TECHNICAL BROCHURE

A Global Leading Geophysical Solution Provider

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BUSINESS SCOPE

As a leading geophysical provider, BGP delivers fully integrated, end-to-end geophysical services and proprietary technologies for the energy industry. With operations spanning 88 countries and 300+ clients, BGP delivers reliable, high-quality services while striving to be a responsible and sustainable partner in the energy sector.

- Onshore Seismic Acquisition
- Offshore Seismic Acquisition
- Seismic Data Processing
- Seismic Data Interpretation & Reservoir Geophysics
- Geophysical R & D
- BGP Borehole Division Technology
- Non-seismic Surveys
- Geophysical Software Systems
- Equipment Manufacturing
- Multi-client Business
- New Energy Business

WEIGHT IMPULSE SOURCE (WI SOURCE)

WI is a spark-free, remotely controlled crawler-mounted weight-drop seismic source equipped with a high-precision Time Break acquisition system. A centralized on/off alternating technique was developed to support up to 20 groups of WI sources for high-efficiency seismic data acquisition. Over 430,000 seismic shots have been acquired in field operations. The technique is validated by high-resolution seismic profiles, delivering a highly efficient solution for shallow seismic exploration in complex areas.

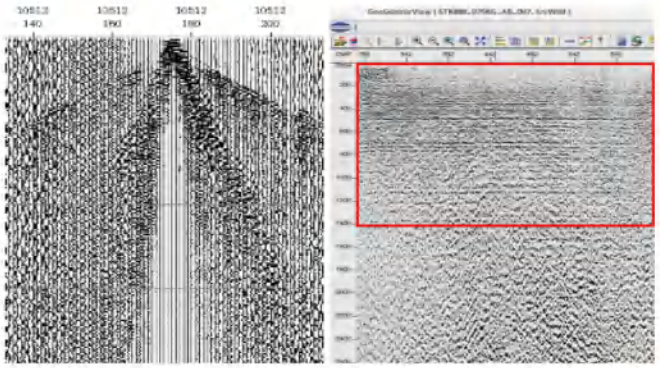
Spark-free remote-controlled Wi source and high-precision TB unit

System features

- Microsecond-level TB accuracy
- Non-electric spark
- Capable of climbing 45°slopes
- Supports synchronous 20 group sources for high-efficiency acquisition
- 75kg of weight drop & 500kg of total weight

High quality images of shallow target layers

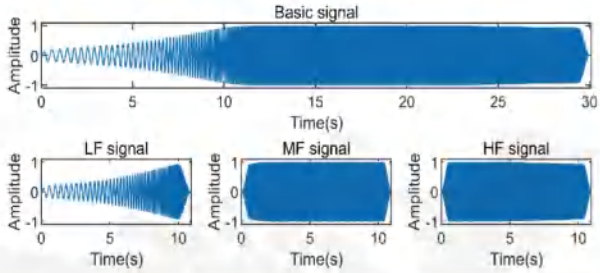
- TB controller suitable for various weight drop seismic source.
- Shooting energy penetrate the shallow target layer up to TWT 0.6 to 1.2s.
- With the appropriate fold coverage, can get clear image of shallow target layer.



MULTI-FREQUENCY SIMULTANEOUS SWEEPING (MFSS)

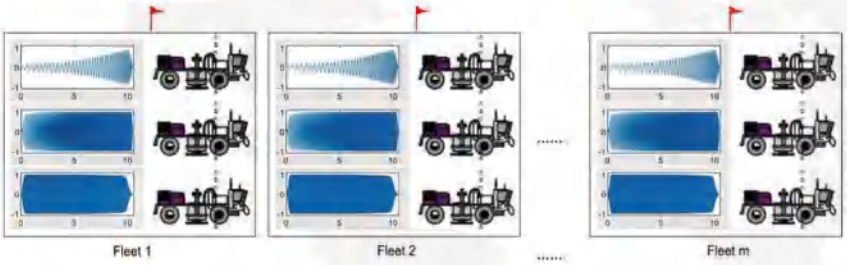
MFSS optimizes the efficiency-quality trade-off of conventional high-productivity vibroseis by replacing traditional sequential single-frequency sweeps with a simultaneous multi-frequency approach.

