Game-changing seismic software

Oil & Gas Technology spoke to Duane Dopkin, executive vice-president of technology at Paradigm about their latest release and the future challenges for oil and gas seismic surveys

Oil & Gas Technology: What is the significance of Paradigm's upcoming 2011 release? Can you tell us some of the highlights of this release?
Duane Dopkin: The Paradigm 2011 release is a composite of years of research and development and is the company's largest synchronised release of exploration, development, and production technology in the company's history. The release carries the signature of 'innovation' that the industry has come to expect from Paradigm with new 'game-changing' technologies that redefine the work flows and best practices in seismic imaging, seismic interpretation, geologic interpretation, and subsurface modelling.

This application release is being provided on Epos version 4.1, Paradigm's scalable infrastructure and data management system. The release marks the first for customer deployment of Paradigm interpretation solutions on the Windows 7 platform.

In addition to the introduction of a rich set of geoscience applications, this release also pays particular attention to collaboration, enabled and strengthened by creative software usability enhancements, ergonomic software design, and enhanced data integration in support of multi-disciplinary workflows.

The release also pays particular attention to measureable application performance with the expanded use of multi-core (CPU and GPU) applications in the areas of seismic imaging, seismic attribute calculations, voxel-interpretation, and subsurface modelling. Project productivity is also enhanced with continuous integration improvements and new workflows like interpretation with modelling and new knowledge control and auditability solutions for multi-scenario management.

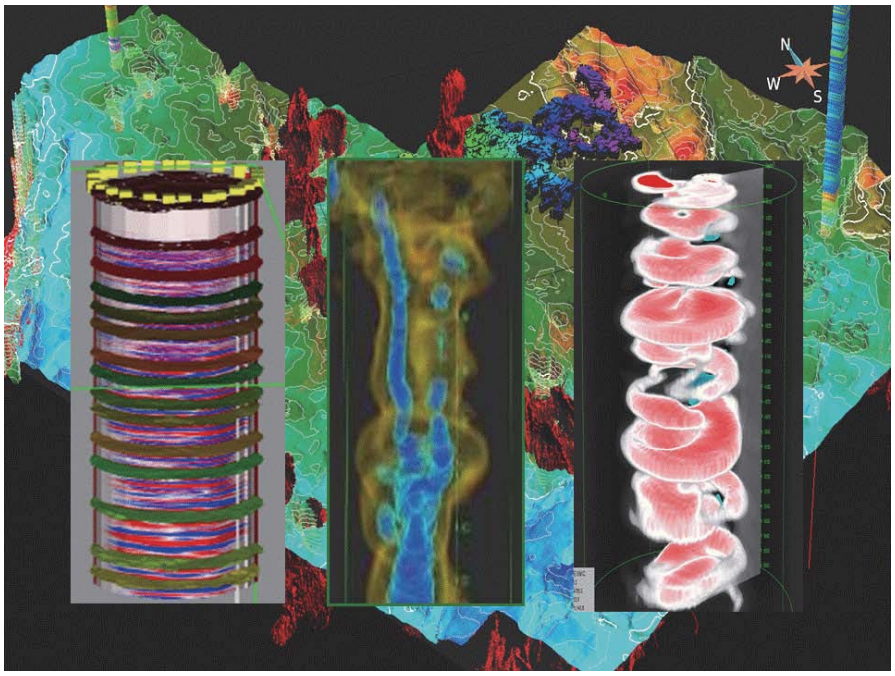

Figure 1 - Full azimuth reflection and direction angle gathers capture 360 degrees of in-situ and continuous azimuth for improved fracture detection, anisotropic measurements, amplitudes, and images

OGT: Pre-stack data has been incorporated in your interpretation solution in the new

release. Why is this so important?
DD: Historically, the use and analysis of pre-stack data were reserved for applications and windows foreign to the main interpretation canvas. However, increases in network bandwidth, disk speeds, and computer memory (RAM) coupled with advances in software engineering (e.g. efficient roaming formats, acceptable compression schemes, and parallel data reads) have made access to and direct use of pre-stack data a practical solution for interpreters in their preferred interpretation canvases.

The timing of these advances is essential, as seismic imaging algorithms are being driven by geologically-constrained and parameterised velocity models, requiring collaborative decision making between velocity modellers, seismic imagers, and seismic interpreters to assure a quality image and quality outcome. Pre-stack seismic data provide an objective assessment of the outcome and should be considered a standard interpretation data object.

