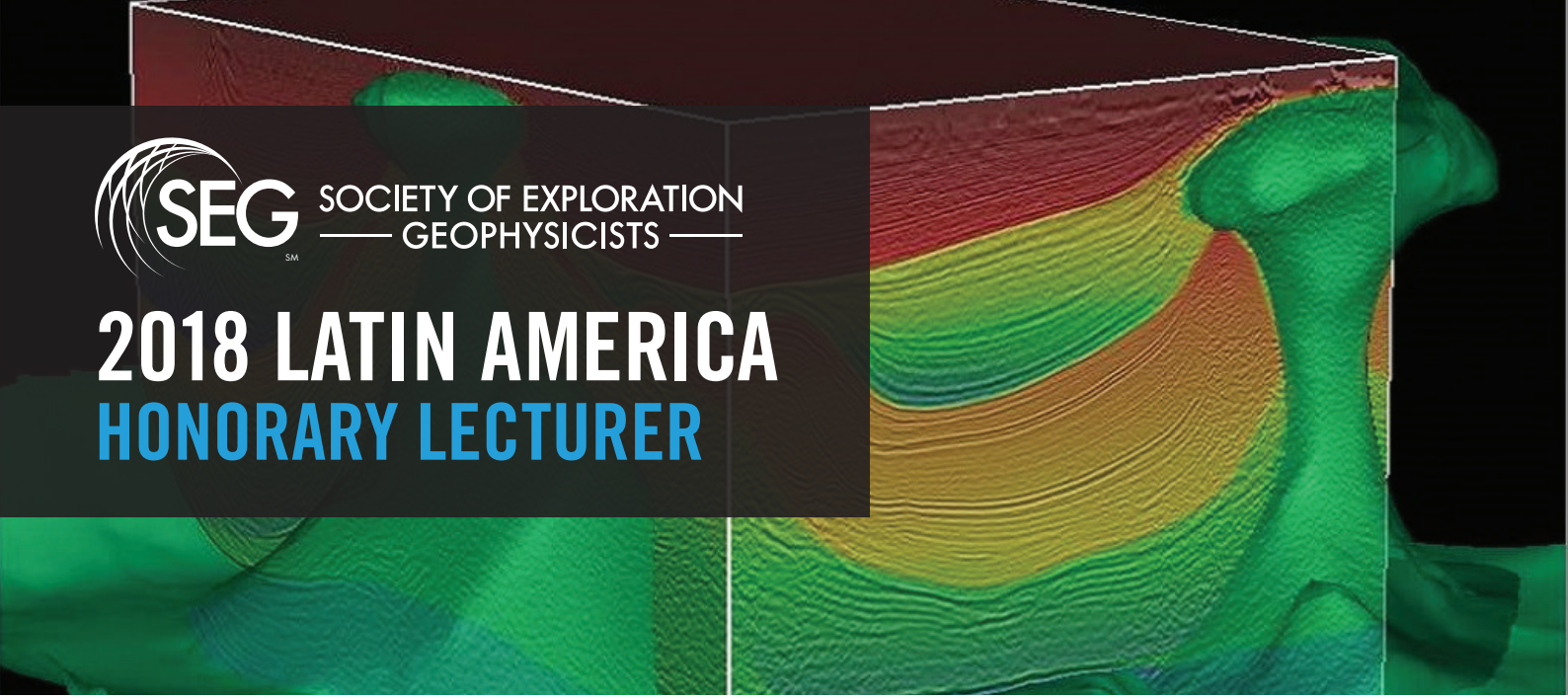

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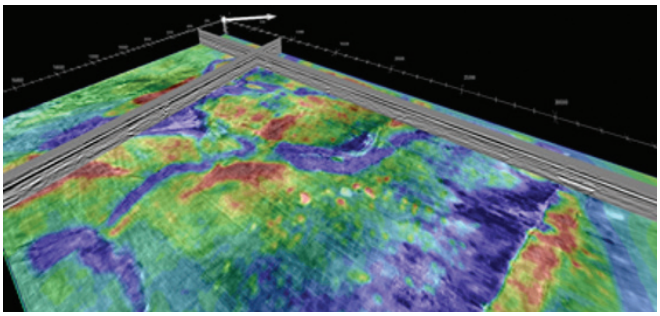
How recent advances in seismic depth imaging can enhance prospect identification and appraisal