Signal decomposition



MFSS segments a long-duration sweep into multiple shorter signals. Specifically, the basic sweep signal (a) is divided into N segments (e.g., 3), as illustrated in (b).

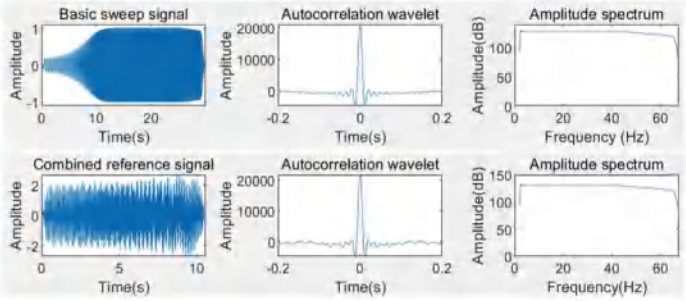
Simultaneous, multi-frequency sweeping



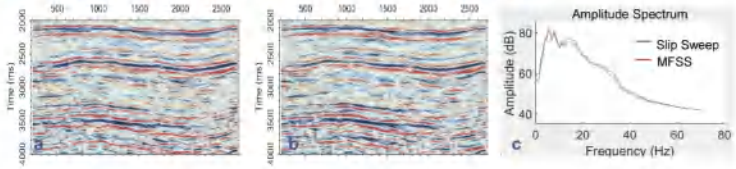
N distinct signal segments are distributed to N vibrators within a fleet. All vibrators in a fleet then sweep simultaneously at the same shot point.

Preprocessing of MFSS data

The N independent multi-frequency sweep signals are stacked to serve as the reference signal for correlation, as shown in the right figure. Subsequently, cross-correlation is applied to the acquired shot data to obtain the normal shot gather.



Applications of MFSS



PSTM profiles of (a) slip sweep and (b) MFSS, and (c) amplitude spectra

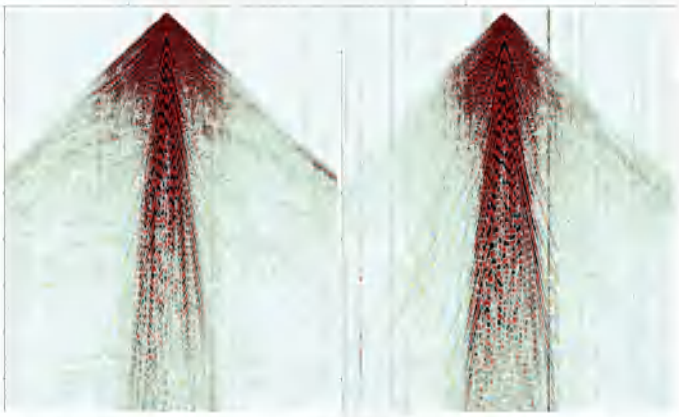
The N independent multi-frequency sweep signals are stacked to serve as the reference signal for correlation, as shown in the right figure. Subsequently, cross-correlation is applied to the acquired shot data to obtain the normal shot gather.

