Advances In Core Characterization Of Carbonate Reservoirs

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ABSTRACT

Alberta contains significant deposits of oil and gas in carbonate formations. These carbonates generally have tight matrix structures, resulting in low primary porosity and permeability. As a result, laboratory characterization of carbonates is a slow and tedious process. In recent research projects we combined a number of different techniques to address the core characterization of several carbonate formations hoping to obtain some generalized predictive correlations for carbonate reservoirs.

Considerable work was done using low field NMR, which is an emerging technology that shows great promise in rock characterization. In a single NMR experiment, rock properties like porosity, irreducible water saturation (Swi) and permeability can in theory be measured. Previous results in the literature give disparaging accounts of NMR's applicability for carbonates; this work investigates the difficulties in estimating the properties of complex pore systems and demonstrates that low field NMR can be a valuable tool for carbonate reservoir characterization.

The experimental procedure complemented NMR spectra with several other core analysis methods, including porosity from gas expansion, porosity from brine saturation, air and brine permeability and x-ray tomography. Several cross-correlations and empirical models were tested against the experimental data.

The results show that porosity estimates from NMR match very well with those obtained from gas expansion and brine saturation. Swi estimations also agree with the values obtained from mass balance. The existing permeability models fail to predict accurate values for these samples. The new correlation, which is based on the relative fractions of small and large pores present in the rock, seems to be better at predicting permeability. Without knowledge of pore connectivity, however, the permeability predictions are still quite poor.