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Digital rock physics offers shale rock insight at molecular level

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Want to get so close to the Marcellus Shale that you can see its pores? You need digital rock physics.

This type of analysis uses medical scanners, such as CT scans and X-rays, to produce images of rocks at the molecular level, which allows geologists to study where in the rock oil and gas accumulates and enables them to calculate features such as permeability.

According to Joel Walls, a director of unconventional technology at Ingrain Inc., digital rock physics has found a niche — "and a large market" — in shales that are typically more difficult to analyze with traditional lab techniques.

Ingrain is perhaps the best-known name in digital rock physics. The Houston company has been working in the Marcellus for several years, Walls said.

"We have data and samples in from half a dozen Marcellus wells (now)," he said. "It tells you about the details of how the gas is trapped in the rock and how you might go about getting it out."

Ingrain is analyzing core samples from five Range Resources wells in Washington and Greene counties. It's a technique Range is adding to its standard engineering toolbox to better understand its Marcellus prospects, according to Bill Zagorski, the company's vice president for geology.

During a standard core analysis, a cylinder of earth about four inches wide is extracted and examined to determine the thickness of the formation, natural fractures and the location of the better organic zones in the rock.

"But we can't see the pores in 3D. We can't see where the gas is trapped," Zagorski said. Ingrain's images define pore systems and can tell the company where the gas is in relation to those pores.

Range got its first 3D models of the Marcellus Shale this month.

The method is said to be spreading in appeal.

During a Pittsburgh visit, Chevron CIO Louie Ehrlich singled out digital rock physics as one of the most exciting emerging technologies in oil and gas development.

"Today, we're throwing waves at it," Ehrlich said. "In the future, we'll be able to understand specific rocks."

According to spokesman Nate Calvert, Chevron isn't "using the technology to actively prospect for oil and gas," but the company has run such scans on rocks and "(we) believe it has promise."

As with many other aspects of shale development, Walls sees digital rock physics being pioneered by large, independent oil and gas producers, although multinational corporations also are doing experiments with the technology in their research facilities.

Geologists at EXCO Resources Inc. engaged Ingrain to run a high-resolution medical scan of a core sample from the Haynesville Shale about three months ago which, according to Senior Petrophysicist Eugene Piekenbrock, proved useful.

But EXCO has stopped short of doing the pore analysis, which requires a higher resolution image.

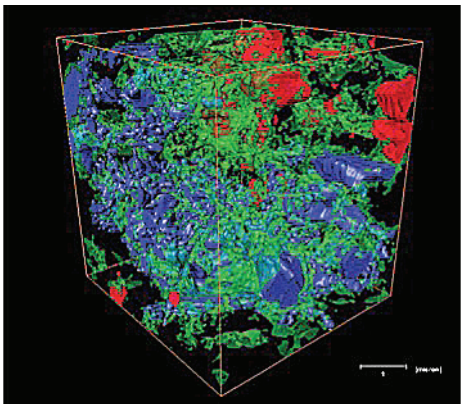
"I still have a real issue of how we can scale up something that's captured on that small of a level up to an entire reservoir," Piekenbrock said.

He's also concerned that samples being scanned on the surface may not behave the same as when the rock is compressed under the pressure of the formation.

"I think it's useful in terms of defining the elephant we have here, but I think it's more qualitative than quantitative," he said. And, "it's pretty pricey for what we get out of it."

But Zagorski said the cost is worth it.

"It's expensive but it isn't. In the scheme of what it costs to drill a single pad or group of wells, this is a relatively small investment," he said. "It might be costing us half a million dollars to do this, but every well that we drill is $4 (million) to $5 million. If we're drilling thousands of wells, (and) if we're learning something, it's very cost effective."



COURTESY OF INGRAIN INC.

A 3D model of shale magnified 10,000 times. Green areas represent organic matter, blue shows open passages for gas to flow through, and red shows closed passages.

Regardless of the cost, Zagorski said this type of analysis isn't likely to be used on every well in the future.

"It's going to be somewhat of a reconnaissance (practice)," he said.

Extrapolating information about a rock formation that stretches for more than 100 miles from a scan's microscopic scale is "one of the biggest challenges we have to deal with," said Zuleima Karpyn, associate professor of petroleum and natural gas engineering at Penn State University.

The Center for Quantitative X-Ray Imaging at Penn State has scanned rocks for Exxon Mobil, Hess Corp., Shell, Halliburton and Statoil.

The Center is beginning its first Marcellus project with an oil and gas firm, Karpyn said. The project involves scanning shale rock samples to study how hydraulic fracturing fluids move through them, she said.

Digital rock physics has been around for a decade, Karpyn estimated, but it's usefulness for shale characterization has only become evident very recently.

"This is only going to grow," she said.