Calibrating Nuclear Magnetic Resonance (NMR) Response to Capillary Pressure Curves in Fine Grained Lithologies: Pretty Hill Formation, Otway Basin, South Australia

Al-Ghamdi, Ali[1], J. Kaldi[2], P. Boult[3], P. Tingate[2] (1) Saudi Aramco, Dhahran, Saudi Arabia (2) University of Adelaide (ASP), Adelaide, Australia (3) Primary Industries and Resources, South Australia, Adelaide SA, Australia

Nuclear magnetic resonance (NMR) tools are commonly used in formation evaluation. NMR T2 distribution data have been used previously to build down-hole pseudo capillary pressure (PPc) curves in reservoir quality rocks. The objective of this study is to generate NMR-derived down-hole PPc curves in fine grained lithologies in order to estimate displacement pressures and thereby sealing capacity.

NMR T2 relaxation time distributions of flood-plain facies at Redman-1 were converted to PPc curves. Displacement pressures were selected from PPc curves and compared with actual MICP curves at different percentages of non-wetting phase saturation. The best percentage in displacement pressure estimation is the 20% saturation with correlation coefficient of 0.59. Statistically, the correlation coefficient of the 20% saturation is too low for meaningful calibration.

The reason for the lack of robust calibration is related to the actual properties of the rock: the Redman-1 flood-plain samples have high iron contents (Fe2O3 content between 5.21-7.16 wt%). The iron is mainly fixed within chlorite and biotite in these samples. Consequently, T2 response is affected by the internal magnetic field gradients which depend on the magnitude of the magnetic susceptibility. Surface relaxivity changes and high pore to throat size ratio also contribute to the difference between the two measurements.

Magnetic susceptibility, surface relaxivity and pore to throat ratio affect significantly T2 response. Therefore, using the NMR response to estimate displacement pressures in iron-rich, fine grained rocks is not recommended. However, further studies in rocks of low magnetic susceptibility might yield more significant correlations.