Unconventional Thinking

Mark Whitley: First mover in the Barnett and Marcellus

Exploration opportunities for conventional oil and gas appear to be tapering off in western Canada. The oilsands, an unconventional source, already dominate crude oil activity. Natural gas investment is starting to follow the same pattern, with ever greater emphasis on coalbeds, tight sands, and shales. Although the operational challenges are formidable, the rewards could boost the industry to new heights.

Water is one example of the looming technical challenge. An 11-stage frac along a single horizontal wellbore in a shale gas formation consumes 60,000 to 100,000 bbl of water-as much as 3.5 million gallons. And that water must be fresh so it can protect the flow of methane from unwanted chemical reactions. In somewhat arid areas, residents are bound to be concerned. Northeastern British Columbia, site of Canada's most exciting unconventional gas initiatives, has a lot of water but the super-natural province also has a lot of green activists.

The Barnett Shale of Texas illustrates the benefits that shale gas could bring to service companies and workers. In 1988, 13 vertical wells were drilled into this formation, followed by 42 in 1993 and 211 by 1999. As the combination of horizontal drilling and multi-stage fracs kicked in, the Barnett saw more than 500 horizontal wells completed in 2004, more than 1,000 in 2005 and upwards of 2,000 in 2006. And those are sophisticated, costly wells, not shallow holes punched with rapid efficiency into the prairie.

Last month, Oil & Gas Inquirer surveyed the powerful Montney and Horn River Basin plays now underway in British Columbia (see article Montney and Horn River: Two Superplays Drive Drilling And Technology). In this month's issue of OGI are personal profiles of five individuals-two service professionals and three explorers-whose work showcases the scale, risk, and promise of shale gas prospects across the continent. These individual profiles will be published online weekly during November and December.

At Mitchell Energy, Mark Whitley was never able to decide if his boss is a hero or a lunatic, or maybe both. "What's definitely clear to me is that George Mitchell's incredible determination is responsible for the shale gas boom that we see unfolding today across North America," says Whitley, who led the Mitchell engineering team that unlocked the Barnett Shale in the Fort Worth Basin. "A lot of people use the word 'visionary' pretty casually, but George is the real thing. He somehow sensed what could be done and kept chasing his vision long after any rational person would have given up."

Whitley's own resumé is distinguished, including a key role in the Marcellus Shale. The chemical engineer (B.Sc-Worcester Polytechnic Institute, M.Sc-University of Kentucky) has held senior positions at Devon Energy and Quicksilver Resources. In 2005, he became senior VP of engineering technology with Range Resources Corp. There, Whitley has spearheaded development of the Marcellus Shale, located in Pennsylvania, West Virginia, and New York. Terry Englander and Gary Lash-geoscientists with state universities-estimate that the Marcellus contains more than 500 Tcf.

Although shale is normally an impermeable rock, natural fracturing can create sweet spots. Shale gas production in some areas-Michigan's Antrim Shale, the New Albany Shale in the Illinois Basin, the Upper Devonian shale formations in the Appalachian Basin, the Louisiana Haynesville, the Woodford Shale in Oklahoma, and others-dates back as much as a century. Natural flows were usually modest, and had

petered out in some areas by the late twentieth century. Gas shows encountered during the 1970s in the Barnett, although quite prolific, were regarded as little more than a nuisance.

The modern shale gas era began virtually unnoticed in 1981 with a vertical well drilled to 8,000 ft in Texas by Mitchell Energy. The independent producer's interest was spurred because its shallower gas reserves-conventional sands at a depth of 5,000 ft-in the same region were declining. "It's difficult to exaggerate how far off the beaten track George was headed," Whitley says. "During that period, explorers were chasing prospects offshore and in deep structures like the Rocky Mountain Foothills. No right-thinking person paid any attention to shales."

Even so, Mitchell tried fracing its 1981 well, with little result. For more than a decade, the producer kept drilling vertical wells and experimenting with different hydraulic fracturing techniques. Foam nitrogen and CO_2 lacked enough pressure to move the sand proppant, says Whitley, who spent more than 20 years with the company. Cross-linked gels worked better but cost too much. To make matters worse, natural gas prices remained low through the '80s. Mitchell hovered near financial ruin, its boss reportedly drawing on his personal account to meet the payroll from time to time.

Mitchell's board wanted to abandon shale gas in favour of more promising alternatives. Why did the wildcatter persist in the face of repeated setbacks? "He's a Texan, he grew up in Galveston, and his parents are Greek immigrants-maybe that has something to do with it," Whitley suggests with a smile. Galveston, a port built on a low-lying island, was struck in 1900 by the deadliest hurricane in American history, and ranks among the most storm-vulnerable cities in the United States.

Students at Texas A&M University, where Mitchell studied petroleum engineering, like to boast that there's no give up in an Aggie. "George is living proof of that motto, probably the best example they've got," Whitley comments. "In the 1990s, gas prices finally rose and the company began to make some money." At the same time, Mitchell made a key discovery: slick water fracs work very well in the Barnett and other brittle shales (the Horn River Basin's Muskwa Shale in northeastern British Columbia is also relatively brittle).

Because a brittle shale does not bend much, a modest amount of sand is enough to prop open the fractures, which reduces cost. Also, a light proppant load eliminates the need for gel carriers. The term "slick" refers to a friction-reducing chemical that enables the water to be pumped more quickly into the formation. When horizontal drilling and multi-stage fracturing were applied after the turn of the century, production began to soar. Devon Energy acquired Mitchell for $3.5 billion in 2001. The state oil and gas regulatory agency estimates that the Barnett Shale has 27 Tcf in place, and annual production surpassed one Tcf last year.

Four years ago, Range Resources began accumulating reports on the Marcellus Shale. "We searched government archives, old boxes in garages, anything we could turn up," Whitley says. That research showed that older wells, some drilled by cable tool rigs, had sometimes blown out in the formation, indicating a gassy, charged reservoir. The Fort Worth-based producer has now collected data from 8,000 wells and acquired 1.4 million net acres in the play.

Drilling began with vertical re-completions in the target formation, then moved into an exploration phase. "We've now got more than 100 wells, including two dozen horizontals, in the Marcellus. Our last 10 wells have averaged 4.9 MMcf/d, which is tremendous performance," Whitley reports. "Range is the first mover in this shale, and we have more information than anyone else in terms of gas content, fracture analysis, and so on. Personally, I think the Marcellus has more characteristics in common with the Barnett than any other shale prospect in North America."

For the most part, the Marcellus appears to be a horizontal drilling proposition. In three or four years, Range has accomplished what took eight or ten years in the Barnett. Although production is being held back by processing capacity constraints, the company is confident that its progress will be rapid. "The industry will achieve success in other shale formations as well," Whitley predicts. "A lot of companies have sprung from people who acquired their expertise at Mitchell Energy-I think of shale gas as George's personal contribution to an energy-hungry world."