NMR CHARACTERIZATION OF PORE SPACE ATTRIBUTES OF THE FONTAINEBLEAU SANDSTONE

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Abstract

The Fontainebleau sandstone is well known for its homogenous mineralogical makeup (99% quartz), large grains (~250 µm), good sorting, silica cement, and a wide range of porosity and permeability. The lack of impurities on the grain surfaces of this sandstone imparts a lower surface relaxivity as compared to other sandstones and makes nuclear magnetic resonance (NMR) analysis complex.

We quantify NMR petrophysical properties such as porosity, pore size distribution and permeability for 63 Fontainebleau samples. We measured longitudinal (T_1) and transverse (T_2) relaxation times using inversion recovery (IR) and Carr-Purcell-Meiboom-Gill (CPMG) pulse sequences, respectively. We use other petrophysical properties, such as helium porosity and permeability, formation factor, and conductivity as reported in the literature.

We find that NMR and helium porosities agree within 1 p.u. difference for porosity values lower than 13 p.u. and within 2 p.u. for larger porosity values. We identified 4 classes of samples using porosity, permeability and logarithmic averages of T_2 (T_{2LM}). Each group shows narrow porosity and permeability ranges with wide and overlapping T_{2LM} ranges. The large change NMR - T_{2LM} response does not correspond to significant changes in porosity and permeability. We postulate that the T_{2LM} variations within each group are indicative of changes in the surface area that, in turn, is controlled by diagenetic rock cementation. We will present results of restricted diffusion and permeability models from Coates and SDR methods coupled with nitrogen adsorption data to model surface changes.