

Formation Evaluation and Permeability Prediction in a Highly Heterogeneous Reservoir – The Kuparuk C-Sand

Klein, Jim D.¹, Mark Scheihing¹, Laird D. Little², Dirk Seifert² (1) ConocoPhillips, Houston, TX
(2) ConocoPhillips Alaska

The Kuparuk River Field in Alaska is one of the largest oil accumulations in North America. Approximately one-third of the OOIP is contained in the C-sands, which are shallow marine sandstones characterized by intense bioturbation and complex diagenesis. Siderite content is extremely variable, leading to large variations in permeability, porosity, and capillarity on the sub-foot scale.

Interpretation of mineralogy, porosity, and water saturation from wireline logs is relatively straightforward, provided mineralogy and core heterogeneity are considered. Predicting log permeability is more difficult due to extreme scatter in porosity-permeability cross plots. Deterministic porosity-permeability transforms are poor predictors, since the results do not replicate the scatter present in the core data.

A new method has been developed for the prediction of permeability. This method is based on random selection of values of core bulk density from sub-groups based on log RHOB and petrofacies. For each log depth, selection of core bulk density points is repeated until the density averaged over a sliding window matches the RHOB log. The values of core porosity and permeability that correspond to the selected value of core bulk density are then selected as the final result at each depth point. The method duplicates the statistical distributions of the core porosity and permeability values, with values obtained every half-foot. Upscaled permeability at 1 and 2 ft increments match kH based on core-plug data, on a well-by-well basis. The values are also consistent with kH determined from maximum flow rates observed in a large number of wells.