MULTI-COMPONENT PROCESSING

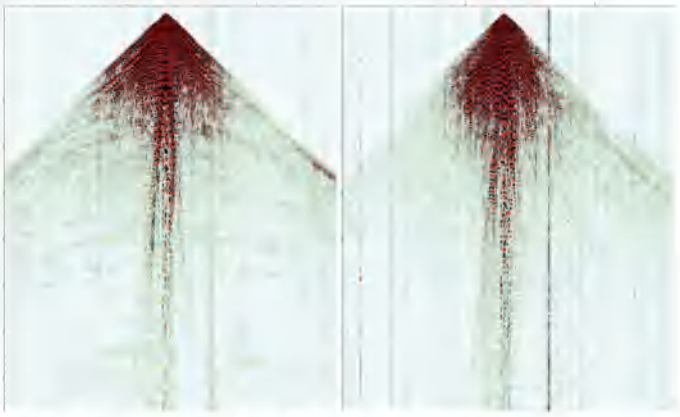
A comprehensive suite of functions for multi-component data processing and interpretation are available, including multi-component data preprocessing, PS-wave static correction, VTI multi-parameter iterative analysis, azimuthal anisotropic parameter estimation, VTI prestack time/depth migration, S-wave splitting analysis, multi-component horizon matching, multi-wave joint inversion and full-wave joint attribute extraction etc., which are well able to meet the processing demands of explorations such reservoirs as tight sandstone, carbonate rock, shale gas and heavy oil.

Polarization filtering

By utilizing the differences in polarization characteristics between desired waves and noise waves, the surface wave energy in multi-component seismic data is suppressed, thereby improving the signal-to-noise ratio of pre-stack multi-component seismic data.



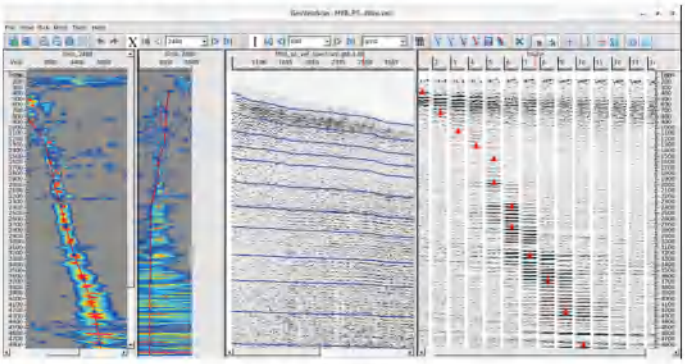
Z (left) and R (right) component before polarization filtering



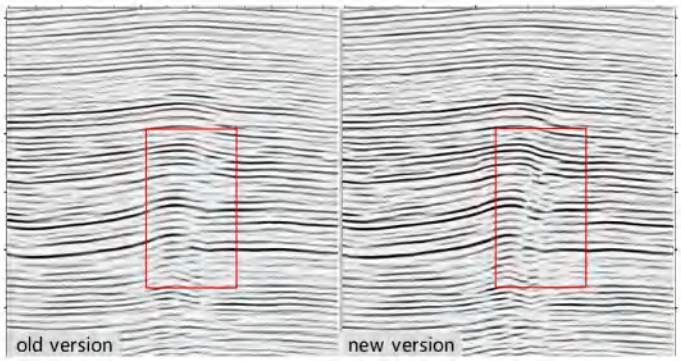
Z (left) and R (right) component after polarization filtering

VTI anisotropy multi-parameter iterative analysis

This technique features VTI bispectrum analysis, four-parameter analysis, and multi-azimuth multi-parameter analysis. The new version introduces gama field scanning function, which effectively improves the imaging of small faults in converted waves section.



