Depositional Facies Patterns and Resultant Heterogeneity in Carbonate Sand Reservoirs - Insight from Modern Analogs

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Processed satellite images, derived bathymetry, and sand body interpretation maps of three key areas of modern carbonate sand deposition on Great Bahama Bank are organized into a GIS to develop morphometric data that can support reservoir characterization and modeling. Collectively these three sand deposits occur along an ~370 km belt paralleling the platform edge and show a range of depositional facies patterns found in grainstone reservoirs.

(1) Rimming the southern end of Tongue of the Ocean (TOTO) is the broadest expanse of “high-energy” sands found in the Bahamas, a tidal bar and channel belt covering 3123 km^2 with bars extending onto the shallow platform for nearly 20 km. This sand deposit is generally characterized by narrow sand bars separated by wide, deep channels and a lack of islands.

(2) A variation of the tidal bar motif occurs at the northern end of Exuma Sound (Schooner Cays), where a belt covering 716 km^2 is progressively set back from the platform edge toward the west and, in comparison to TOTO, contains broader and more irregular sand bars up to 15 km long with relatively deep and narrow channels and few small islands.

(3) Sands associated with tidal channels and the numerous islands of the Exumas chain along the western edge of Exuma Sound occur primarily as flood tidal deltas in a 272 km^2 linear belt set back from the platform edge, with delta lobes extending 5-10 km onto the platform. The islands, often two or three paralleling each other, and the inter-island gaps (= channels) control the distribution of sand.

In each of the three cases, the carbonate sand belt was interpreted by selecting different water depth intervals and different portions, for instance sands in shallow high-energy zones versus those at deeper depths, were highlighted for visual analysis and morphometric measurements. For example, sizes (area, principal axis ratios) and shapes (perimeter, shape factor) of sand bodies are compared at a variety of scales, e.g., the total sand belt, domains within the sand belt identified by common patterns of sand bodies, individual tidal bars or deltas, and shallowest portions of tidal bars or deltas. Profiles and spatial analysis tools enable sand body and channel spacing, position relative to the platform margin, and volumes to be characterized. We think such results add value to the characterization and modeling of carbonate reservoirs and improve our understanding and predictability of reservoir heterogeneity.