UNCONVENTIONAL CARBONATE RESERVOIR CHARACTERIZATION USING SONIC VELOCITY AND CHARACTERIZATION OF PORE ARCHITECTURE: AN EXAMPLE FROM THE MID-CONTINENT MISSISSIPPIAN LIMESTONE

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The Mid-Continent Mississippian Limestone is an unconventional carbonate reservoir with a complex history. Oil and gas have been produced from vertical wells for over 50 yr, but horizontal activity has illustrated how crucial it is to understand the petrophysical characteristics to target producing intervals.

The objective of my project is to identify how the relationships between sonic velocity, porosity, pore architecture, and permeability in carbonates dominated by macro-pore systems differ from carbonate mudrocks containing pores at the micro- to nano-scale. Identification of how these dominant pore systems differ, and confirmation of key pore architecture features that control permeability within carbonate mudrocks has the potential to enhance predictability of porosity and permeability trends within fine-grained, low porosity, low permeability carbonates.

The velocity response has been measured from four cores in Oklahoma and one core from Kansas. Thin sections are available for the cores located in Oklahoma but need to be created for the Kansas core. Samples from one core in Oklahoma have been analyzed with a scanning electron microscope using argon milled samples, but analysis from the remaining cores are required to understand how the pore architecture varies within the data set. A subset of samples from key facies identified from a high resolution sequence stratigraphic analysis will be analyzed using a micro-CT machine to obtain a three-dimensional (3-D) view of the pore architecture. The high resolution 3-D CT scans will be correlated to the two-dimensional data set from static photomicrographs to better understand how different pore types relate to the total permeability.

AAPG Search and Discovery Article #90249 2015 Grants-in-Aid Projects