

Facies-Based Rock Physics in the Nelson Field, United Kingdom Central North Sea – Part II: Rock Properties

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Our recent experience in a number of global basins has demonstrated the value of an integrated approach to developing rock and fluid acoustic properties for the quantitative interpretation of seismic data. Additional interpretive synergies are realized when the rock properties work is done within a collaborative workflow, leveraging petrologic and lithologic observations to constrain the development of rock physics models.

Reservoir and elastic properties for the identified petrofacies were extracted from key (cored) well control, and subsequently used to develop rational, facies-specific rock physics relationships. The key wells were subject to rigorous data QC and deliberate 'seismic petrophysics', including core-log calibration, fluid acoustic properties modeling, and quantitative shaly sand evaluation. In this workflow, the integration of lab- and well-based data is essential to the development of rock physics models with predictive capability. Distinct facies-specific elastic properties for the reservoir (sand) and non-reservoir (mudstone) lithologies were determined, which are clearly understood in the context of geologically meaningful facies associations. Two important examples of geologically-defined variability: 1) acoustically variable mudstones ('soft' clay-rich mudstones vs. 'hard' silt-rich muddy turbidites); and 2) reservoir quality (porosity, permeability) in clean high NtG sandstones.

The development of these facies-specific results and relationships aid in the understanding of field-wide variation in reservoir properties and expected seismic response. The results can be used to enhance static reservoir model(s), and serve as the basis for developing a field-scale, facies-specific elastic properties volume amenable to dynamic (4-D) production monitoring.