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Sequence Geometry as a Predictor of Reservoir Architecture

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The role of seismic data in reservoir characterization and prediction of reservoir quality continues to grow in importance as data quality and availability increase. One important limitation of these data is vertical resolution, which is often not sufficient to resolve the cycle/flow-unit scale that is so important for characterization studies. Yet if a link between external sequence geometry as defined by 3-D seismic and flow-unit architecture can be established, then another dimension can be added to the interpretation power of the 3-D data.

One of the greatest advantages of outcrop data is the opportunity it affords to examine the external geometry of a sequence and the internal cycle and flow-unit architecture of that sequence simultaneously. Outcrop analog studies of Cretaceous, Permian, and Pennsylvanian reservoirs document the link between sequence geometry, accommodation, and cycle and flow unit architecture. Important geometric parameters for characterizing external sequence geometry include progradation-aggradation ratio, offlap angle, shelf-to-basin bathymetry, and position of maximum accommodation. These geometric attributes are indicators of the total accommodation of the system, and thus should be linked to better-documented cycle-scale indicators of accommodation (ex. cycle thickness and symmetry, facies diversity and preservation, cycle amalgamation, shingling of cycles).

With the outcrop data as a control, it is logical to test the hypothesis that sequence geometry, as delineated from high-resolution seismic data, could serve as an important tool for predicting reservoir architecture in the subsurface. This approach will be particularly beneficial in fields with lesser well control or where existing simulation models do not adequately explain production history. Examples of seismic expression and internal reservoir architecture will be illustrated to demonstrate the application of sequence geometry as a predictor.