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Using Seismic Attributes to Predict Reservoir Properties—Potential Risks

Advances in software for generating seismic attributes and the growing emphasis on production geophysics have led to the widespread use of seismic attributes as predictors of reservoir properties. Often, we can show—using seismic modeling or from rock physics—a physically justifiable relationship between a seismic attribute and the reservoir property of interest. When this is true, we can reduce greatly the uncertainty of interwell predictions of reservoir properties.

The first critically important step in the use of seismic attributes is to accurately tie the well and seismic data—both vertically and aerially. Successful application then relies on identifying a seismic attribute that is significantly correlated with the reservoir property being modeled. If found, the dense seismic data can be used to guide the interpolation between sparse well data using geostatistical, regression, or neural network techniques. The purpose of this process is to estimate volumes of petroleum in place or to make reservoir management decisions such as the location and number of wells, depletion strategy, or gas and water injection operations.

All of the prediction methods—regression, geostatistics, and neural networks—require the interpreter to make inferences from a small number of wells to a larger population assumed to be represented by that sample. Inference should not be based solely on an empirical relationship between a seismic attribute and reservoir property derived from the small sample. This study quantifies the probability of observing spuriously high correlations between the well and seismic data; that is, the probability of observing a significant sample correlation when the seismic attributes are actually uncorrelated with the reservoir property. If the correlation is indeed spurious and the seismic attribute is used as a predictor, not only will the estimated reservoir property be biased, but its error variance will be underestimated. This can lead to highly confident, but very inaccurate, predictions and, ultimately, to poor reservoir management decisions.

Biographical Sketch

Cynthia T. Kalkomey received a Ph.D. in statistics from Southern Methodist University. She worked for 18 years at Mobil's E&P Technical Center for both exploration and producing, most recently as manager of reservoir characterization. She left Mobil in 1998 to start Kalkulations, Inc., her own consulting and training company. Her technical interests are probability and statistics, risk analysis, geostatistics, 3D reservoir modeling, and reservoir characterization.

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