Seismic Geomorphology of the Shelf to Slope System on a Mixed Carbonate Siliciclastic Setting with Implication for Sedimentary Processes and Petroleum Prospectivity

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Abstract

The shelf-slope system has played an important role on transferring sediment from the coastline to the basin floor area. In addition, mixed carbonate-siliciclastic setting provides variation on the lithology with complex architecture and depositional elements. These provide involution to understand its sedimentary processes and capabilities in term of petroleum prospectivity. Therefore, our study aims to a) describe seismic architecture, b) describe depositional element, c) understand sedimentary processes, and d) describe petroleum prospectivity of the shelf-slope system on a mixed carbonate-siliciclastic setting - Northwest Shelf of Australia. An offshore 3D seismic reflection (full-stack time migrated) and 8 wellbore data (completion logs and check shots) were used in this study with traditional horizon-fault seismic interpretation and seismic geomorphology techniques (including seismic facies and attribute analysis). These resulted in 42 Eocene horizons of the shelf-slope complex sigmoid-oblique clinoforms that contain submarine channels, gullies, reefs, and sandbars. The submarine channels are having V to U-shaped trough-fill with relatively medium to high amplitude, whereas gullies have smaller size compared to the channels and mostly attached to the shelf-edge with uniform geometry. In addition, the reefs are characterized by mounded with relatively hummocky and isolated low-high amplitude, whereas the sandbars have relatively gentle mounded with isolated high amplitude and distributed parallel to the shelf-edge. The submarine channels and gullies in the study area are products of sediment gravity flows, whereas the reefs are developed by organisms in a stable shelf and sandbars deposited parallel to the shelf-edge through long-shore drift current in the shelf. In addition, bottom current also redistributed the submarine channels deposits in the lower slope area. Submarine channels, gullies and sandbars are progradational agents that transfer sediment from shelf to the basin floor with alternating up-building and depositional bypass, while the reefs act as a sediment source. These kinds of systems are favorable for petroleum prospectivity where all depositional elements act as reservoir and stratigraphic traps, while submarine shales and reefs could act as source rocks and seal. The workflow and results presented in our study could be implemented and also be an analogue for similar cases worldwide.