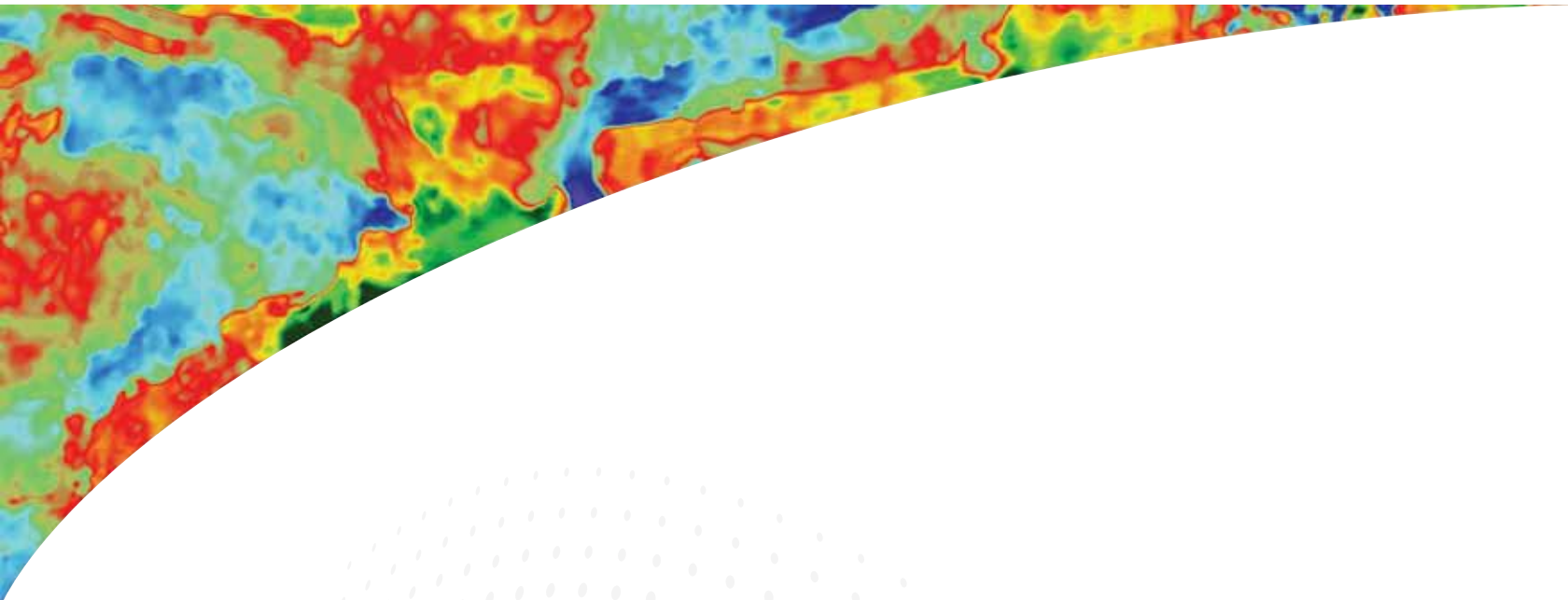


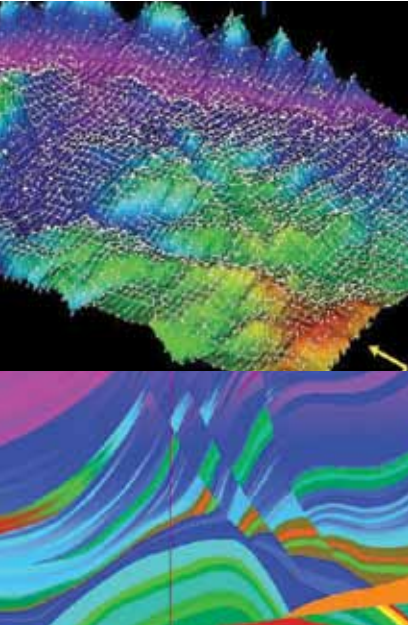


→ Charged to innovate. Driven to solve.™

Data Processing



Data Processing



Regardless of the oil & gas exploration environment, reducing risk and optimizing production is the name of the game. Whether working with complex marine salt bodies or unconventional land shale reservoirs, the goal is the same – reduce the risk and cost of finding and producing hydrocarbons.



