



New Rock Physics Company Ingrain Pioneers Digital Rock Properties Measurement

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At this year's SPE Annual Technical Conference and Exhibition, first time attendee Ingrain brings the upstream industry a new paradigm in rock properties measurement that allows operators to create smarter, more efficient field development plans.

The oil and gas industry's future lies in maximizing fields already in production and developing unconventional assets – opportunities that come with a range of technical challenges that previously prevented their development. It is imperative that the industry develop new, digital technologies that allow operators not just overcome the challenges of increasingly complex assets – but allow them to do so efficiently and effectively.

Ingrain was formed in 2007 to commercialize a game-changing technology that is based on a novel approach that unites advanced imaging techniques with patented computational methods. First, high-resolution (< micron) images of rock fragments, such as cores, plugs or drill cuttings, are obtained. The images are then processed to accurately delineate the sample's pore space. The resulting "digital rock" is then subjected to virtual experiments that rigorously simulate physical reservoir conditions, such as flow properties. Based on patented algorithms, these computations determine a range of basic and complex rock properties, including porosity, absolute permeability, capillary behavior, relative permeability, electrical conductivity, elastic constants and velocities, and grain and pore-size distributions.

Ingrain's digital process allows operators to make quicker, more informed decisions. Conventional reservoir rock-property measurements begin by stopping on-site operations to obtain a core sample – an incredibly costly procedure. This sample is then sent to a lab, where physical experiments are conducted – a time consuming process that greatly reduces the utility of the resulting data in on-site operations. Further, the physical experiments cause the rock sample to deteriorate; meaning only a limited number of experiments can be conducted. This limits the number of reservoir scenarios that can be tested and the amount of information that can be obtained from an operator's reservoir.

Key benefits of Ingrain's technology include:

- Results that can be used in operational decisions: Ingrain's digital process enables near real-time computational experiments to provide definitive results for processes like multiphase fluid flow that currently take days or weeks in a physical laboratory. Multiple measurements also can be taken across a reservoir, allowing reservoir engineers to obtain continuous logs of permeability and other computed properties.
- Accurate Measurements on a Wide Range of Rock Types: The imaging component of Ingrain's method vastly expands the types of rock for which properties can be measured, ranging from the most friable oil sands to the tightest gas sands, as well as carbonates.
- Reduced Need for Costly Coring Operations: Ingrain's technology is conducive to smaller fragments of rock, such as drill cuttings, that simply cannot be processed in a physical laboratory. Measuring physical properties from cuttings greatly reduces and often even eliminates the need for costly and risky coring operations.
- Enhanced Information on Mature Fields: Vast repositories of already stored drill cuttings and cores can now be efficiently mined to populate reservoir models with accurate physical properties that are crucial to formulating field management strategies.
- Non-Destructive Procedure Allows Repeated Tests on the Same Sample: Ingrain's digital rocks can withstand endless virtual experiments, compared to physical samples that often break down under the stress of traditional tests. Working with a digital rock ensures that the established relationships among all measured properties accurately characterize the rock sample.

By providing operators with unprecedented insight into their reservoirs, Ingrain's technology is allowing upstream operators to more effectively develop their fields today. For more information on Ingrain's digital rock

INGRAIN



properties measurement process please stop by booth number 2553 throughout the Society of Petroleum Engineers conference.