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3D Mapping and Visualization of Carbonate Slope and Basin Floor Reservoir Strata: Bringing the Outcrop to the Desktop

Carbonate slope/toe-of-slope deposits remain one of the least understood and exploited reservoir associations in the geologic record. Existing models of carbonate slope sedimentation promote disorganized line-fed individual turbidites and debris flows forming strike-elongate slope aprons, downplaying fan-channel associations. Observations from ancient greenhouse systems such as the Devonian of the Canning Basin and the Cretaceous Golden Lane-Poza Rica system support this model. Production data and 3D seismic from Early Permian icehouse carbonate slope fields point to channel-fan systems as forming important deepwater reservoirs.

Outcrop analog data greatly enhances understanding of deepwater carbonate targets. We have employed OPTECH's ILRIS ground-based LIDAR (light ranging and detection) tool to produce a high-resolution (10 cm point spacing) 3D image of the outcrop wall. This image provided the 3D base map for constructing a geologic model of the fan/channel architecture. Horizons and measured sections were mapped onto the pointcloud and transferred to GoCad for model construction. Comparison of the 3D outcropmodel with seismic and well data from reservoirs highlights the importance of stratigraphic architecture in defining producing trends and internal flow barriers and compartments. Reservoir strata are dominantly grain-dominated high-density turbidites or grain-flows shed off the latest Wolfcampian-early Leonardian shelf margins during periods of high-amplitude sealevel shifts. Individual basin-floor fans consist of homogeneous ooid-peloid grainstones forming high-quality reservoirs. Complex multistory compensational stacking within channel fills suggests that recovery efficiencies in channel systems will be low.Flow-barriers are interstratfied mud-dominated debris flows and hemipelagic mudstones.