

Rudist Shoals to Shoreface Sands of the Cenomanian to Turonian on the Arabian Plate

David P. Taylor¹

¹Saudi Aramco

Abstract

The rimmed carbonate platform margin of the Cenomanian to Turonian succession forms subtle combination traps requiring integrated well and seismic sequence stratigraphy. Cenomanian age grainy rudist shoals were deposited on local stratigraphic highs of older depositional sequences. Passing upwards to the Turonian succession the carbonate succession shifts to siliciclastic deposition. This clastic sequence comprises deep lagoon mudstones and middle to upper shoreface sands. Identification of this upwards transition from rudist shoals to shoreface sands is possible with a sedimentology and biostratigraphic calibrated seismic stratigraphic framework. Expansive outcrops and correlation assist with identifying key surfaces and cyclicity.

The rudist shoal sequence of the Mishrif Member commences with bank and shoal facies and vertically passes upward to shoal and lagoon facies, followed by distal shelf and pelagic basin. This sequence is sufficiently thick to interpret directly on seismic data. In platform areas the Cenomanian/Turonian boundary is a karstified surface and significant seismic mappable event. Locally, high energy shallow marine shoals characterized by rudist fragments in a grainstone matrix have been deposited. This sequence passes upwards to muddy sandstones. This significant change to siliciclastic deposition is also a seismic mappable event and likely candidate for the Early- middle Turonian sequence boundary (Tu1 SB). Depositional models based on well and seismic interpretation and the use of modern analogs assist with visualization of shoal extent and setting.

The Cenomanian to Turonian Mishrif to Tuwayil members are dominated by prograding deep lagoon and rudist grainstone shoal-complexes. Shoals demonstrate lateral facies change to detached lower energy shoals encased in middle shoal facies. The successive sequence consists of caprinid rudist shoals, overlain by lagoon facies coinciding with the Cenomanian/Turonian boundary. Open marine carbonate mudstones deposited at this boundary form a seal to grainy rudist-rich shoals. The subsequent Early-middle Turonian sequence shows a dominant mid to outer shelf facies. This sequence passes upwards to muddy sandstones, highly burrowed and pyritic and represents a significant shift to siliciclastic input. Turonian age grain-rich shoaling complexes are locally deposited immediately below the Early-middle Turonian sequence boundary (Tu1 SB) and overlain by terrigenous muds deposited in shallow open marine and deep lagoon settings. Above this sequence boundary, sandstones show low angle cross-stratification and burrows interpreted as a transition from middle to upper shoreface. This clastic sequence is a candidate for the Early-middle Turonian lowstand system (Tu1 LST). The Ruwaydah Member marks a return to open marine carbonate deposition and terminates at the mid-Turonian unconformity (K150 SB).

Depositional cycles consisting of rudist shoals and shoreface sands are mappable once bounding surfaces have been identified. The Cenomanian/Turonian boundary is a karstified surface and significant seismic mappable event. The upward shift to siliciclastic deposition is also a mappable event and coincides with the Early-middle Turonian sequence boundary. Identification of this upwards transition from rudist shoals to shoreface sands requires a sedimentology and biostratigraphic calibrated seismic stratigraphic framework.