Eagle Ford Pore Architecture for Reservoir Optimization

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Abstract

Viewing a reservoir at the grain and pore scale results in enhanced understanding, by providing information on porosity distribution, organic material volume, and organic material pore textures. This presentation describes the methodology and results of an unconventional reservoir study which identified the distribution of porosity and organic matter (OM), as well as the relationship between porosity and permeability. Our dataset comprises both 2D scanning electron microscopy (SEM) images and 3D Focused Ion-Beam Scanning Electron Microscopy (FIB-SEM) volumes.
The data and images analyzed reveal some important facts about the Eagle Ford shale. Some of these observations are:

- Predominant pore type in Eagle Ford is dependent on zone (Upper EF or Lower EF) and maturity
- Pendular (bubble) type organic matter (OM) pores are more common in oil window Both pendular and spongy type OM pores are common in gas/condensate window
- More mature samples have smaller average pore sizes than less mature samples.
- Different porosity-perm trends reflect differences between upper and lower Eagle Ford and differences in thermal maturity.

The current assumption is that OM is originally solid and that, depending on the initial OM composition, it develops porosity with increasing maturity. The pendular porosity probably develops first in the oil window then later, in a second stage of maturation in which gas evolves, the spongy porosity may develop also. Some samples develop only spongy porosity. This may be due to initial OM composition or perhaps a more rapid rate of burial and maturation.

Some samples have little porosity in the OM even though the conditions for maturation existed. This may be due to initial OM composition, or the porosity may have been created then lost due to compaction and outward migration of hydrocarbons. Considerable uncertainty remains, especially about how the OM composition varies on a microscopic scale, but digital rock physics and SEM imaging provide unique capabilities for unraveling some of shale’s mysteries.