Multi-Seismic Attributes Facies Classification for Reservoir Identification, Offshore Moattama Basin

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Abstract

The offshore Moattama Basin in Myanmar is a significant gas-producing basin, supporting energy needs for domestic consumption and international export. As major fields decline, new gas resources become crucial. Accurate reservoir facies prediction is essential for evaluating gas potential and developing a conceptual plan. This study utilizes multiple seismic attributes, enabling classification of seismic facies which act as proxies for litho-facies and improving reservoir distribution and the geological depositional model.

This study analyzes geological configurations and characterizes seismic facies through several steps: seismic interpretation, seismic attribute generation and analysis, principal component analysis (PCA), clustering, and seismic facies classification. Multiple attributes (RMS amplitude, discontinuity, cosine of phase, instantaneous frequency, and relative acoustic impedance) are generated, and their correlations are examined. PCA is used to reduce dimensions based on attribute contributions and variance. K-means clustering is applied to PCA components for facies classification. The optimal number of clusters is determined by comparing lithofacies distribution with well data and geological models. The study provides cross-validated seismic facies, which are integrated for reservoir distribution prediction.

Seismic attributes, PCA, and clustering techniques can classify seismic facies into four groups: SF1 (carbonate platform), SF2 (carbonate ramp), SF3 (volcanic flow and ash), and SF4 (crystalline basement rocks). These facies are calibrated with well data, such as wireline logs, side-wall core, and conventional core, providing insights into paleogeography and enhancing reservoir prediction. Volcanic and crystalline basement facies occur in the NNE-SSW trending volcanic arc, surrounded by carbonate rock deposits. The western side of the volcanic arc exhibits carbonate platform seismic facies, mainly consisting of packstone and wackestone carbonate. In contrast, the eastern side shows carbonate ramp seismic facies, predominantly composed of globigerinid wackestone/packstone and mudstone deposited in deeper adjacent waters, as observed from nearby wells.

Well results indicate that carbonate platform exhibits superior reservoir qualities, including porosity and permeability. Therefore, areas with carbonate platform are potential targets for future appraisal and development. Since current studies often rely solely on conventional amplitude attribute analysis for litho-facies determination, which can lead to misinterpretation in data-scarce areas, this study proposes an integrated approach that combines seismic, well, biostratigraphy, depositional model, and structural restoration data. Importantly, it emphasizes the significance of multi-seismic attribute facies classification in understanding paleogeography and reservoir distribution and facilitating accurate volumetric estimation for further field evaluation.

Keywords: machine learning, seismic attributes, facies