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Sandstone Reservoir Quality Prediction: Methodology and Examples

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ABSTRACT: In regions with high thermal exposures well and seismic data often are an inadequate basis for constraining rock properties in all areas of interest given that wells do not provide sufficient sample coverage and seismic data can be difficult to interpret unambiguously. In such cases sandstone diagenetic models provide a unique means to augment more conventional approaches for rock property prediction when linked to sedimentologic, petroleum system/basin, and rock physics models.

The primary input for our approach toward diagenetic modeling includes compositional and textural characteristics of sandstones at the time of deposition, the effective stress and temperature histories for the sandstones, and model parameter values that are constrained by calibration to analog samples. We couple these process models with stochastic methods that describe the variability in, and co-variations among, compositional and textural characteristics at deposition for a given sandstone type to predict distributions in rock properties through geologic time.

A priori diagenetic models have been developed for a number of important processes including compaction, quartz cementation, illite formation, grain-coating chlorite development, secondary porosity from feldspar dissolution, and plagioclase albitization, among others. We use an a posteriori approach that relies on analog sandstones to consider the effects of diagenetic processes for which accurate deterministic models have yet to be developed. This suite of diagenetic models predicts the composition, texture, and porosity of sandstones through geologic time. These results, in turn, serve as input for models that predict permeability and seismic velocities.

This modeling approach has been used for reservoir quality risk assessment of prospects and plays in a broad range of geologic settings. In field development studies it has been useful for constraining water drive during production by predicting reservoir properties in undrilled flank positions.

Speaker Biography: Rob Lander's primary interest is in understanding the controls on diagenetic processes in clastic rocks and using this understanding to develop accurate models of rock properties away from well control and through geologic time. He is the inventor or co-inventor of several simulation systems for diagenesis and reservoir quality prediction including Touchstone, Prism2D, Exemplar, and Cyberstone.

Rob co-founded Geocosm LLC (based in Durango, Colorado) and co-directs the company's Consortium for the Quantitative Prediction of Sandstone Reservoir Quality (RQC), which was established in 2001 and currently has 23 members. He also is a Research Fellow with the Bureau of Economic Geology and collaborates with the Fracture Research and Applications Consortium at The University of Texas at Austin. Rob established Geocosm in 2000 after a stint as Technical Director of Geologica AS in Stavanger, Norway. Prior to his time in Norway he was a Senior Research Geologist at Exxon Production Research in Houston, Texas. He has a Ph.D. in Geology from the University of Illinois at Urbana-Champaign and a B.A. in Geology from Knox College.

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