Our global centers combine the technological expertise of GXT and the regional knowledge and processing experience of our partners to deliver state-of-the-art geoscience technology solutions to E&P firms operating in the region.

ADVANCED DATA PROCESSING

ION's GX Technology (GXT) group is a leader in advanced land and marine imaging, including pre-stack depth migration (PreSDM). Oil & gas companies apply our high end solutions to produce the highest fidelity subsurface images. By developing new technologies, new methodologies, and new business models, we provide our clients with a full range of seismic data processing services that enable them to gain significantly greater value from their seismic data.

GLOBAL EXPERIENCE

We continue to expand our footprint, honing our regional expertise around the world. With partnerships and processing centers strategically located worldwide, GXT delivers unparalleled technical expertise and provides high quality images that help reduce exploration and production risk.

INDUSTRIAL STRENGTH CAPACITY AND THROUGHPUT

Our globally distributed network of Linux-clusters, each scaled to local needs, combined with our major compute hub in Houston allows us to routinely conduct some of the largest imaging projects in the industry.

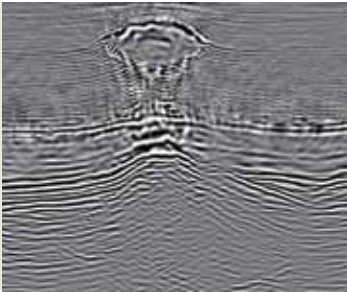
COLLABORATIVE

Working collaboratively with our clients, we help accelerate the introduction of new methods and technologies. Whether working to better define and resolve a particular challenge or seeking to discover new opportunities in a region, we work closely with E&P companies to deliver seismic images of the highest quality within the budget and timing constraints they demand.



SUSTAINED LEADERSHIP

We are constantly advancing and applying PreSDM technologies to tackle the most sophisticated depth imaging projects with high structural complexity, complex overburdens, rapid lateral velocity changes, and complex salt bodies. Our progress in reverse time migration (RTM) enables the algorithm to run at an industrial pace, thanks to the proprietary tools and computational methods we've created. We are driving breakthroughs in key areas such as complex azimuth and full-wave processing, and have a full suite of wide azimuth (WAZ) tools, all of which help to unlock the potential of reservoirs both offshore and onshore.



GXT delivers unparalleled technical expertise, providing high quality images that help reduce exploration and production risk.

A FULL SUITE OF OFFERINGS

We have a broad portfolio of offerings that address needs throughout the entire workflow. From removing multiples in marine acquisition environments to identifying fractures in reservoirs, our imaging technologies allow us to clearly define a solution to ensure that our customers' goals are met. Our offerings include:

Pre-processing

- Noise Removal
- Signal Processing
- Multiples Removal
- Statics

Advanced Imaging

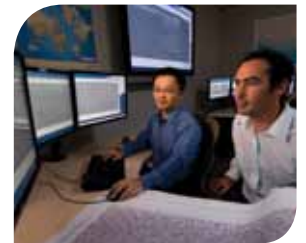
- Pre-stack Time Migration (PreSTM)
- Pre-stack Depth Migration (PreSDM)
- Reverse Time Migration (RTM)
- Velocity Model Building
- Real-Time Model Morphing and Migration (RTM³)
- Wide Azimuth Tomography (WAZ Tomo)
- Waveform Inversion (WFI)
- Azimuthal Anisotropy
- AVO/Inversion
- 4D
- Offset Vector Tiling

Full-wave Imaging

- Land 3C
- Marine 4C

Reservoir Solutions

- Rock Physics Studies
- Inversions
- AVO
- Attribute Analysis
- Fracture Detection
- Interpretation
- Reservoir Management
- Pore Pressure Prediction
- VSP Processing & Interpretation

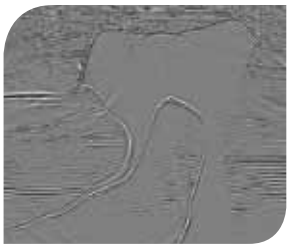


GXT's highly trained team of industry-leading processors and researchers delivers game-changing capabilities to our customers worldwide.



Our global compute-intensive data centers allow us to provide our customers with optimal results, in a timely and efficient manner.

Data Processing



WHY REVERSE TIME MIGRATION?

RTM is the purest form of PreSDM wave equation. Unlike other PreSDM methods, such as Kirchhoff or beam migration, RTM does not impose compromising assumptions that could affect image quality.