γ field scanning

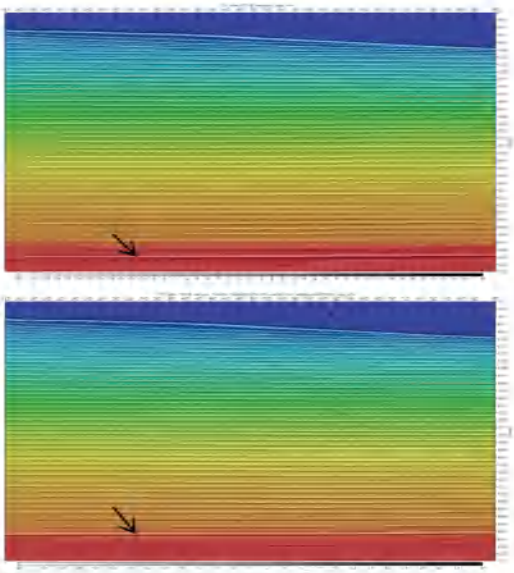


Converted image

MULTI-COMPONENT PROCESSING

Joint P and S wave tomography technology

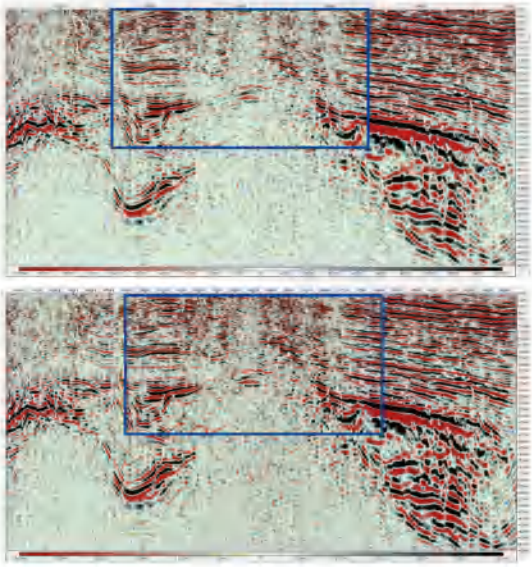
A joint tomography technology based on the constraint of imaging depth differences between P-waves and S-waves has been developed. The algorithm takes into account the asymmetry of source-receiver positions in converted-wave imaging gathers, which further improves the stability and accuracy of the algorithm.



► The converted-wave migration section before (upper) and after (lower) the S-wave velocity update, overlaid with the true Vp velocity

Converted-wave migration technology

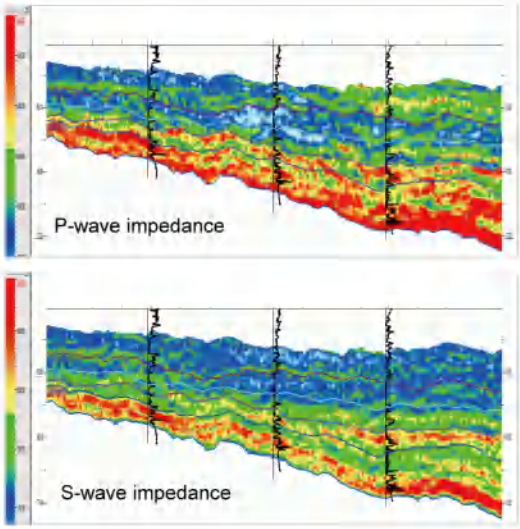
It supports converted-wave imaging in topographically varying surface (dual-datum) environments, incorporating VTI, TTI, and TORT anisotropy as well as viscoelastic media. The imaging accuracy and efficiency remain at the forefront of the industry.



◄ Comparison of conventional converted waves depth migration of (upper) and converted waves Q-compensated depth migration (lower)

Multi-component inversion: from qualitative to quantitative

The key technical bottlenecks were broken through of converted wave AVO inversion, elastic impedance inversion and multi-component post stack/pre-stack joint inversion. A series of multi-component inversion techniques have been formed from qualitative to quantitative.



► Pre-stack joint inversion and interpretation results of field multi-component data

MULTI-CLIENT SEISMIC SOLUTIONS

BGP Multi-Client provides the highest quality Multi-Client geophysical and geological data & services to the global oil and gas industry to assist with licensing rounds and the preparation of regional data programs. BGP has acquired a vast amount of multi-client seismic data in onshore and offshore basins in South America, Europe, Africa, Middle East and Asia Pacific. A database of gravity and magnetics is also available.

Features

- Focusing on client demands
- Providing flexible MC services or a combination of Multi-client and Contract services
- Utilizing continued technological development to improve subsurface understanding
- Satisfying all the seismic requirements of clients by offering 2D, 3D, 4D seismic survey design, acquisition, processing, interpretation, and reprocessing.

