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Quick and Simple Porosity Measurement at the Well Site

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Porosity is the single most important petrophysical property. Typical measurements of porosity are done via down hole logging tools and core analysis. These methods either do not generate immediate porosity data while drilling, are complex, expensive, or prone to error. Furthermore, modern drilling produces cuttings that are not suitable for most conventional porosity measurements as they are crushed into very small “grain like” pieces. Nuclear Magnetic Resonance (NMR) measurements overcome the shortcomings of traditional porosity measurements, allowing porosity to be determined efficiently and accurately on drill cuttings. In addition, the NMR measurement of the cuttings provides not only the porosity but the pore size distribution as well (assuming the cuttings are not crushed beyond the pore size).

We have developed a simple measurement of porosity using benchtop NMR on modern drill cuttings. This has included extensive work in optimizing our experimental technique to minimize error which we will describe in this talk. For instance, to measure the porosity of cuttings, they must first be saturated with water. During this saturation process, the cuttings acquire a significant amount of water on the surface of the cuttings which can be confused for water in the pores during the NMR measurements. This can lead to an overestimation of the porosity of the cuttings. We have developed a unique method for eliminating the surface water involving centrifugation of the cuttings prior to the NMR measurement. Our experimental technique has been tested on both shale and sandstone samples to date. Using crushed core plugs as a surrogate for cuttings, we have been able to reproduce porosities to within 5% of the known porosities for both shale and sandstone samples.

Currently, we are furthering our testing by using real cutting samples from different fields, predominately from unconventional reservoirs. The results of this survey will be discussed in this talk, including problems in reproducing porosity for cuttings derived from polycrystalline diamond bits.