Historically, RTM has been very compute intensive. GXT achieved a breakthrough in the implementation of the RTM algorithm that, along with ongoing additions of computing capacity, enables us to process 30 times more data using RTM today than when the technique was introduced, dramatically reducing turnaround time. More recently, we introduced methodologies to allow the efficient, RTM-based processing of wide azimuth (WAZ) and complex acquisition datasets and have demonstrated the ability to commercially apply anisotropic TTI reverse time migration.

PRE-PROCESSING

Statics, Noise Removal, and De-multiple Technologies

By enhancing the signal-to-noise ratio, we are able to optimize seismic data for advanced pre-stack time and depth imaging. Relative amplitude processing, rigorous noise analysis and its removal with appropriate tools, and stringent quality control using specially developed QC tools are necessary steps to accomplish these goals. We have developed statistical and global quality control methods for quick identification of data problems, enabling delivery of high quality processing products on time.

VELOCITY MODEL BUILDING

Pre-stack Velocity Model Building

We have a proven suite of pre-stack velocity analysis and model-building tools to obtain the best possible velocity model for each project. An inherent part of the process, our multi-azimuth TTI and wide azimuth tomography are natural precursors for determining velocities for complex imaging projects. Utilizing our R&D experience and ongoing research in full-wave tomography and waveform inversion, we are able to take a dedicated approach to velocity model building and have both the methods and tools to address each imaging challenge.

IMAGING

Reverse Time Migration

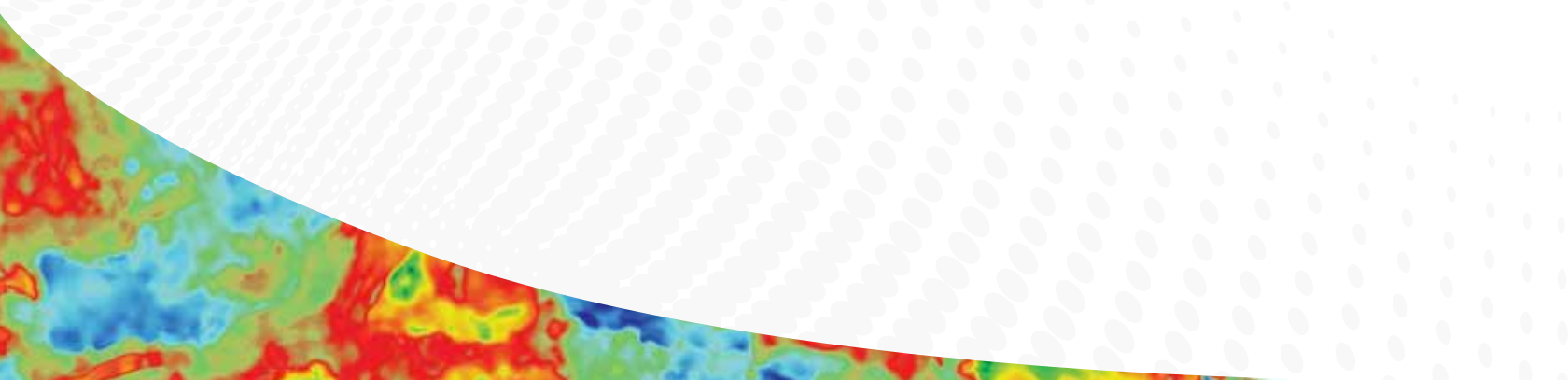
GXT is known for our pioneering work in the field of reverse time migration (RTM). When commercially introduced as a production-ready product, it was revolutionary. Since then, we have been delivering step-change improvements in image quality to leading E&P companies around the world, allowing them to increasingly utilize GXT RTM for their most critical, time-constrained seismic imaging projects, including surveys that were acquired using complex azimuth geometries.

Multicomponent (Full-wave) Imaging

Challenging environments pose unique obstacles, and reservoir potential in these cases can best be unlocked through cutting-edge, integrated solutions that incorporate full-wave technologies. GXT is a recognized leader in developing technologies across the entire seismic workflow that are helping the oil & gas industry move into the full-wave era. To realize the benefits of full-wave data, several guidelines for acquiring the data include:

- Acquiring data using high fidelity multicomponent, single point sensors such as VectorSeis®
- Designing wide azimuth surveys
- Acquiring a full range of offsets
- Recording and preserving the maximum seismic bandwidth

GXT has advanced full-wave imaging tools and technologies to properly sample images of the reservoir acquired using the guidelines above.



