Extracting Lithofacies from Digital Well Logs Using Artificial Intelligence, Panoma (Council Grove) Field, Hugoton Embayment, Southwest Kansas

Martin Dubois[1], Geoffrey Bohling[1], Alan Byrnes[1], Shane Seals[2] (1) Kansas Geological Survey, University of Kansas, Lawrence, KS (2) Pioneer Natural Resources USA, Inc, Irving,

PC-based software applications have enabled effective use of digital log data, particularly in the reservoir-engineering realm. Geologic applications are typically focused on reservoir geometry that is then "filled" with generalized lithofacies based on limited subjective observations. Developing lithofacies-robust geologic models for reservoir analysis of large heterogeneous reservoirs like the Panoma Field is impractical by traditional methods. In this study, a neural network implemented in the Excel add-in Kipling.xla was used to predict lithofacies from a large set of digital well logs.

The Panoma (Council Grove) Field in southwest Kansas lies stratigraphically subjacent to the more prolific Hugoton (Chase) Field, and has recovered 2.8 TCF of gas from 2,600 wells since its discovery in the early 1960's. Gas comes from the upper seven fourth-order sequences of the Permian Council Grove Group. Lithofacies controlled petrophysical properties dictate gas saturations and accurate discrimination of lithofacies reduces error in predicted permeability and gas volume.

The neural network function of Kipling.xla was "trained" on data from eight wells including half-foot digital rock descriptions of two thousand feet of core and digital wireline logs. Neural network models were optimized for lithofacies prediction by varying neural network parameters, lithofacies lumping and judicious selection of seven predictor variables. Digital logs from 530 wells were batch-processed and lithofacies and probabilities predicted at half-foot resolution for use in a detailed reservoir model. Techniques employed here could be applied to other large and complex reservoirs where accurate representation of lithofacies heterogeneity in the 3D volume is key to realistic reservoir analysis.