MC activity map

Benefits

- Accessing high quality geophysical data at a lower cost
- Allowing exploration companies to prospect on trend or regional basis–promoting higher exploration and development success rates
- Ability to improve the knowledge base quickly, using readily available data
- Lowering the economic barriers to exploring and producing oil and gas, therefore allowing smaller E&P companies access and entry to riskier and often more expensive plays
- Improving the efficiency of E&P investments, resulting in better investments
- Reducing risks associated with survey permissions, acquisition and data processing

Suriname 3D multi-client project seismic section

BGP INNOVATOR – HYBRID SEISMIC VESSEL

The BGP Innovator is the world's first dedicated hybrid node handling and multi-source vessel focused on shallow water OBN seismic operations, which has been designed to deliver superior acquisition solutions in shallow water areas through ocean bottom node seismic operations.

BGP INNOVATOR Key Specifications	
Flag	PANAMA
Class	BV and CCS
Year of Built	2022
Length	88.235 m
Breath	16.90 m
Minimum Working Draft	2.50 m
Maximum Working Draft	2.85 m
Air Draft	13.90 m
Dynamic Positioning System	MT
Propulsion Type	Full Eiesel Electric Driven System
Main Generators	4 x Wartsila Generators Set
Main Propulsion	2 x ZF Azimuth Thrusters
Bow Thruster	3 x ZF Tunnel Thrusters
Fuel Capacity	470 m^3 (100%), 423 m^3 (90%)
Fresh Water Capacity	300 m^3
Economy Speed	9.0 Knots
Sailing Endurance	40 Days
Living Capacity	60 Persons Including Marine Crew

Seismic Equipment	
Node Capability	Up to 4000 Nodes
Source Capability	6 x Gun Arrays
	Single / Dual / Triple Gun Sources
Seismic Compressor	3 x 48 m^3/min
Working Pressure	2000 Psi
Source Controller	GunLink 4000

Main features

A) High-level vessel performance

- Dynamic positioning design
- Ultra shallow draft design
- Minimum draft 2.5 meters

B) Multi-function seismic equipment

- Node handling function
  Modularized deployment and retrieval system for NOAR operation with a back deck storage capacity of up to 4,000 nodes and 240 nodes can be charged and downloaded simultaneously.
- Source operation function
  Featuring full-volume air gun sources to support triple-source operations, the vessel integrates the Gunlink 4000 digital gun controller for real-time source QC.
- Integrated navigation function
  On-board integrated navigation system, DolphinTM delivers multi-vessel navigation and high-precision source & receiver positioning capabilities.
- Onboard OBN data QC system
  BlueWhale™ on-board OBN seismic data QC and management system delivers a daily seismic data handling capacity of up to 10 TB via 10 computing nodes and 8 storage nodes.

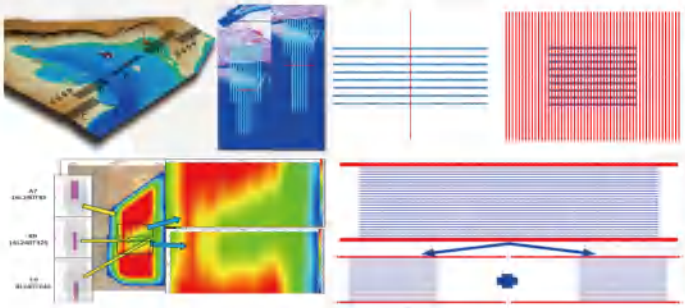
OBN SEISMIC EXPLORATION SOLUTIONS

BGP OBN briefing

Ocean bottom node (OBN) seismic exploration service, supported by software and equipment owned by BGP, has become a focus area for BGP in recent years, with regards to both technology and business development. This acquisition methodology requires extensive planning and integrated navigation of the seismic flotilla to achieve optimal operational efficiency for node deployment and retrieval, comprises massive data QC and on-site processing and yields superior 4-component seismic data with full azimuth, high fold, long offset and high SNR.

