Integrating Seismic Technology and Core-Log Analysis in Characterization of Reservoirs with Complex Lithologies

Chen, Jiajie, and Don Caldwell, Marathon Oil Company, Houston, TX

In a western African oil field with mixed siliciclastic-carbonate inputs, applying seismic amplitude volumes to resolve reservoir architectures was highly challenging. Here we took an alternative approach – using seismic acoustic impedance (AI) volume as the base for an integrated study involving regional geology, depositional environment, sequence stratigraphy, detailed seismic-core-log correlation, facies analysis, and reservoir modeling. The intervals concerned correspond to two 3rd order cycles, but the AI volumes were actually capable of revealing 4th order cycles by some high AI streaks. We described available cores, linked the seismic AI with log curves and core data, and further developed a depositional model based on which reservoir framework was established. Two new wells were drilled based on this model; both successfully predicted the positions of reservoir tops and payzone distribution. This study led to new understanding on reservoir architecture and flow unit distribution, depositional processes and their relationship with hydrocarbon accumulation. It also provided a reasonable volumetric estimation that was important to our field development plan. We conclude that for a complex geological setting with mixed carbonate and siliciclastic inputs, it is important to apply innovative seismic technology and integrate a large spectrum of datasets and methodologies in order to understand how the depositional systems and associated lithofacies responded to regional tectonic activities and global eustasy sea level variations, and how the reservoir zones distributed under the overall geological setting. All these results prepared us in a better position in business decision and field development.