Kirchhoff PreSDM/PreSTM

Our Kirchhoff pre-stack depth migration (PreSDM) algorithm is amplitude preserving, making it the premier choice for AVO studies. Our solution utilizes turning ray techniques to image very steep dips and overhangs and also compensate for anisotropic conditions. Our PreSDM is significantly faster than other Kirchhoff methods applied in the industry. As a result, a “no compromise” approach is employed in selecting depth imaging parameters to migrate the seismic data, resulting in higher quality subsurface images in less time. If the geology of a project requires only time imaging, our Kirchhoff pre-stack time migration (PreSTM) is the logical choice.



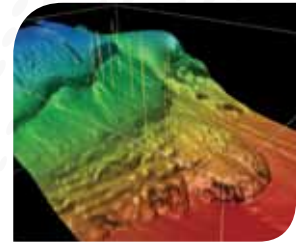
GXT has developed statistical and global quality control methods for quick identification of data problems, enabling delivery of high quality processing products on time.

Unconventional Reservoirs

GXT is uniquely qualified to help E&P operators understand the geology of unconventional reservoirs, including shale plays, to help maximize the exploration and production of these reservoirs. In North America shale plays alone, we have completed over 200 processing projects covering over 18,000 square miles using a combination of enhanced imaging and advanced geophysical analysis techniques including stress field estimation, fracture characterization, and rock property studies.

RESERVOIR SOLUTIONS

As part of our toolkit of advanced seismic acquisition equipment, software, data libraries, and services, GXT's Reservoir Solutions group enables E&P companies to reduce exploration risk, appraise and develop their reservoirs, and optimize production. We are a leader in interpreting large, full-wave (multicomponent) surveys and integrating geophysical, geological, petrophysical, and rock physics information to identify lithology, fluid, or fracture intensity within hydrocarbon reservoirs. Advanced services include VSP processing, gather conditioning, amplitude variation with offset or angle (AVO/AVA), AVO and rock property modeling, spectral extension, pre-stack and post-stack inversion, and rock property prediction for reservoir characterization and interpretation.



Our reservoir services help E&P companies reduce drilling risk, maximize productivity, and control costs.

CASE STUDY: UNCONVENTIONAL GAS

CHALLENGE: Drill wells in reservoir zones with highest fracture intensity

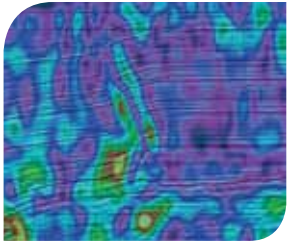
SOLUTION: End-to-end, full-wave imaging program

RESULT: Integrated project identifies best well in the region

A fully integrated E&P company that held a large acreage position in the Sichuan Province in east-central China was formulating plans for a multi-well development drilling program in that field.

Once the data were acquired, GXT processed and interpreted the data to include noise removal and P-wave and C-wave processing. In addition, specialized data processing techniques were applied and advanced geophysical analyses were conducted to assess azimuthal velocity variations and shear-wave splitting within the reservoir.

Since the project was completed, the client has increased drilling success rates of economic wells from 35% to 85%. One of these wells became the most productive well in the entire region and nearly doubled production from the field. Nearly 20 well locations have since been identified.



WHY AZIMUTHAL VELOCITY ANALYSIS?

Azimuthally varying velocity is a common phenomenon in wide azimuth land 3D seismic data. The anisotropy can be an effect of vertically aligned fractures and/or unequal horizontal stresses. When azimuthal velocity anisotropy is not dealt with in seismic processing, the seismic image is often degraded. Azimuthal velocity analysis allows the measurement and correction of azimuthal velocity anisotropy effects in wide azimuth seismic data and is particularly important in shale gas plays. The result is often an improved seismic image including better reflector continuity and higher stratigraphic resolution.

Azimuthal Velocity Analysis

Many hydrocarbon plays, including shale gas, are impacted by subsurface anisotropy, which causes seismic velocities to vary according to source-receiver direction (or azimuth). Unless properly accounted for in processing, this anisotropy can degrade seismic image quality. The solution is AZIM™ imaging, used to measure and correct for directional velocity variations. This award-winning technique uses a full azimuth, non-sectoring approach to azimuthal velocity analysis. The results of AZIM imaging often include improved reflector continuity and stratigraphic resolution within the data. In addition, important velocity anisotropy attributes can be obtained that, when properly constrained, may provide information about fracture density and orientation, as well as the magnitude and direction of horizontal stress fields.



