Seismic-While-Drilling Technology Takes ETW Spotlight

Ted Moon, *JPT* Online Technology Editor

While Seismic-While-Drilling (SWD) methods have been investigated for nearly 30 years as a complete, real-time alternative to conventional vertical-seismic-profiling (VSP) techniques, the industry has yet to accept it beyond a rather narrow scope. Expanding this scope was the focus of a recent SPE Emerging Technology Workshop (ETW) held in League City, Texas.

SWD technology, until recently primarily referred to as drill-bit (DB) seismic, began as a method to detect the natural vibration from the end of the drill bit by means of surface geophones, enabling geophysicists and drillers to use these data in real time to optimize drilling efficiency, predict pore pressures ahead of the bit, and verify reservoir models.

This technique has been eclipsed by another method, particularly for deepwater offshore drilling applications, which is based on traditional wireline methods that use a standard offshore air-gun seismic source at the surface with suitable receivers or sensors in a downhole tool. This, together with recording and processing capabilities, is part of an enhanced logging-while-drilling (LWD) tool.

Nonetheless, proponents of DB/SWD technology believe the technique has untapped potential in certain applications. The ETW was seen as the ideal forum in which to discuss this. ETWs are interactive events designed to give participants a field's-eye view of new technologies and to expedite the adoption of these technologies by publicizing their initial successes as they move from laboratory to field.

Andy Hawthorn of Schlumberger helped organize the League City event. "When I got involved, the entire focus was on theory and processing of DB seismic. But because there are still so many limitations with it, we had to include the LWD seismic [LWD/SWD], which has replaced it more successfully on an economic basis."

Open Dialogue, Collaboration Promoted

According to SWD ETW Chairperson Bob Radtke of Technology International, the workshop's open format encouraged lively discussion and debate on the future of the technology. "We had presentations describing the current state of the art, as well as detailed sections on surface source, downhole source, emerging technologies, and case histories," Radtke said. "In addition, this workshop was unique, in that we had a special keynote speaker, Nansen Saleri."

Saleri, manager of Reservoir Management, Saudi Aramco, and a 1991 SPE Distinguished Lecturer, delivered an address titled "The Technology Factor: How It's Changing Upstream Performance." His talk described how the SWD method would be useful for increasing understanding of reservoirs in the Middle East and elsewhere, and indicated that significant producers may be ready to give this technology extensive use.

Another special feature of the ETW was the presentation of two "Legends of SWD" awards to Bruce Marion and James Rector for their 1991 demonstration of the first successful use of drill-bit reverse VSP employing drill-bit-correlated data.

Jorge Lopez, a project leader for Shell, was one attendee who saw the workshop as an opportunity to catch up and collaborate on the latest developments in SWD. "Most of my day-to-day research activity is in traditional VSP, where the sources are on the surface, and you have to pull out the drillstring and run a geophone downhole," Lopez said. "But I saw some presentations on drill-bit noise that gave me some research ideas.

"We plan to acquire the data to test these ideas through collaboration with Bob [Radtke]. He already has some data, which he is willing to share, and we will contribute on the data-processing side. Hopefully, we can accomplish more by working together than he has been able to accomplish thus far by working on his own."

SWD Benefits and Drawbacks Cited

"One key benefit of SWD technology is that it can be run without interrupting drilling," Radtke said. "Not only is there a high cost to stopping the drilling process, but you might cause some major problems downhole if you are not careful."

Radtke mentioned that many attendees considered the tool's look-ahead capability as an important feature that the industry should exploit as a service. "There were several case histories presented, from service companies, where the potential existed to look several thousand feet ahead of the drill bit. Some case histories indicated that it was possible to look that far ahead and anticipate any abnormal pressures that currently increase blowout risk."

For the geophysicist, the SWD technique is seen as helping to verify geomodels in real time, while drilling, and narrowing the cone of uncertainty existing with any geophysical model.

Other attendees were less optimistic about SWD technology. "I have always been cautious on the value of this technology, particularly LWD/SWD, for many reasons," said Brian Hornby of BP. "Historically, there has been a lack of good real-time quality control. I don't like black boxes, and

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making decisions based on a number that just comes up the drillpipe can be risky."

Other attendees pointed to several technology and manpower gaps that must be filled before SWD technology can see strong growth. "I think more drilling engineers need to be invested in developing this technology, not just the geophysicists," Radtke said. "That said, I don't see getting drilling engineers involved as a real challenge, but there does need to be more communication between the geophysicist and the driller."

