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Quantitative Seismic Geomorphology and Reservoir Architecture of Clastic Depositional Systems: The Future of Uncertainty Analysis in Exploration and Production

Quantitative seismic geomorphology (QSG) is a new discipline that seeks to integrate geomorphologic principles with interpretations of seismic images for quantifying reservoir character, understanding depositional system evolution, and interpreting sedimentology. QSG involves measuring dimensional and spatial information from seismic images and analyzing that data within the context of well-established process geomorphic principles and experimentally derived relationships to develop tools for prediction of reservoir character and depositional systems' architecture.

QSG applied to Pliocene and Miocene units in the northern Gulf of Mexico allow differentiation of fluvial reservoirs, each containing different fill types. QSG applied to Pleistocene units in the deepwater regions of Trinidad allow development of sinuosity vs. slope relationships for prediction of deep-marine architecture around shale diapirs and details regarding run-out distances of debris flows. QSG applied to Tertiary fluvial units in the Gulf of Thailand enables discrimination of detailed reservoir units within large incised valleys and smaller distributary and tributary drainages.

Parameters measured include element sinuosity, meander wavelength and radius of curvature, channel and valley width:thickness, meanderbelt width and rates and directions of meander migration, debris-flow dimensions, scarp heights, run-out distances, and depositional and transport slopes. Lithologic data from well logs and core, as well as relationships derived through experimental- and modern-systems study of similar deposits, have been used not only to ascertain relationships between morphic and petrophysical character, but also to predict spatial distribution of reservoir elements. Probability analysis using quantitative data derived from QSG enables geologists to assess uncertainty, improve estimates of reservoir rock volumes and drainage areas, and improve field design.