DEVELOPMENT OF A PREDICTION MODEL FOR CARBONATE MICRO-FACIES AND PORE TYPE FROM BOREHOLE IMAGE LOGS OF THE SILURIAN-AGED NIAGARAN-LOWER SALINA PINNACLE REEF COMPLEX OF THE MICHIGAN BASIN

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ABSTRACT

Manual interpretation of borehole image logs is time intensive and highly interpretive, requiring core analysis along with image log analysis. The project will use multivariate statistics and image analysis techniques to generate a prediction model for identifying carbonate micro-facies and porosity type from resistivity image logs focusing on the Niagaran-Lower Salina Pinnacle reef complex of the Michigan basin. The chosen geologic setting has complex stratigraphy, high well density, and available well data including image logs, whole core sections and thin section data. The hypothesis is that carbonate micro-facies and pore types are identifiable in image log profiles using quantitative methods. One-to-two wells with all of the required data (resistivity and acoustic image logs, core sections, and thin sections) will be chosen as the primary well for modeling. A training data set, derived from physical facies and porosity characterizations in cores and thin sections will be correlated to the image log profile. The image log data will then be parameterized by examining aspects of the acoustic and resistivity logs including spatial distribution, shape, thickness, and resistivity value quantitatively using pattern recognition techniques. The shape of pores will be characterized using Fourier analysis. Multivariate discriminant analysis will then be used to identify-significant classification attributes required to build the model. A multi-class supervised classification model will be built for both acoustic and resistivity logs and pore shapes. The model will be calibrated using log response and cores from a second well array. The prediction model generated by this project may be applied to similar geologic settings, and used as the basis for algorithms that generate automated facies and pore-type predictions from image log data, thus cutting costs and providing insight into lateral changes of lithology, facies, porosity, and reservoir characteristics.

AAPG Search and Discovery Article #90298 2016 Grants-in-Aid Projects