RC05

Dolphin Field: Sedimentology and Reservoir Architecture of a Supply-Dominated, Accommodation-Controlled System, ECMA, Trinidad

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Abstract

The Dolphin Field was discovered in 1976 with the Dolphin-1 exploration well drilled by Texaco. Four appraisal wells were drilled from 1982 to 1995 to delineate the field. Development drilling from a fixed platform began in January, 1996 with a series of eight development wells. The field has been on production since March, 1996 and currently produces at 250 mmscfpd (capacity 400 mmscfpd) from as many as 14 separate, stacked reservoirs. Hydrocarbons are trapped within a three-way closure against a major down to the east, normal fault. The Dolphin Field is located centrally within the Columbus basin and approximately 75 km from Galeota Point on the southeastern coast of Trinidad. The Dolphin platform represents the most distal production facility in the Columbus basin.

The sedimentological database for the field comprises wireline or LWD log data for all wells; whole cores from the Dolphin-4, Dolphin-5 and DAP-2 wells; and high resolution borehole image log data (FMS/FMI) from 5 wells. These data have been used to construct a depositional model for the field and to assist with regional exploration efforts.

The sedimentary succession encountered at Dolphin Field comprises more than 8,500ft of Pleistocene-aged clastic sediment interpreted as marine deposits with distal influence from the Proto-Orinoco delta. Whilst the section is dominated by claystone deposits, it is punctuated by very fine grained, reservoir quality sands at the tops of multiple cycles that have been denominated alphabetically down section as A through G; production has been established from the C through G sands. These mud-prone successions suggest that the Dolphin area was commonly in a low energy clastic shelf setting, with cyclic development of more proximal, high energy sub-environments.

From the base of the section upwards, the G Sands record high energy, shallow marine, wave-dominated shoreface deposition probably subject to episodic reworking by high magnitude storm events. Rapid transgression followed G Sand deposition, establishing a dominantly low energy shelf setting. Temporary regression subsequently allowed accumulation of sand within the distal shoreface environments recorded in the F Sand. The Lower E Sands contain evidence of deposition within a deeper, upper slope environment (outer neritic to upper bathyal) in which sand accumulation was principally associated with gravity flow processes. This succession is interpreted to have been deposited during a period of high accommodation space resulting in significant back-stepping of the shelf margin. As accommodation space decreased the shelf system was re-established culminating in the high energy shallow water deposition recorded in the Upper E Sands. Subsequent transgression again established the dominant, low energy shelf environment, with minor progradational events recorded by the D and C Sand influxes. A sheet sand architecture and a high degree of lateral reservoir continuity are observed within the high energy G and Upper E sands. Conversely, the C, D and F units are characterised by greater detrital clay content, predominantly heterolithic or interbedded fabric, and a lesser degree of lateral continuity. This reflects deposition of these sands within a more distal, lower energy shelf environment (lower shoreface to offshore transition) with episodic sand influx associated with storm processes and/or distal deltaic influences.

The Dolphin reservoirs record a complex hierarchy of cycles which reflects the dynamic interplay of eustatic and local tectonic controls on a supply-dominated depositional system. The described sequences record the superposition of temporary regressive phases within a regime of generally high standing relative sea level, persistently high sediment supply rates, and subject to basin and local tectonic subsidence. Critical to regional exploration, the tops of the G and Upper E sand intervals correspond to extensive, mappable surfaces, marking initial flooding of the system and signifying increasing availability of accommodation space.

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