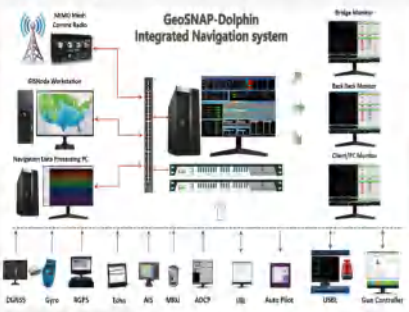
BGP OBN key techniques

1. OBN geometry design

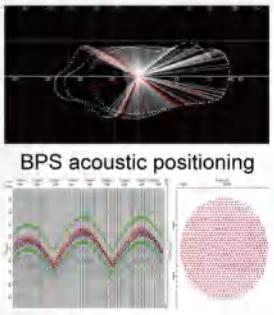


Geometry design for various terrains

2. Integrated navigation & positioning



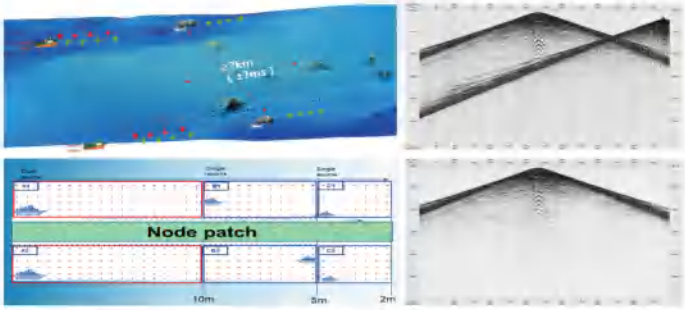
Dolphin integrated navigation system



BPS acoustic positioning

BGP FBP solution

3. Marine seismic high-efficiency acquisition



Multiple sources blended shooting

Data de-blending

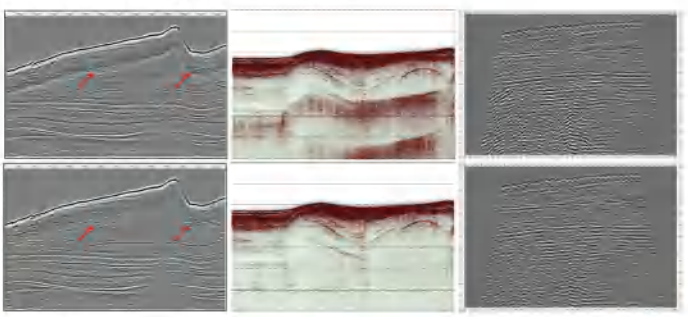
4. OBN automatic deployment & retrieval system

