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Innovative Solutions Pave Way Forward

By Kari Johnson

Not long ago, the playbook in unconventional operations called for drilling horizontal wells about anywhere in a "blanket" formation, so long as the wellbore stayed in zone to allow stimulation at regular intervals spaced along the lateral. The name of the game was breaking rock. While well productivity remains a function of creating fractures in low-permeability rock, oil and gas producers have come to appreciate the importance of how and where laterals are placed to ensure access to quality rock.

Creating Differential Value

Arshad Matin, president and chief executive officer of Paradigm, notes a critical distinction between conventional and unconventional formations that is greatly affecting the role of geophysics. "Exploration traditionally has been about finding hydrocarbons," he says. "With unconventional reservoirs, we know where the hydrocarbons are; they are pervasive, but not necessarily recoverable. The challenge really is economic extraction."

The critical business need revolves around identifying the optimal sweet spots and then drilling that area in a cost-effective manner. That demands greater speed in workflows, Matin asserts.

"Operators will tell you the ability to create differential value is how well they can operate their workflows for hydrocarbon extraction," he remarks. "Field operations are being Web-enabled. Seismic data and drilling information are being collected in real time. All of this contributes to faster and more economic extraction."

It also requires broader integration between different disciplines, according to Matin. An efficient workflow spans and integrates petrophysics, geophysics, geology and engineering in a seamless fashion, he adds.

"As larger companies move into unconventional plays, they bring a greater rigor and full portfolio of technology and techniques to bear," he says.

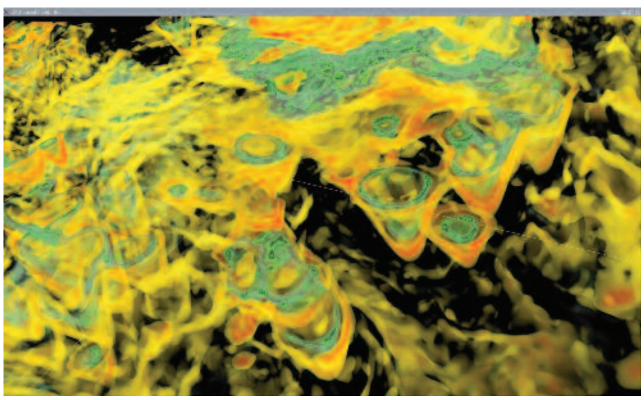
Matin identifies three key changes that have a dramatic effect on economics:

- Integrating advanced science into a single platform;
- Making advanced science accessible and usable to everyone; and
- Improved computational efficiency.

"To perform high science, you often had to go to a specialized platform," Matin observes. "That took time to move data back and forth, and the data looked different and felt different. The key is to integrate into the main platform advanced science that previously sat in specialized tools."

Matin says he wants to "democratize" advanced science for everybody, and not just the most senior and experienced staff or the best capitalized operators. "To me, advanced science means precision science and mathematical algorithms that are not restricted to the domain of specialists," he offers. "The balance that must be struck, however, is that the needed scientific precision cannot be lost in order to improve usability."

Automating basic data analysis functions provides a way to streamline processes and improve productivity, Matin goes on. "With a shortage of experienced talent in the industry, anything that can create more capacity through automation will be helpful to everyone. Horizon and fault extraction are two excellent areas for automation," he holds. "Making software more intuitive and easier to use, with comprehensive online instruction and training, is also very important to operators."



Field operations in unconventional resource plays require broad integration between different disciplines with an efficient workflow that seamlessly integrates petrophysics, geophysics, geology and engineering. Shown here is an example of multisurvey, regional-to-prospect interpretation and visualization capabilities from Paradigm that are enabled by integrating advanced science into a single platform that everyone can access and use, as well as improved computational efficiencies.

Finally, Matin says next-generation display technology, coupled with advances in graphics processing units (GPUs) and multicore processors, are enabling new visualization and processing capabilities that can improve data interpretation productivity and effectiveness.

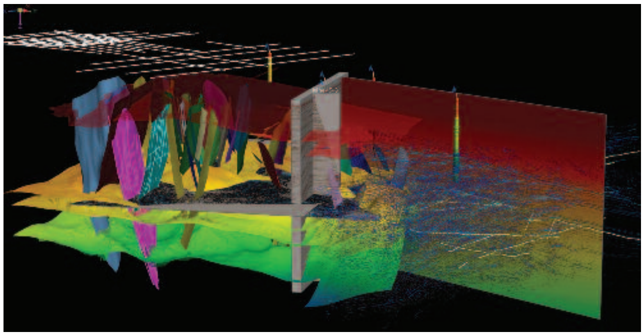
"Interpreters now can work on high-definition, large-screen displays and process massive amounts of data in real time," he observes. "Multicore HPC and GPU solutions are making high science computing available to everyone at a low cost. Part of the reason people are making more use of seismic is that they can do things now on standard hardware that they could not in the past."

GPGPU-Enabled Workflows

Paradigm is an example of a geophysical software company that makes extensive use of the general purpose graphic processing unit to improve interpretation accuracy and speed by assisting geoscientists who have to interpret and model data under tight project deadlines, says Duane Dopkin, executive vice president of technology at Paradigm Software.

The company uses GPGPU for such activities as voxel-volume rendering for generating extremely high-fidelity 3-D rendered images with rapid refresh speeds, and for eliminating the graphical artifacts common with slice-based rendering, according to Dopkin.

GPGPU also supports stratigraphic interpretation with multihorizon flattening and on-the-fly seismic attribute computations at Paradigm. The GPGPU is used in model operations to construct geologic grids, where the grids are created by solving large inversion matrices, continues Dopkin.



Paradigm Software is among the geophysical software and service companies making extensive use of general purpose graphic processing units to improve interpretation accuracy and speed. Shown here is a Karst visualization in the Barnett Shale using graphic processing unit-based rendering.

"While some of these algorithms are coded with CUDA specifically, other implementations are more general, where the same code base is compiled for both GPGPU and multicore CPU operations," he details. ❒