

An Assessment of NMR Permeability Response in Carbonate Reservoirs

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Permeability calculations from nuclear magnetic resonance (NMR) devices have been proposed in various ways. The most commonly used model is the Coates equation that requires previous knowledge of the formation or lab-derived measurements to calibrate model parameters.

The Bray-Smith equation for direct calculation of permeability from only the NMR T2 response has recently been proposed and applied in a number of different North American reservoirs. Results have been very promising in sand, shaley sand, and conglomerate reservoirs. A significant number of comparisons of calculated and actual permeability have created great confidence that these values are valid in these reservoirs.

Carbonate reservoirs can be more complex. Secondary porosity from fractures is almost identical to that observed in siliceous reservoirs. Other types of secondary porosity are unique to carbonate reservoirs, which include vugs and solution enhancement of existing irregularities in both deposition and composition of the reservoir. An adequate description of these characteristics is desirable to help determine the productive potential of these reservoirs.

This paper demonstrates the application of the Bray-Smith permeability equation to determine the production capacity of these formations. In our study, we include examples of NMR T2 derived permeability in pure, unaltered carbonates, sections with secondary porosity from fractures, secondary porosity from solution enhancement, and examples of vugular porosity development. There are also samples of NMR porosity descriptions compared to formation imager responses.

This paper presents a comparison of predicted production rates versus actual production rates in these reservoirs.