Shale Reservoir Properties from Digital Rock Physics

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A majority of the whole core samples recovered in the US today come from shale reservoirs. The uncertainty in interpreting shale well log data is sometimes matched or exceeded by the uncertainty observed in traditional methods of analyzing core samples. Most commercial core analysis methods in use today were developed originally for sandstones and carbonates exceeding 1 millidarcy in permeability. High quality organic-rich shale on the other hand is usually lower than 0.001 millidarcy. This extreme low permeability creates substantial challenges for existing methods and has contributed to the rapid rise of a new approach to reservoir evaluation called Digital Rock Physics or DRP.

DRP merges three key technologies that have evolved rapidly over the last decade. High resolution diagnostic imaging methods that permit detailed examination of the internal structure of rock samples over a wide range of scales; advanced numerical methods for simulating complex physical phenomenon; and high speed, massively parallel computation using powerful graphical processing units (GPU's) that were originally developed for computer gaming and animation.

Based on pore-scale images from a wide range of organic shales, it can be seen that organic material is present in a variety of forms. Three primary forms, non-porous, spongy, and pendular are commonly observed. These pore types are largely controlled by kerogen type and thermal maturity, and they exert large influence on the porosity, permeability, and overall shale reservoir quality.