

A new digital rock physics lab has just been opened in Abu Dhabi, offering clients the ability to get detailed and accurate reservoir characterisation data within just 60 days, saving months or even years over traditional physical labs. We spoke to Ingrain's Manager for the Middle East region, Gary Sinclair about his company's latest venture.

Reservoir characterisation fast-tracked by new digital lab



Ingrain's innovative new lab



Gary Sinclair

Congratulations on the opening of Ingrain's new Digital Rock Physics Lab in Abu Dhabi. What services will the lab provide?

Ingrain provides special core analysis services (SCAL) using 3D imaging and computed simulations. By digitising reservoir rocks in 3D at extremely high resolution and analysing them, Ingrain can quickly and accurately deliver crucial information for reservoir characterisation.

Ingrain's technologies fall into three categories – CoreHD® whole core CT imaging and logging, vRock® digital reservoir rock creation, and computational algorithms for SCAL. The heart of Ingrain's technology is the high-resolution 3D imaging of reservoir rock samples and creation of vRock® digital reservoir rocks. vRocks® can be created from whole core, sidewall cores or even drill cuttings. From these vRocks®, Ingrain uses proprietary algorithms to determine rock properties such as porosity and absolute permeability as well as produce SCAL data (including relative permeability, capillary pressure, Archie's exponents "m" and "n," and elastic properties).

The greatest value to operators in the Middle East region can be achieved by using Ingrain's multi-scale digital rock physics workflow. Using the CoreHD® Suite and rock properties computed from vRocks®, operators can quickly identify rock types within whole core and accurately assign upscaled rock properties such as porosity

(including micro-porosity), absolute permeability, relative permeability and capillary pressure. This proven workflow delivers accurate SCAL results within 60 days, compared to months or even years from conventional physical labs.

Please can you give us some facts and figures about the lab, such as how many employees the lab will have, what equipment will be in use, the cost of setting the lab up, location etc?

Our 950 sqm purpose designed facility is situated in Mussafah, Abu Dhabi. We currently have seven employees based in Abu Dhabi and this team is supported by staff from our Houston (US) Head Office as and when required. We plan to increase the number of Abu Dhabi employees up to fifteen by year end.

"The Ingrain digital rock physics lab produces SCAL data from whole core, core plugs and even drill cuttings, and does so much faster than conventional physical labs"

To date, we have installed and commissioned a high resolution macro scanner with a scan resolution of 0.5 mm. This machine is capable of scanning whole core and plugs in a very rapid time frame. In addition we have a Micro CT scanner that can scan a range of resolutions sufficient to resolve the micro pore space associated with carbonates in the Middle East. Additional scanners will be added as required by workload.

The set up of the Abu Dhabi facility is the result of a multi-million dollar investment by Ingrain over the past year.

What benefits do you hope the lab will bring to clients within the region?

The Ingrain digital rock physics lab produces SCAL data from whole core, core plugs and even drill cuttings, and does so much faster than conventional physical labs, and at lower overall cost.

Physical SCAL experiments are costly, can be difficult to conduct and are prone to inaccuracies. In the physical lab, many core plugs must be cut to provide an acceptable pool from which plugs are selected for SCAL work. Typically, two or three times SCAL tests are run to provide one result that is acceptable to the reservoir engineer. Ingrain's digital rock physics lab provides full SCAL results within a matter of weeks. Most importantly, Ingrain can produce all SCAL results

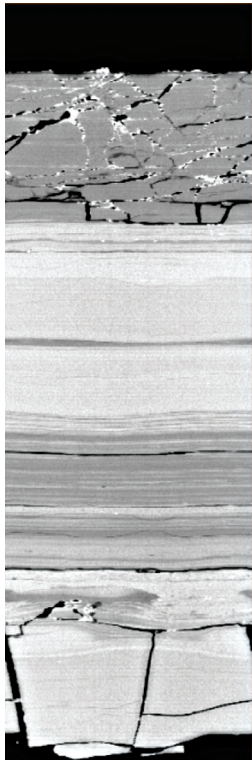
from the same individual rock sample, which significantly reduces the cost, waste and error typical of physical core analysis methods. Furthermore, the operator can make informed sample selection decisions using CoreHD® data, which means that fewer plugs need to be cut and fewer tests run. When taken as a whole, the digital rock physics SCAL services provided by Ingrain are a dramatically better value than physical SCAL programs.

Oil companies considering new venture acquisitions can also gain from the use of the Ingrain services. Often, acquisition decisions have to be made in a rapid time frame with limited access to field data. Digital rock physics data can be provided in a time frame that allows reservoir data to be provided to aid the acquisition decision.

You recently announced the launch CoreHD® technology. Can you explain what exactly CoreHD® is please?

CoreHD® is Ingrain's technology for high definition CT scanning and logging of whole core, from which we produce the CoreHD® Suite of three products:

Continuous Core Viewer: Consists of a continuous movie (.mpg file format) of approximately 2000 0.5mm digital cross-sections per meter, indexed to a Z-axis 2D image of the whole core to show the location of the image slice being viewed. This is the basic deliverable from Ingrain's whole core CT scanning. It provides superior image quality compared to conventional whole core CT scanning. The movie file can be viewed in any commercial media player that is capable of showing MPEG files (Quicktime, Windows Media Player, etc).



