Geologic Modeling of External and Internal Reservoir Architecture of Fluvial Depositional Systems

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An integrated study of several reservoirs located in central Africa that are interpreted to represent fluvial depositional systems, revealed a systematic updip to downdip variation in external and internal reservoir architecture. Both large-scale and small-scale reservoir descriptions were applied to generate several geologic models that were used for reserve estimates and field-development plans.

The study integrated facies and petrophysical analyses of cored intervals, well-log correlations, 3-D seismic interpretations, and outcrop interpretations. Based on this study, three fluvial-facies belts were interpreted to characterize the subsurface reservoirs. Proximal (updip) fluvial-facies belts are interpreted to represent lowstand fluvial sandstones that are characterized by amalgamated channel complexes that form thick, widespread sheets. Medial fluvial-facies belts are interpreted as lowstand deposits of amalgamated to semi-amalgamated bar complexes that form thinner and less laterally persistent reservoirs. Distal (downdip) fluvial-facies belts are interpreted to represent lowstand sandstones characterized by thin, yet laterally persistent, bar complexes.

Proximal fluvial facies were modeled using typical object-based modeling software to populate the zones with channel elements that are clustered to form channel complexes. Medial and distal fluvial facies were modeled using a recently developed software module that populates the zones with discrete bar elements that are distributed along thalwegs; these elements then are clustered to form amalgamated bar complexes. This bar-modeling capability provided a better description of the inclined shale baffles that bound the fluvial bars, which previously had not been adequately captured in reservoir models. Individual fluvial elements within the facies models were used to control permeability and porosity distributions. The resulting geologic models provided improved reservoir descriptions, which more closely match pressure-transient well tests and short-term production tests than did previous modeling methods.