Facies Analysis and Permeability/porosity Prediction from well log data using the Non Parametric Regression with Multivariate Analysis and Neural Network in the Reservoirs of the Hassi R'Mel Southern Field (Algeria)

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Abstract

The knowledge of permeability is critical to developing an effective reservoir description. Permeability data can be obtained from well tests, cores or logs. Normally, using well log data to derive estimates of permeability is the lowest cost method. To estimate permeability, we can use values of porosity, pore size distribution, and water saturation from logging data and established correlations. One benefit of using wireline log data to estimate permeability is that it can provide a continuous permeability profile throughout a particular interval.

This paper will focus on the evaluation of formation permeability for a sandstone reservoir in the reservoir formations of Hassi R'Mel Field Southern from well log data using the Multivariate methods. In order to improve the permeability estimation in these reservoirs, several statistical regression techniques have already been tested in previous work to correlate permeability with different well logs. It has been shown that statistical regression for data correlation is quite promising in. We propose a two-step approach to permeability prediction that utilizes non-parametric regression in conjunction with multivariate statistical analysis. First we classify the well log data into electrofacies types. A combination of principal component analysis, model-based cluster analysis and discriminant analysis is used to characterize and identify electrofacies types. Second, we apply non-parametric regression techniques to predict permeability using well logs within each electrofacies. Three non-parametric approaches are examined via alternating conditional expectations (ACE), generalized additive model (GAM) and neural networks (NNET) and the relative advantages and disadvantages are explored. The results are compared with three other approaches to permeability predictions that utilize data partitioning based on reservoir layering, lithofacies information and hydraulic flow units. An examination of the error rates associated with discriminant analysis for uncored wells indicates that data classification based on electrofacies characterization is more robust compared to other approaches. For Porosity and permeability predictions, the ACE model appears to be the best among the three non-parametric approaches.

Keywords
Well logs; Permeability; Multivariate Statistics; Neural Network; Hassi R'Mel; Algeria