Applications for NMR Rocking-Typing: Concepts and Preliminary Ideas

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Most people associate Nuclear Magnetic Resonance (NMR) core analysis with the calibration of NMR logging data. Few associate NMR core data with sedimentological observations or the obvious link between sedimentology and rock typing. Our preliminary work shows that quantitative data derived from NMR core analysis provides an excellent tool for rock typing. Our experience also shows that NMR is completely compatible with mineralogical and textural information as well as with Mercury-Injection Capillary Pressure (MICP).

Rock typing is a well used technique for geological modeling. Too often, however, individuals base rocks on observations instead of measurements. Typically, the basis for rock typing comes from core description, thin section description or something similar. Descriptive rock types are instructive but too often fail to fit well into the geological model largely because it is impossible to upscale non-quantitative parameters with certainty.

Results from out work show that geometric variations imparted to rock formations from the combination of depositional processes and diagenesis processes are infinite. The range of variation explains why it is difficult to formulate rock-typing schemes from standard approaches. Even measured porosity and permeability distributions fail to characterise the variation because these values are not even unique to lithology much less to a set of petrophysical parameters.

NMR core data makes it possible to encapsulate the range of variability and identify groups having similar characteristics. Our studies show that rocks from different reservoirs group naturally into envelopes bounded by end members. One end member is the rock type having the largest abundance of small pores while the other end member is the rock type having the largest abundance of large pores. Members of the subfamilies will reside within the envelope. Subfamilies represent the variations in pore geometry that is the continuum created subtle differences impart to the rock by the depositional and diagenetic processes. It is possible to characterise the unique distribution of pore-size abundances statistically, which provides a quantitative measure for segregating pore types into families having similar pore geometries.

Another interesting aspect of NMR is the ability to upscale simply by summing individual distributions, which is a technique similar to stacking data. The variability inherent in one sample is transferred to the next sample accentuating the predominant pore-geometric feature (i.e. samples having an abundance of large pores added to a sample having an abundance of large pores will create a hybrid carry characteristics of both and weighted by the amplitude of the data.