Insights of Core Analysis Data Interpretation by Use of Digital Rock Physics

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Abstract:

Digital rock physics (DRP) has been around for decades and is continuously improving with advancements of high-resolution imaging, faster-computing, and improved understanding of fluid flow in porous media. Traditional DRP applications have been predicting rock properties in challenging conditions such as unconsolidated samples, tight rocks, and irregular-shaped samples that are difficult to measure. In this study, DRP is used to better understand physical measurements, their interpretations, and reconcile different core analysis data for more complete formation evaluation.

Carbonate cores were mounted in a specially designed high pressure MicroCT core-holder as such stress can be applied to the imaged core to simulate reservoir stress. High resolution microCT was used to scan the samples at different stresses to monitor the effect of stress on pore structure. Based on the high-resolution images, DRP was used to extract rock capillary pressure (Pc) at different stresses, which allowed to evaluate the effect of stress on rock properties. To complement and calibrate petrophysical properties derived from DRP, rock characterization was carried out including XRD, thin section, SEM, porosity and permeability, followed by measurements of Pc using centrifuge and porous plate methods at different stresses.

Results from this study of integrating DRP and physical measurements show that Pc obtained by different methods agree well at ambient conditions. With increasing in stresses, differences in Pc have been observed, which allowed to provide correlations between applied stress and differences in changes in rock properties, which can then be used in integrated reservoir studies.

In summary, DRP helps to explain physical measurements and interpreted results to gain insights of complex relationships between rock properties and test conditions of core analysis..

Bio:

Mohammed Al Hamad is a Team Leader, part of the Geology, Rock Physics and Recovery Group at SDCR (Schlumberger Dhahran Carbonate Research Center), located in the Dhahran Techno-Valley. He joined SLB in 2012. Mohammed obtained his bachelor's and master's degrees both in petroleum engineering from KFUPM. He invented and co-invented a number of patents and published several journals and conference papers. In 2016, 2017, 2019 and 2020 he was Recognized by SPE-KSA Young Professional as a winner of the KSA Research Paper Contest. His areas of interests include EOR, petrophysics, interfacial science and reservoir engineering.