Rapid Interactive RTM Scenario Testing Improves Image Quality Beneath Complex Salt

A new workflow assesses seismic image quality throughout the velocity model-building process.

CONTRIBUTED BY PGS

Producing reliable high-quality images beneath very complex and rugose salt bodies presents a continuous challenge in places such as the Gulf of Mexico and offshore Brazil. At the heart of the problem lies the fact that the distortions to the seismic wavefields introduced by local subsurface complexities are so great that meaningful images will only be created when the associated velocity model represents the actual salt geometry sufficiently closely to enable a representative image to form. Any divergence from the correct geometry results in a very rapid deterioration of the image quality beneath it. Scenario testing of different salt geometries has been employed for some time with the aim to speed up the model-building process and to ensure fast convergence towards the best subsurface image. PGS has advanced the salt scenario testing technique further by developing a highly efficient and interactive workflow that enables the use of the most accurate reverse time migration (RTM) imaging technology available to date.

The company will be showcasing this new model-building process to its E&P customers with a live demonstration at its booth at SEG using a 3-D dataset from the Santos Basin offshore Brazil.

Real-time quality control

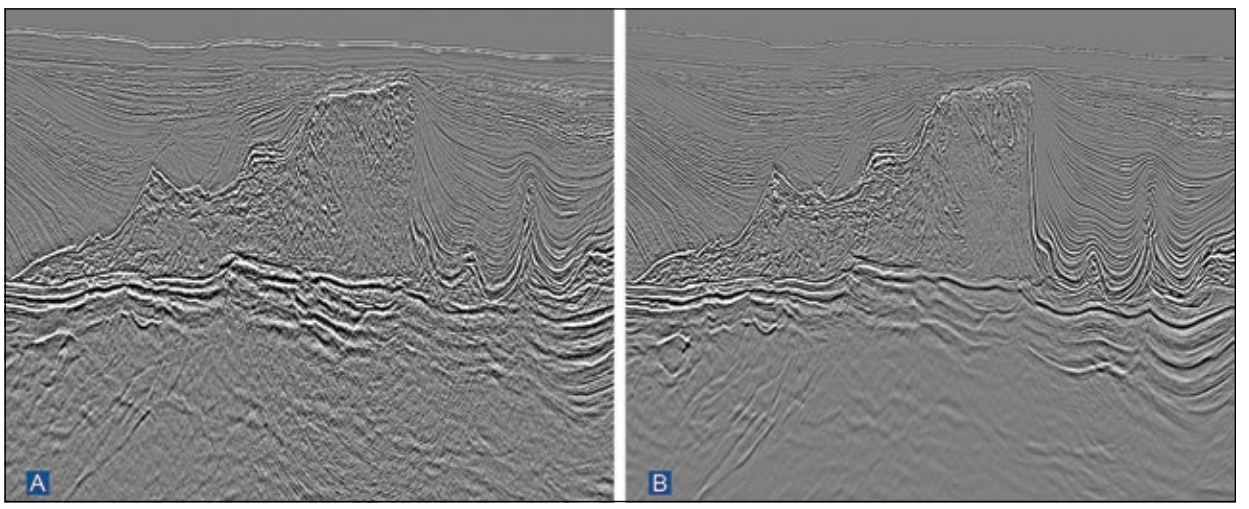
The developed workflow combines PGS holoSeis 3-D visualization and interpretation capabilities with some of the most advanced imaging technology, including the use of RTM True Amplitude Angle Azimuth Gathers (TA3GS), and allows for quantitative quality control (QC) to assess the seismic image quality iteratively throughout the velocity model-building process. Variable subsurface illumination effects that result in locations of substantial image uncertainty will be identified. These areas can then be targeted for velocity model improvement, helping to focus salt scenario testing efforts on areas that have the biggest uplift potential.

Benefits beyond image improvements

As shown in live demonstrations, a significant image improvement is observed through the application of the new workflow to 3-D seismic data from the Santos Basin that enables the focusing of interpretation efforts on the highest reward areas. The process also provides a better understanding of acquisition geometry limitations and their impact on subsurface illumination and in turn enables the real-time design of acquisition configurations for maximum illumination at target level. Finite difference modeling will be performed for real-time illumination QC through a linkup to PGS' supercomputing center in Houston.

PGS is currently reprocessing 35,000 sq km (13,514 sq miles) of data from the Santos area, called Santos Vision, with Area 1 deliverables available now.

Please visit booth 2122 to sign up for a private demo. ■



The use of the latest interactive salt scenario model-building workflow has resulted in substantial improvements in the clarity for images beneath complex salt bodies between the legacy data (right) and the new Santos Vision product (left). (Source: PGS)

Geophysicists Look to Improve Quality of Depth Imaging

A new dual-tree framework allows processors to produce wavelets that are oriented in six distinct directions.

