Inter-well Scale Heterogeneity in a Late Jurassic Carbonate Ramp

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The well-exposed Upper Kimmeridgian carbonate ramp between Jabaloyas and Arroyo Cerezo, Iberian Basin, Eastern Spain, provides an excellent analog to stratigraphically equivalent subsurface reservoirs, such as the carbonate ramps of the Arab-D of the Middle East and Smackover of the Gulf of Mexico. Critical questions regarding inter-well heterogeneity and correlation motifs for low-angle ramp systems can be addressed using continuous exposures that encompass a full range of inner to outer ramp facies. Outcrops in this area provide complete and extensive (> 10 km) 3D exposures of the ramp succession in both depositional dip and strike directions.

At Arroyo Cerezo, a 40 m thick and 2 km long, dip-oriented continuous section has been studied in detail. Lithofacies and bounding surfaces have been mapped on a continuous photomosaic and were complimented by five measured sections (500 m spacing) and petrographic analysis. Facies recognized (in down-dip direction) include: 1) low-energy oncolitic rudstone-floatstones and peloidal-skeletal wackestones-packstones, 2) moderate-energy packstones-grainstones with different proportions of peloids, bioclasts, ooids and oncoids, and 3) high-energy ooid-peloid-oncoid and intraclast grainstones that pass down-dip into wackestone-packstones of the offshore proximal environment. Coral-microbial mounds commonly occur in mid-ramp settings.

Detailed inter-well scale mapping of continuous dip-oriented exposures documents distinct prograding ramp clinothems with transitions from inner- to middle-ramp settings occurring within 2 km, where maximum depositional dips are less than one degree. This facies transition compares closely to that observed in many time-equivalent reservoir settings, where relatively short-length facies dimensions and steep depositional dips differ significantly. The Arroyo Cerezo outcrop indicates that the apparent ramp-facies continuity, when based on a 5 km well log correlation, is most likely a lithostratigraphic perspective. Use of detailed spatial and temporal analysis of high-quality outcrop analogs promotes more realistic models for understanding the inter-well, meter-scale heterogeneity governing reservoir fluid movement, and may help optimize and enhance hydrocarbon production.