Facies-Based Rock Physics in the Nelson Field, United Kingdom Central North Sea – Part I: Petrofacies Characterization

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Calibration of seismic amplitude response requires an accurate prediction of acoustic properties for reservoir and non-reservoir rocks and pore fluids at varying conditions. The estimation of seismic amplitude variation with offset and time-lapse response (4-D) is similarly dependent on reliable rock and fluid property information.

Building on Shell's successful efforts to characterize facies-based rock properties in unconsolidated sediments in Tertiary basins, this study extends the application to older, diagenetically complex rocks in the UK Central North Sea, and reveals significant variability in reservoir quality and elastic properties, for both sandstones and mudrocks.

Nelson Field provides an excellent opportunity to examine the relationship between sedimentary facies and rock properties within channelized turbidites of a basin-floor submarine fan system. The large volume of core and well-derived petrophysical data available allows the creation of a simple lithofacies scheme, based on lithologies, surfaces, sedimentary structures and textural characteristics at mega-and microscopic scales. Reservoir types include coarse-grained and poorly sorted (S-Ta), medium-grained and moderately sorted (Tb and Ta) and fine-grained, laminated sands (Tc). Dirty sands comprise debrites (D) and possible slurry flows (SF). Mudrocks consist of silty, muddy turbidites (MT) and clay-rich, abandonment shales (HS). This classification allows a direct link between petrofacies, facies associations and elastic rock properties.

Using this scheme, facies-derived rock properties can be generated for non-cored wells, integrate them into static reservoir models, provide a better understanding of in-fill targets, and serve as the basis for development of a field-scale elastic properties volume necessary for dynamic (4-D) production monitoring.