Use of Interbed Multiple Prediction in Acoustic Impedance Modeling: Example from an Eolian Dune Reservoir, Saudi Arabia

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The uppermost member of the Permian Unayzah Formation is an accumulation of Eolian dunes and related deposits, and is an important reservoir of non-associated gas. The seismic data over these rocks appear to be of reasonably high quality. However, due to large contrasts in rock properties in the overlying section, these data are heavily contaminated with coherent interbed multiples. Importantly, these multiples mask primary energy at the reservoir level.

The presumption that seismic data is primarily “clean” is inherent in most conventional acoustic inversion software packages--all energy in the seismic trace is assumed true signal and must therefore be accounted for in the final result. Several acoustic impedance (AI) models have been generated over the formation using these software packages and, while results have been acceptable for limited purposes, the calculated impedance has always understated and underestimated actual porosity in the field. As such, these acoustic impedance models have not been considered useful for preconditioning geocellular models of the reservoir.

A methodology has been recently introduced which incorporates predicted multiple energy into the generation of synthetic seismograms and uses these in the generation of an acoustic impedance model. During calculation of the model, the algorithm separates presumed signal from predicted noise; the final product is an AI model which, if properly calibrated, produces a residual error that consists largely of coherent, interbed multiple noise.

The resulting AI model as run over the reservoir is far more optimistic as a predictor of porosity and has successfully predicted the porosity of a well in a blind test; such data can now be properly incorporated into a geocellular model of the reservoir. The result is a true integration of both geological, geostatistical and geophysical data into the final result.