CONTRIBUTED BY SAUDI ARAMCO

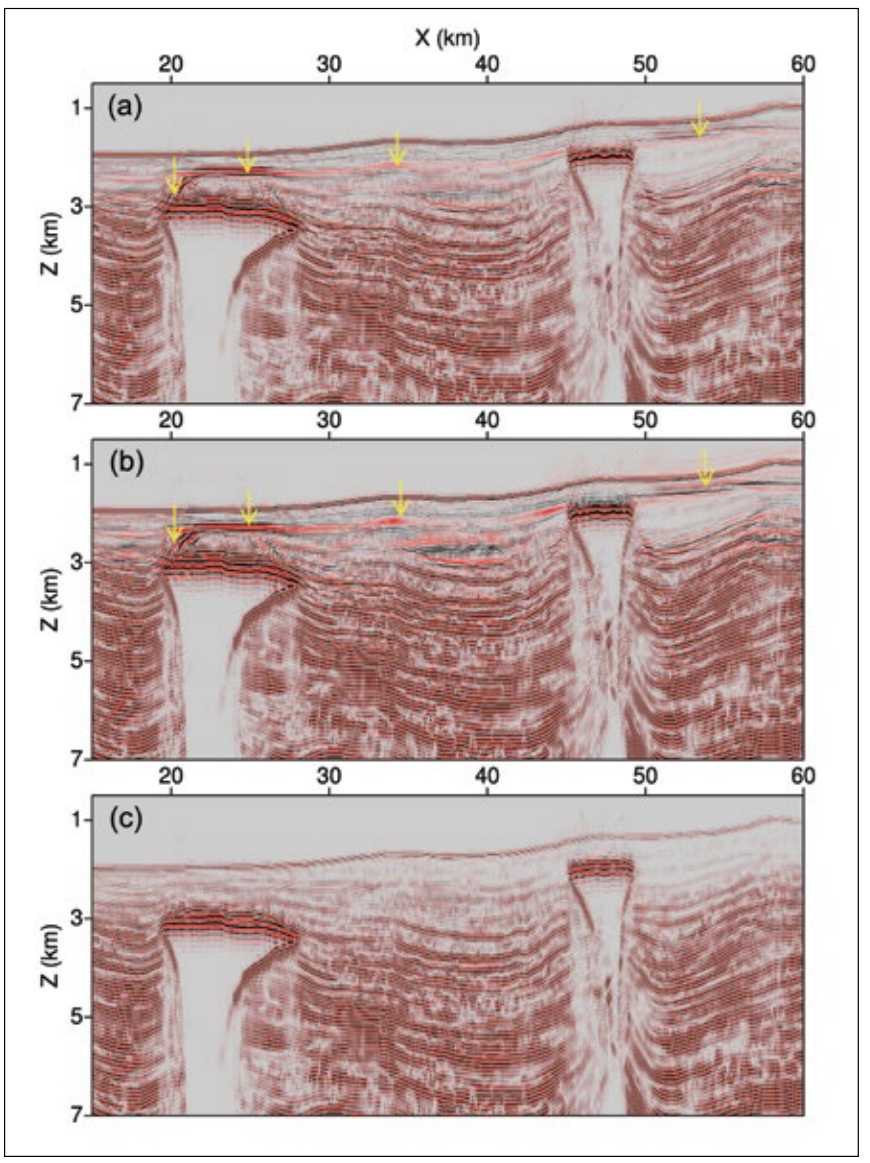
Aramco and its EXPEC Advanced Research Center (ARC) researchers have made significant contributions to industry, particularly in the area of land and shallow-water seismic acquisition and processing. Known for pushing the limits on acquiring and interpreting seismic data, Aramco's global research and development in the area of geophysics continues to grow and includes work from the Aramco Delft Research Center, the Aramco Beijing Research Center and the Aramco Research Center-Houston.

One of the more than 25 papers and presentations by Aramco during SEG presents findings on a new method designed to improve the quality of depth imaging results for complex structures from Houston-based geophysicists.

Set for Sept. 28 at 11:00 a.m. during the technical session in SPMI 7 (Room 361A), author Hong Liang notes that depth imaging is a preferred seismic imaging tool to obtain accurate geological structure, locate potential reservoirs and help improve drilling success rates.

Reverse time migration (RTM) is a powerful tool for imaging complex structures. "However, it suffers from noise that could degrade the image quality," Liang said. "This paper presents a new method of computing the weighting function for the inversion-based imaging condition in the wavelet domain to optimally attenuate RTM artifacts and improve image quality."

Liang's paper, "Wavelet Domain RTM Image and Surface Offset Gather Enhancement Using Inversion-based Imaging Condition," was inspired by the idea of a local attribute matching filter designed to match the hydrophone and geophone components as described in a 2010 SEG paper on ocean-bottom seismic noise by Zhou Yu



The first image (top) shows the migration stack image after a Laplacian filter was applied using conventional cross-correlation imaging condition. In the second image, the weighted sum of the time derivative and gradient images with the weighting function derived in the spatial domain is applied. The third image shows the same image using Liang's proposed weighted sum with weighting function derived in the wavelet domain. (Image courtesy of Saudi Aramco)

of BP. The Aramco researcher's new method derives the weighting function for the inversion-based imaging condition from the dual-tree wavelet transform domain.

"Dual-tree wavelet transform is a relatively recent extension of the discrete wavelet transform. It provides multiresolution sparse representation and directional selectivity in two or higher dimensions," said Liang. "It originates from the field of digital signal processing and has various applications in image processing. It was used very recently for seismic data processing, and in our paper

See **GEOPHYSICISTS** continued on page 14