

Improving Shale Reservoir Evaluation Using Digital Rock Physics for Smarter Core Plug Sampling

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The rise of unconventional shale plays as an economically feasible way for producing oil and gas has spurred core analysis into adopting techniques for shale reservoir characterization that's traditionally used for conventional reservoirs. Well log data is used to determine plug sampling locations but can fail to capture the resolution needed to accurately account for heterogeneities at the whole core and plug scale. Without enough supporting data to help supplement traditional well logs, shale core plugs meant to characterize the reservoir are taken indiscriminately. Traditional laboratory analysis can then take several months to return results, leading to an inefficient and costly method of reservoir characterization.

The combination of Digital Rock Physics (DRP) and high resolution X-Ray and FIB/SEM imaging can help supplement well log data. The CoreHD® workflow, utilizing 0.625mm resolution X-Ray CT imaging of whole core, uses dual energy scanning to produce density and effective atomic number logs. Analysis of the CoreHD® logs allow for the observation of mineralogical/lithologic changes at much higher resolutions compared to traditional well logs. The CoreHD® data can be qualitatively categorized into CoreHD® facies which clusters the data points into a four or more partition color-coded representation of density and effective atomic numbers. The signatures of these color partitions are directly related to the combinations of low to high density and effective atomic number values, which represent varying amounts of silica and carbonate material and varying porosity.

Further FIB/SEM imaging of plugs chosen from each CoreHD® facies analysis shows lithologic and porosity changes that are reflected in the CoreHD® logs. Therefore, using the CoreHD® facies analysis helps provide plug locations that are more representative of the variations present in a shale reservoir, concentrating on the elements of rock that determine the reservoir's performance.