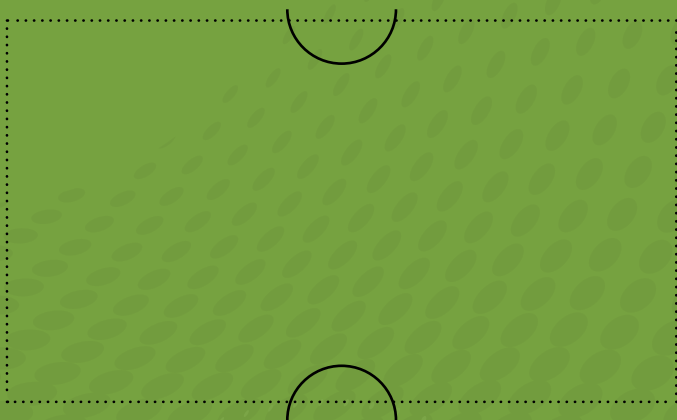
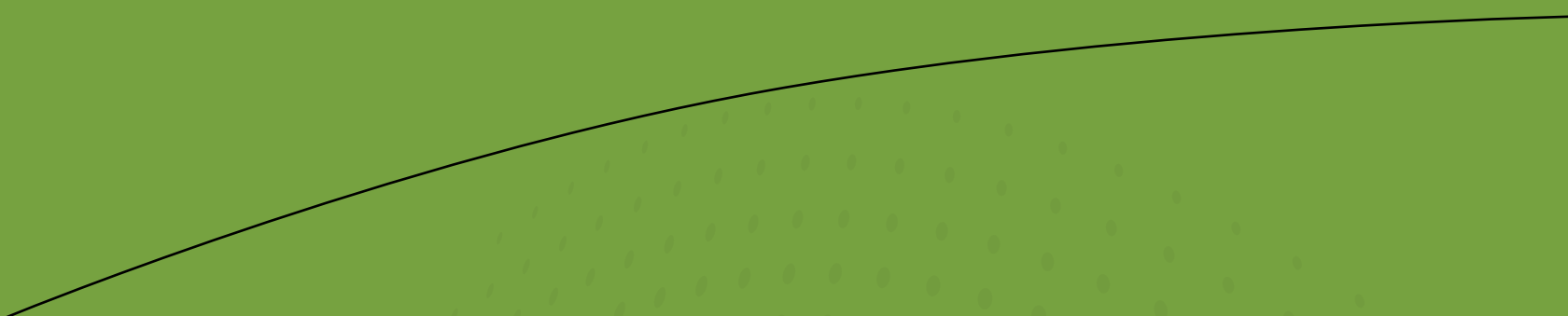
GXT is committed to developing tailored solutions that address our clients' unique business challenges.

Wavelet-based AVO Analysis

While traditional AVO methods are somewhat mature, GXT has developed next-generation AVO tools and approaches that extend the utility and application of the technique. A key proprietary GXT tool is wavelet-based AVO (WAVO™). Building off the foundations of AZIM anisotropic processing, WAVO extends applications of the more traditional AVO technique to harder rocks, deeper horizons, thinly bedded or fractured reservoirs, and areas with low signal-to-noise ratios.

COMMITTED TO YOUR SUCCESS

As a premiere processing company, we are committed to developing tailored solutions that address our clients' unique business challenges across all acquisition environments, including subsalt, sub-basalt, naturally fractured reservoirs, and the Arctic. Through our expertise and ongoing R&D efforts, we continue to push the limits in advanced imaging, developing new and innovative technologies in collaboration with our clients to help ensure their exploration and production success.



→ **Charged to innovate. Driven to solve.**

ION Geophysical Corporation is a leading provider of geophysical technology, services, and solutions for the global oil & gas industry. ION's offerings are designed to allow E&P operators to obtain higher resolution images of the subsurface to reduce the risk of exploration and reservoir development, and to enable seismic contractors to acquire geophysical data safely and efficiently.



To learn more about how ION helps
oil & gas companies and seismic
contractors solve their toughest
imaging and operational challenges,
visit us at iongeo.com

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