

Magnetic Resonance Utilization as an Unconventional Reservoir Permeability Indicator

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Unconventional reservoirs require unconventional solutions. Horizontal drilling into these reservoirs followed by intensive perforating and fracture treatment techniques have been the accepted standard for producing these wells. The general thought process was that the closer these perforations could be placed and treated, the greater the production rates.

Recent papers that show the results of production logs in the horizontal sections of these wells present a dilemma. Even though many different intervals have been attempted in the wells, only one or two of the intervals in each well are actually producing—either the completions are ineffective or the production logs are suspect.

In addition, data published recently also show the plastic nature of these unconventional reservoirs. In one study, the rock was placed in three-dimensional stress conditions and then perforated. Within 48 hours, the perforation tunnel had closed off, eliminating the ability of fluids to migrate to the well, which could also be a source of decreased production. A technique was required to find intervals of the well that could support open perforations to maintain contact of the formation to the well.

Magnetic Resonance Imaging Logs were added to the logging program to establish additional parameters that could be used for reservoir description. The Bray-Smith equation, which has been used for several years to describe permeability, was used as a base for adjustments. The observation for the relationship of the bin size definition to permeability was established through laboratory NMR work. The algorithm was adjusted to apply specifically to unconventional reservoirs. We have already used this relationship to select additional intervals for perforation and treatment and have eliminated other sections that would have been completed under the previous completion programs.

In this paper, we present the base case for this relationship and establish the general relationship between bin size and unconventional permeability. We expect to publish conclusive relationships of unconventional reservoir permeability to production rates as we acquire a history of data.