interpretation. Where large, varied, datasets occur, as in well log and seismic data analyses, these learning techniques can provide insights to enhance subsurface interpretation and to delineate subtle stratigraphic traps. Integrated Machine Learning Unsupervised log facies and seismic facies techniques are applied to an oil field characterized by a tidal depositional setting, with distributed hydrocarbon-charged reservoir units - oil filled, wet or with tar. The depositional setting transitions from a shelf into a deeper water basin defined by salt beds and consists of stacked hydrocarbon reservoirs with varying potential for stratigraphic traps. The techniques applied in the study include: - Definition of a seismic chronostratigraphy 3D model using a post-stack migrated 3D seismic volume to generate a series of stacked horizons for sequence stratigraphy interpretation seismic sequence definition. - Application of a horizon-based 3D seismic facies Unsupervised classification technique using neural networks for noise reduction and seismic facies map generation. - Application of a log-based facies classification technique using well-log elastic and petrophysical properties to define log facies for reservoir heterogeneity investigation. - Generation of Frequency Decomposition seismic attributes including geobody analysis to identify salt beds. The results of the integrated datasets derived from Machine Learning techniques provide indispensable information to generate a 3D Earth Model and to surgically map depositional sequences. The Machine Learning techniques may help with reducing exploration risk and identifying potential stratigraphic traps in field development settings.