Different views of the pre-stack data can be invoked to meet different project objectives. The simultaneous display of multi-line gathers provides a convenient way to quickly assess the integrity of the seismic data processing and imaging procedure and the resultant image quality. Here, the software and hardware advances referenced previously have a huge influence on the efficacy of the process of roaming through large volumes of pre-stack data.

Juxtaposed displays of pre and post stack data allow a convenient discrimination between different sources and types of seismic reflectors and an assessment of the imaging velocity model. By bringing pre-stack data into a common interpretation canvas, computer-assisted horizon propagations can be extended to the pre-stack domain.

By extending interpretation canvas support to pre-stack data, years of interpretation development and a wealth of interpretation utilities are available for application to this new data object.

OGT: You have called the new release 'game-changing'. Can you explain why?
DD: At Paradigm we believe a 'game-changing' release is a collective balance of innovation, performance, integration, usability and ergonomics. It is only with this balance that we able to refer, with confidence, to the release as 'game-changing'. A game-changing release is one that has the potential to genuinely change the way geoscientists explore, prospect, characterise, develop, produce, and well plan.

Let me provide you some examples.

The Paradigm 2011 release continues to extend and improve the multi-survey capabilities of the seismic interpreters. In this release traverse definition, management and handling is essentially a seamless operation across multiple 2D and 3D surveys, providing the interpreter with a unified and regional geophysical and geological perspective with no special data preparation or management.

Duane Dopkin, executive vice-president of technology at Paradigm

The release also introduces a new Voxel rendering technology that exploits desktop GPGPU's (general purpose graphic processing unit). This new technology effectively allows the seismic interpreter to change the interpretation scene at will and carry out processes like flattening or filtering, almost instantaneously for reasonable size data sets.

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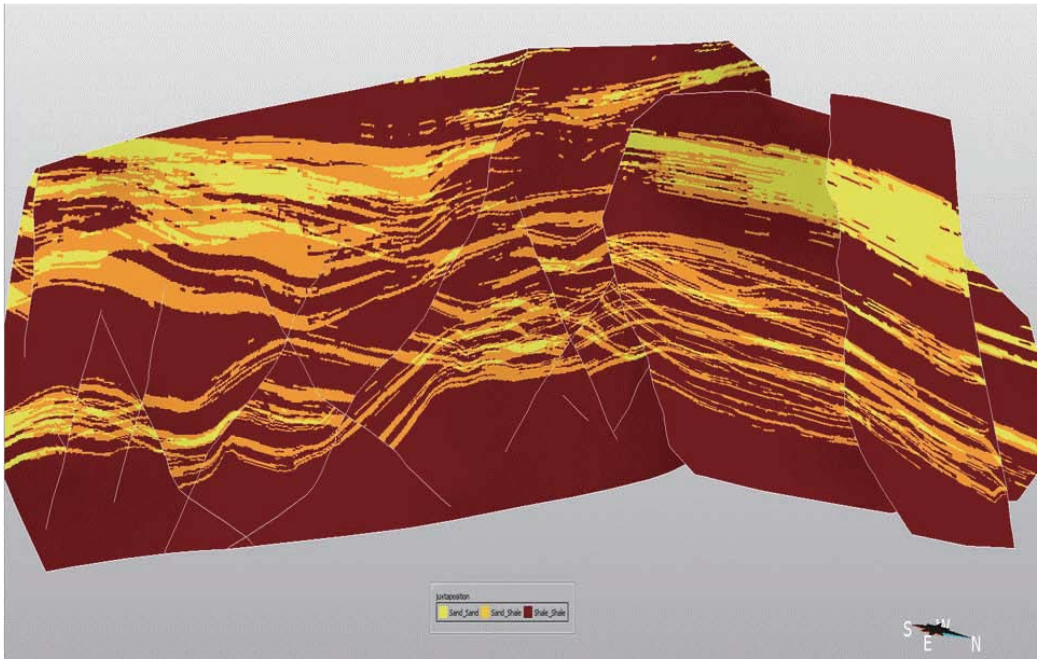

Figure 2 - Modelling with prospect qualification. This image captures the juxtaposition of well facies (sands and shales) against three fault surfaces. Sand versus sand juxtapositions provides potential hydrocarbon conduits and migration pathways while sand versus shale juxtapositions indicates potential trap situations

our true 3D paleo-stratigraphic flattening modelling solution to validate and correct interpretation data without the time consuming iterations that currently challenge project time lines. It also improves fundamental and strategic calculations to the E&P process like volumetrics.