by Ruben D. Martinez, Reservoir Geoscience, LLC, Leander, Texas, USA

ABSTRACT

Seismic depth imaging has matured and become a powerful tool in petroleum exploration to accurately map complex structural frameworks. In particular, over the last few years, more accurate seismic imaging methods have emerged leading to increased resolution of velocity models and seismic images.

High-resolution velocity models and images enhance the accuracy and value of interpretation not only in exploration but also in the appraisal phase and, in some cases, field development planning.



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So how is this high resolution achieved?

Velocity model resolution improvement is achieved by extracting the information content of the seismic amplitudes and phases, in addition to the traveltimes, using advanced methods such as full waveform inversion (FWI). FWI velocity models have resolutions beyond those obtained from classical traveltime tomography.

High-resolution velocity models deliver not only more accurate structural images after conventional migration (Kirchhoff, Beam, WEM, or RTM) but they also can be used to enhance prospect identification, prospect appraisal and to de-risk drilling by using advanced migration methods such as Q migration (QPSDM), imaging of primaries and multiples, diffraction imaging, and least squares migration (LSPSDM).

It is important to recognize that all conventional and high-resolution velocity model building and migration techniques should also incorporate different types of seismic anisotropy depending upon which one fits best the geologic scenarios present in the areas of study.

In this lecture, I will provide an overview of the most popular conventional and high-resolution anisotropic velocity model building and migration techniques used in the industry. The strengths and weaknesses of these techniques will be discussed, and illustrated, to understand their resolution limitations.

I also will discuss and illustrate, with model and real data, the performance of these depth-imaging techniques according to the resolution requirements for the geologic scenarios commonly encountered in conventional and unconventional prospect identification and appraisal with the aim of de-risking drilling.

The lecture will end with comments on my expectations about the future of depth-imaging technology and its impact on conventional and unconventional petroleum exploration, appraisal, and development.

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BIOGRAPHY

Ruben D. Martinez is a petroleum geoscience consultant and instructor with Reservoir Geoscience, LLC. He has been active in the seismic industry for 40 years. Martinez was associated with Geophysical Service Inc. (GSI) as R&D reservoir geophysicist, Halliburton Geophysical Services (HGS) and Western Geophysical as senior research geophysicist, AGI as director of seismic reservoir characterization and Petroleum GeoServices (PGS) as manager signal processing R&D, VP processing R&D, VP seismic processing technology, global chief geophysicist I&E and chief geophysicist I&E NSA. His responsibilities in PGS included directing global R&D and software commercialization of processing and imaging technologies. As chief geophysicist, he was responsible for the supervision and quality assurance of depth-imaging projects, customer liaison, the promotion of best practices, and the commercialization and use of high-end technology. Martinez is author and coauthor of more than 70 technical papers published and/or presented at international conferences and 12 patents on seismic data acquisition, processing, and imaging.

He has also made numerous technical presentations at international conferences and has taught numerous courses and conducted seminars and workshops on seismic processing and imaging. In 2005, he was invited to present the annual Milton B. Dobrin lecture at the University of Houston. He is currently an instructor of the Continuing Education Program of the Society of Exploration Geophysicists (SEG) and the European Association of Geoscientists and Engineers (EAGE). He is a member of the SEG Board of Directors as director at large. Martinez was the recipient of the 2014 Mexican Association of Exploration Geophysicists (AMGE) geophysics award for life-long achievements to geophysics. He earned a BSc in geophysics from the Instituto Politecnico Nacional (Mexico), MSc in geophysics from the Colorado School of Mines and a PhD in geosciences from the University of Texas at Dallas. He is a member of SEG, EAGE, Geophysical Society of Houston (GSH), American Association of Petroleum Geologists (AAPG) and AMGE).

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