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Improving Seismic Interpretation by Reducing Uncertainty With 2-D Modeling and Analytics

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ABSTRACT

When dealing with seismic and well data interpreters often face certain challenges characteristic of both data types. Well data and seismic data are in a way quite opposite. Well data is very detailed vertically while 3D seismic data provide very good resolution laterally, but is much less detailed vertically and typically doesn't provide a direct measurement of the physical properties of interest. Well data gives rich detail in specific locations but the rest of the field remains unknown at that level of detail. Seismic data provides a coarse view of everything, but sharp focus is not possible with seismic alone. However, combining both data types using Geologic models one can get a much better and clearer picture which can lead to a more successful outcome. In this discussion we will examine uncertainty reducing workflows associated with forward and inverse modeling techniques. How can we make predictions as to what attributes will uniquely discriminate between reservoir and non-reservoir rocks and fluids with confidence? Forward modeling of geophysical data uses well-defined geological models to calculate specific seismic field responses. Models can be 1D, 2D or 3D and contain properties like density, P- and S-velocities. In the case of 2D-seismic modeling, the physical properties can be taken directly from well log data, where sonic and density logs have been properly tied to an existing seismic data. Empirically established rock and fluid trends can be used to set expectations and constraints for modeling properties. Combining well log data with geologically reasonable model constraints, a number of modeled seismic responses can be constructed. These models can be used in de-risking accessing the ability of seismic attributes to discriminate and validate or invalidate various geologic scenarios. In the inverse geophysical modeling, an attempt is to reconstruct a physical property model from a set of geophysical measurements. In a seismic inversion, impedance values (multiplication of sonic velocity and bulk density) are calculated by converting an existing reflectivity (i.e. seismic) data. The largest challenge is that the inverse modeling has an infinite number of solutions from a given seismic data set. With the help of Simulated Annealing (SA) inversion algorithm, one can greatly reduce the total number of possible solutions by combining a background model with efficient wavelet estimation for an optimized set of model parameters.