IT managers will be pleased to know that this release will deliver all of the interpretation and modelling solutions on Windows and Linux platforms. Customers can run Paradigm solutions in a hybrid platform environment.

OGT: What about 'game-changing' technologies for the seismic imaging specialists?
DD: By applying new breakthrough full azimuth decomposition and imaging technologies to a fractured reservoir play, we are able to determine fracture orientation and intensity without the need to segregate (by azimuth) the seismic survey into independent sectored datasets. As a result, geoscientists are able to carry out the fully fractured-characterized project in 25 per cent of the time needed to carry out the sectored project. Additionally, the full azimuth decomposition avoids the physical assumptions, approximations, and limitations of the sectored solution, resulting in more reliable fracture determinations.

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OGT: What is the importance of full-azimuth angle domain migration?
DD: In the past decade, the industry has made huge investments in planning and acquiring seismic acquisitions that are both rich and wide in azimuth. These acquisitions are needed as geoscientists seek better reservoir definitions for fractured and stressed reservoirs and in deep water regimes impacted by salt structures with related complex wave phenomena. Benefits from these rich acquisitions have been acknowledged and documented, and include improved multiple suppression, noise suppression

and illumination of target areas. However, while the resulting seismic images inherit many of the benefits of rich- and wide-azimuth acquisitions, the application of current seismic imaging technology falls short in exploiting the full potential of these acquisitions.

To secure a broader return on investment for these onshore and offshore acquisitions, Paradigm has introduced a breakthrough approach to seismic imaging that uncovers and preserves azimuthal data from in-situ measurements made in a special reference system called the local angle domain. Much like a camera equipped for continuous recording at all angles and directions, this seismic imaging upgrade provides a comprehensive decomposition of the recorded seismic data into physical domains that recover and preserve subsurface illumination in all orientations and angles in a continuous manner (Figure 1). This breakthrough technology allows us to better understand subsurface illumination, to better qualify seismic images, to reduce the non-uniqueness of the seismic method, and to better describe the critical parameters of the velocity model.

OGT: I understand your subsurface modelling technology has prospect validation capabilities. Can you tell me a bit more about this and how it works?
DD: A few years ago, Paradigm introduced a new technology (SKUA) designed to solve many of the industry's long standing problems associated with subsurface modelling. The SKUA technology introduced a special transformation of data from deformed geologic space to pre-deformed, depositional or 'paleo-space' where structural deformations and approximations are eliminated or dramatically minimised and stratigraphically-consistent models can be generated.

By working in a true 3D paleo-stratigraphic 'flattened' space, invalid interpretations are not only easy to identify, but can be immediately corrected in either current deformed space or paleo-space with results available for simultaneous inspection in both domains.

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With this transformation, every point of the subsurface knows its paleo-geographic coordinates (i.e. the coordinates at the time of deposition) and many different attributes can be computed and many additional transformations can be performed to validate the interpretation and evaluate prospects.

These interpretation-while-modelling operations and modelling transformations in depositional space create new opportunities for interpreters to qualify prospects during the interpretation and modelling processes.

OGT: The reviews of the package have been very complimentary. This must be very gratifying?
DD: Comments on the Paradigm 2011 release based on early tradeshow previews, customer events, and early access programs have indeed been rewarding. This is a clear recognition of the balance of innovation, performance, integration, usability and ergonomics found in this release. Ultimate gratification will come from customer deployment and testimonials on these 'game-changing' solutions.

OGT: On a more general note can you tell me what you see as the main challenges in the seismic sector?
DD: The seismic sector is constantly challenged by the need to synchronise the continuous changes in acquisition, seismic imaging, and high performance computing. Disruptive changes in any one of these sectors, has a necessary impact and consequence on the others. For seismic processing and imaging, the fundamental challenges of resolution, proper handling of azimuth, amplitudes, and attenuation will continue to evolve and improve.

OGT: What can we expect to see in the way of innovations in the coming years?
DD: At Paradigm, we believe that significant changes in workflows, practices, and outcomes will take place with the adoption of today's innovation. We expect to see fundamental changes in desktop activities aligned with the rapid growth of multi-core computing at the desktop. We expect continuous pressure to manage real-time data, hundreds and thousands of modelled scenarios, and the capture and audit workflows and best practices. We expect to see more web-based applications in our industry with immediate access to results on mobile platforms. We also expect to see breakthroughs in borehole petrophysics and the subsequent real-time integration of results in modern reservoir modelling systems. Continued emphasis on usability and ergonomics will allow for a more rapid update of innovative technologies, particularly among the new generation of geoscientists. ■