CALCULATING VOLUME FRACTION OF CLAY, SILT AND SAND FROM NMR LOGS

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Nuclear Magnetic Resonance (NMR) tools measure a lithology independent porosity through the processes of longitudinal relaxation (T1) or transverse relaxation (T2) of hydrogen nuclei. It is generally accepted that in water-filled pores, the T1 and T2 distribution profiles are equivalent to a pore size distribution.

In clastic rocks, small pores are associated to clay bound water and capillary bound water, and there is a strong correlation between pore size and grain size. Since clay, silt and sand can be classified in terms of their particle size, the distribution of T2 relaxation times can also be used to estimate their respective proportion within the rock matrix.

Mattheson has shown that the NMR relaxation time of clays depends on their compaction, and that there is no universal T2 cut-off to differentiate clay types. However, we have observed that the partitioning of T2 distribution into clay, silt and sand is a robust method that can be applied to the following clastic rocks evaluation:

- Clay volume based on pore/grain size; direct measurement, independent of radioactive or heavy minerals and of formation fluids.
- Silt and sand volumes based on pore/grain size; direct measurement, comparable to Density vs. Neutron or Matrix Density vs. Capture Cross-section methods.
- Lithology independent Total and Effective Porosities; direct measurement comparable to Density, Neutron or Sonic porosities.
- Volume of Irreducible Water based on pore size; direct measurement, essential to reduce uncertainty of hydrocarbon volume in shaly sands and thin beds.

We present applications of this method and a comparison to conventional analysis on log data from North East Borneo deepwater environment.
Volumes of clay, silt and sand, and total and effective porosities from NMR are displayed next to the conventional analysis from GR, Density and Neutron logs.

NMR T2 distribution partitioned into pore size, grain size and rock type.