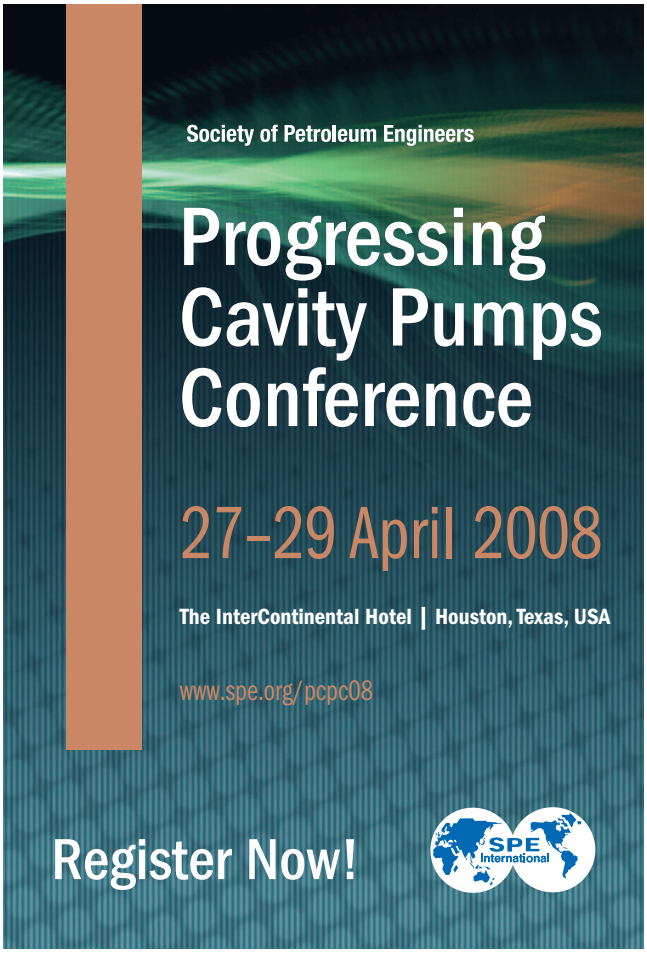
Lopez viewed the current applications as too narrow in scope. "If you really want it to catch on, the applications need to broaden," he said. "Things like the check shot, where you place the bit on the seismic line, are fine, but it is very narrow."

Others, like Sperry Drilling Services' Ron Deady, named several outside technologies that, if addressed, would boost the scope of SWD application. "Several aspects of acoustics need further investigation," he said. "Factors of scale between seismic and acoustic data and the further development of near-term acoustic 'ranging' data, to name a couple, will greatly aid our ability to position wellbores."

Wired drillpipe, such as Grant Prideco's Intelliserv system, was discussed as another enabling technology. Proponents of wired drillpipe envision it as a way to transmit more easily the large amount of raw data between the drill bit and the surface, thus facilitating true seismic processing. "The thing I like about wired drillpipe is the control it affords by enabling commands to be sent to downhole tools," Hawthorn said. Still, he acknowledged that a wired-drillpipe/SWD combination has challenges because the tools would have to be reconfigured, and wired drillpipe itself is still a new technology.

In his presentation titled "Experience and Forward View on SWD Technology," Hornby discussed the progress made and the still-present obstacles to expanding the use of SWD technology. "In my opinion, the only application that really gets a green light right now—meaning that SWD technology can provide a current benefit—is the use of SWD methods to measure time-to-depth," he said. "I feel this way because with the advent of real-time, full-waveform data transmission, one can invoke standard VSP processing tools at the surface by using established quality-control procedures. The result is numbers in which we can have some confidence for both time-to-depth and velocity computations."

Most of the other potential applications would not benefit from SWD technology in the near term, according to Hornby. "With the exception of 1D look-ahead—to which I give a yellow light—all applications beyond time-to-depth have a red light now, meaning that they are several years from meaningful development," he said. "The concept of look-ahead is pretty large, and people not closely familiar with the SWD method might envision all sorts of things. I have seen cartoons of SWD technologies looking 360° around the drill bit, providing 3D visualization. In reality, we cannot achieve that with today's SWD tools."



Major Issues Aired in Final Panel Discussion

The workshop's final session was an open panel discussion, with representatives from the technology providers and oil companies discussing the major issues that need resolving before SWD technology is more widely accepted.

Not surprisingly, opinions differed depending on whether one was a supplier or an end user. Some service providers noted the traditional problem of being unable to recoup development costs and show the profitability needed to continue funding research and development (R&D). "The R&D does not come cheap," Deady said, "and it is being done more and more by the service companies alone. The development costs eventually have to be recouped through the service offering."

