The Multi-scale, Multi-attribute (MA-MS) Calibration; A Methodology for Predicting Sub-seismic Scale Facies from Seismic Attributes

Stright, Lisa [1]; Bernhardt, Anne [1]; Mukerji, Tapan [1]; Boucher, Alexandre [1] (1) School of Earth Sciences, Stanford University, Menlo Park, CA.

Sub-seismic scale rock type prediction is critical in cases where exploration targets are subtle or when sub-seismic heterogeneities impact reservoir performance. However, accurate prediction is inherently challenging due to scale differences between subsurface measurements and the heterogeneous nature of many reservoirs; particularly within deep-water depositional systems. This study focuses on the issues of modeling sub-seismic scale facies while explicitly incorporating the information from each of the disparate data measurements.

A data-driven, multi-attribute, multi-scale (MA-MS) well-to-seismic calibration is presented to address these issues of scale in a statistical rock physics-based framework. This method tackles the pervasive issue of undersampling of subsurface patterns by well logs and cores through statistical rock property generation and forward seismic attribute modeling. In an effort to test our methodology, the general workflow is demonstrated on a subsurface dataset from the Tertiary Puchkirchen Formation in the Molasse foreland basin in Upper Austria. The primary objective was to test if the MA-MS calibration could assist in differentiating thin gas sandstone directly from coarse-scale seismic attributes, guided by the well and core interpretations. The limitations of the MA-MS prediction and its dependence upon the method of seismic attribute generation (i.e., Backus average vs. forward modeling and inversion), varying pore fluid saturations and dominant frequency content is explored through modeling.

The MA-MS cross-plot reveals why it has been so difficult to predict reservoir sandstone with acoustic impedance alone. While distinct at the well log scale, these facies delineations become less distinct at the seismic scale due to smoothing. This inhibits the prediction of the lower proportion thin sandstone, while creating fringe gas sandstone artifacts around mudstone beds. However, by combining P-impedance and Vp/Vs within the MA-MS framework, low proportions of thin-bedded gas sandstone were clearly predicted.