# Characterization of Hydrocarbon Reservoirs Using Pore-Scale Measurements and NMR: A New Approach to Lowering Risk in Carbonate Field Development

**Aaron J. Adams[1] and Wayne M. Ahr[2]**

[1]Anadarko Petroleum Co., 1201 Lake Robbins Dr., The Woodlands, Texas 77380

[2]Department of Geology and Geophysics, Texas A&M University, College Station, Texas 77843-3115

## ABSTRACT

**Carbonate reservoirs are a network of pores and connecting pore-throats that contain at least half of the world's oil. Genetic classification of carbonate pores enables one to map the pore types that have the greatest influence on reservoir performance. Though nuclear magnetic resonance (NMR) logging has been used to estimate pore sizes, it has not been used to identify genetic pore types or to aid in determinations of reservoir quality for different pore assemblages.**

**Five genetic pore types were identified in 40 carbonate and seven sandstone samples from the Alabama Gulf Coast, Texas Panhandle, and Australian Shelf. Results demonstrate close correspondence between NMR-derived pore volumes and 2D pore size and shape gleaned from petrographic image analysis (PIA). Comparisons of real and synthetic pore shapes showed that shapes of all pore types in the medium size range of 20-500 microns (0.02-0.5 mm) can be reliably compared with synthetic varieties, but such comparisons were unreliable for vuggy pores smaller than 500 microns (0.5 mm). T2 relaxation curves revealed distinct amplitude and wavelength patterns between the various genetic pore types. NMR-derived pore volumes on pores with ferroan dolomite interiors underestimated pore diameter by up to three orders of magnitude. Calculated pore-throat sizes from mercury injection capillary pressure (MICP) data correlate strongly with measured permeability.**

**Samples with high, intermediate, or low poroperm values exhibited characteristic T2 curves confirming that reservoir quality can be estimated from NMR measurements, even in carbonates. This new approach will improve flow unit mapping, advance the understanding of compartmentalized targets, and accordingly lower the risk in overall field development.**

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