"Speaking for myself, the big obstacle to overcome is the real-time benefit," Hornby said. "If you don't have a real-time benefit with an SWD tool, then you need a price much lower than that for running a wireline tool."

Deady concluded his assessment of the future of SWD technology with a variation on the theme that timing is everything. "Over the years, I have seen some technologies hit at the wrong time, such as during a downturn," he said. "They don't get the appreciation they deserve, and they get forgotten. I think that the economics could be hitting at the right time, with the additional enabling technologies, to move the SWD technique forward. But it has to show a return on investment to make my manager happy, and it needs to provide a timely, cost-effective solution to make the customer happy."

To learn more about the SWD ETW, contact Radtke by email or phone (radtke@kingwoodcable.com or +281.359.8520).

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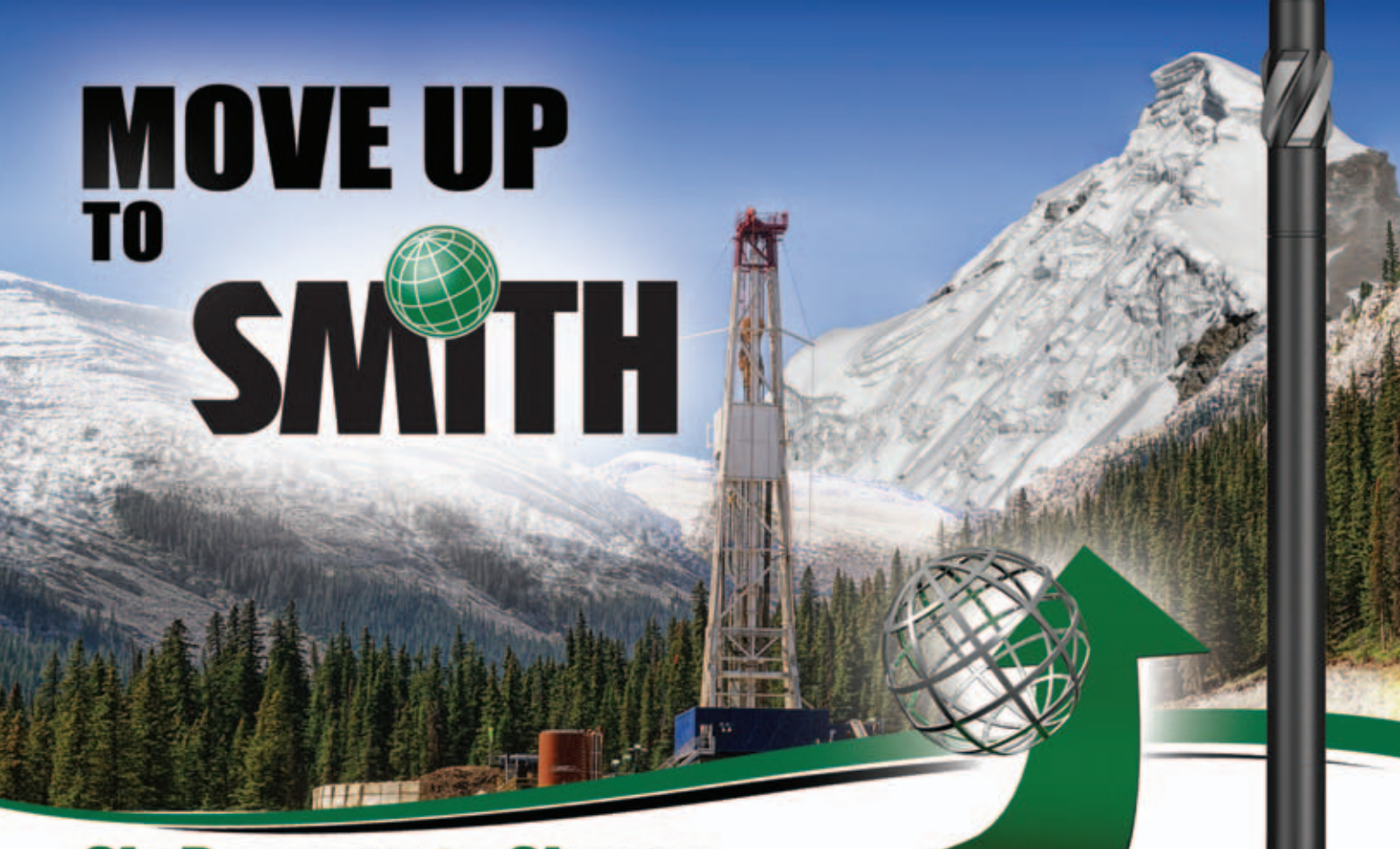

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