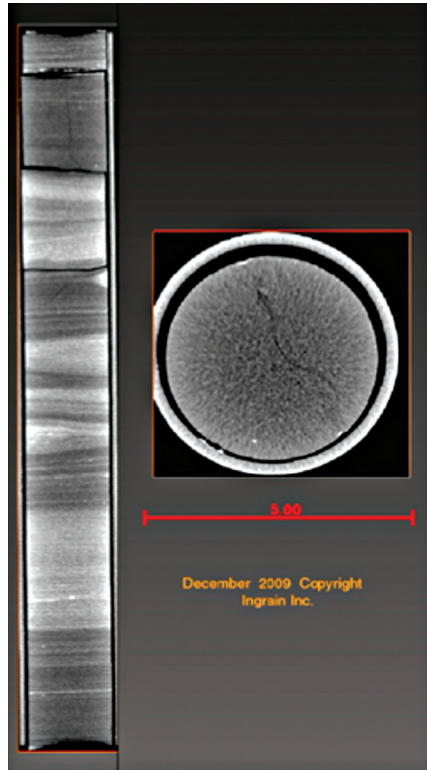
CT borehole

CT Borehole Image: Ingrain uses proprietary image processing software to digitally extract a cylindrical view of the core, which is then digitally "unfolded" to a 2D surface. This provides a borehole image view based on CT density, in a format like that of an FMI or other borehole image log, only at higher resolution. The CT Borehole Image can be extracted from various depths inside the 3D volume to avoid mechanical damage that might be present on the surface of the core.

CT Density Log and Atomic Number Logs: Based on X-ray attenuation, density and atomic number are computed for each voxel. The average of the values for each voxel are then calculated for each digital cross-section. A log is plotted showing the values for each cross-section.

How will CoreHD® increase and complement the range of services you can offer?

CoreHD® data is used with other data by the operator to select SCAL (special core analysis)



Ingrain's Continuous Core Viewer

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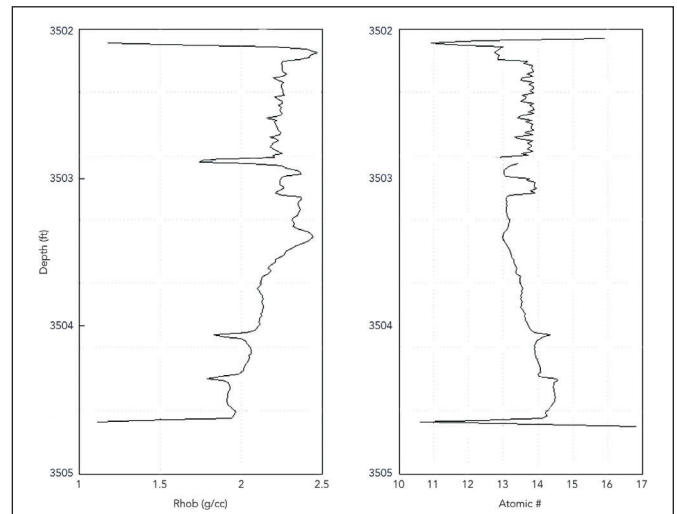
sampling locations such that an optimum number of samples can be taken to represent key rock units. Ingrain then prepares miniplugs for high-resolution CT scanning and vRock® creation. Rock properties and fluid flow characteristics are computed for each vRock®. This multiscale process enables the operator to more accurately upscale rock properties to the rock types identified in the whole core, and from there to the reservoir. Ingrain is the only DRP provider that integrates whole core CT data with pore-scale rock properties computations. The combination of these two key technologies means optimised selection of sampling locations, followed by computation of rock properties that can be quantitatively upscaled to the core. The characterisation of rock units within the whole core can then be tied back to the reservoir model through logs and seismic.

What projects has Ingrain been involved in recently?

Since starting commercial operations in late 2008, Ingrain has imaged over 4,000 rock samples and completed nearly 200 commercial jobs. Our clients for the Abu Dhabi lab include national oil companies in the Middle East region, particularly ADCO. In addition to the Abu Dhabi lab we have facilities in Houston, US and Rio de Janeiro, Brazil.

Ingrain is still a relatively young company having been set up in 2007. How has the market and Ingrain itself evolved over the past three years?

Oil companies and universities began experimenting with CT scanning of oil and gas reservoir rocks in the 1980s, so the interest level in this technology has always been high. It is only because of recent advances in CT scanning hardware and high-performance computing that it has become technically feasible to introduce digital rock physics as a commercial service. Ingrain has introduced technical breakthroughs in the past three years in several areas, including image processing and simulations, particularly in using Lattice-Boltzmann to simulate two-phase fluid flows within an accurate digital representation of the pore space with all of its complexity. ■



CT Density Log and Atomic Number Logs