Module, sonveyor and deployment & retrieval system

5. OBN data quality control system

KL-NodeQC software

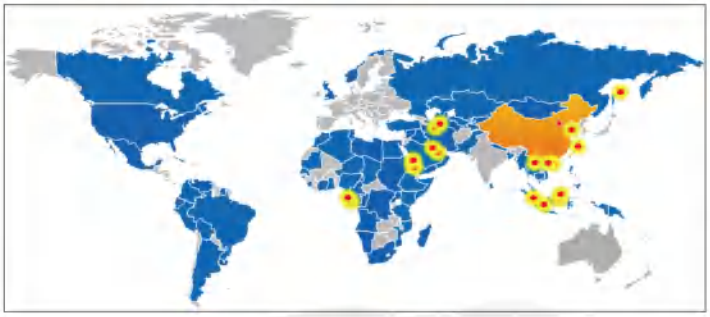
6. OBN data processing



Broadband processing / multiple removal / vz noise suppression

OBN SEISMIC EXPLORATION SOLUTIONS

BGP OBN experience



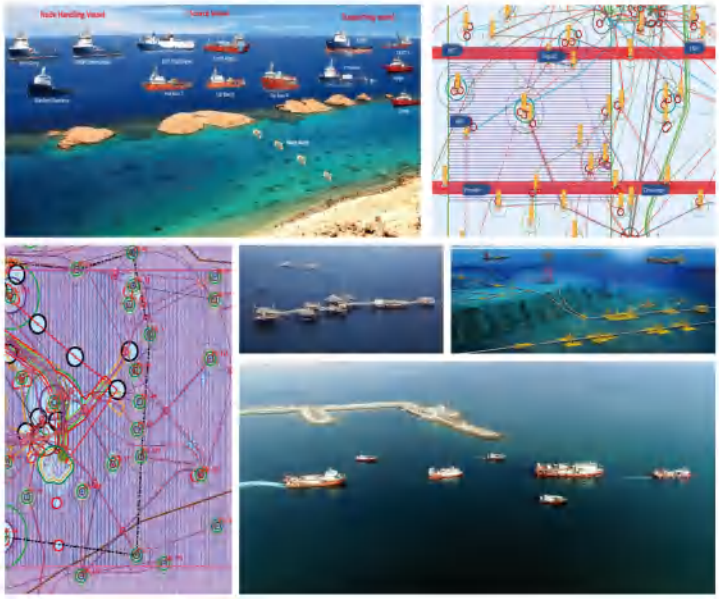
Since entering the OBN market in 2015, BGP Offshore has established itself as the major OBN service provider globally, with more than ten large scale projects to date, and with the surveys in Indonesia, Abu Dhabi, Brunei and Saudi Arabia being the largest OBN projects in 2017, 2018, 2019 and 2023, respectively.

Brunei 3D/4D OBN survey

- 140+ platforms
- 7500+ close passes
- High 4D repeatability
- Sensitive coral areas
- ROV operation (node layout close to obstruction / coral protection)
- No time lost due to SIMOPs
- 4 PB acquired seismic data
- High data quality and improved structural imaging

Middle East OBN survey

- Largest survey area in the world: >30000 km²
- ~200 platforms in the oil field
- Nominal fold up to 9600
- Aspect ratio: 1
- High efficiency blended shooting: max 74113 shots/day with 6 source vessel and 10 sources
- More than 80 million shots
- 2.2 million node locations
- 34,192 close passes in 500m safe distance
- More than 70 vessels, >1450 staff

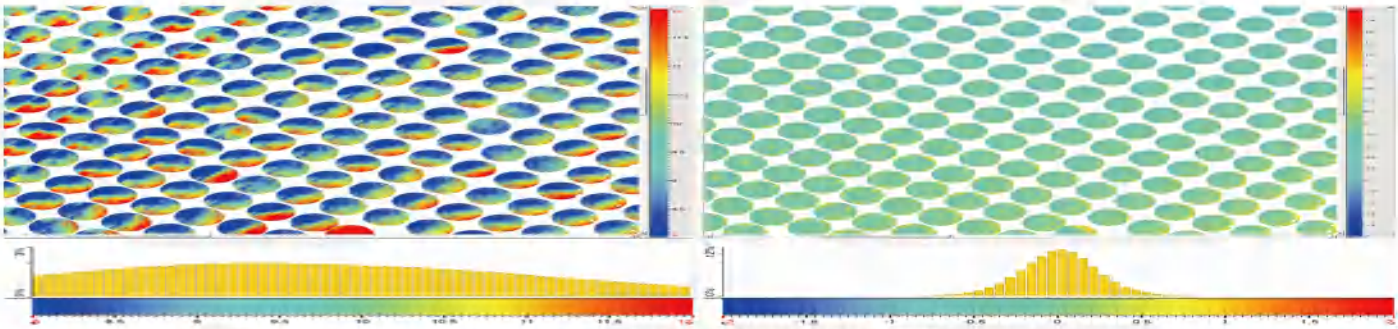


OBN DATA PROCESSING

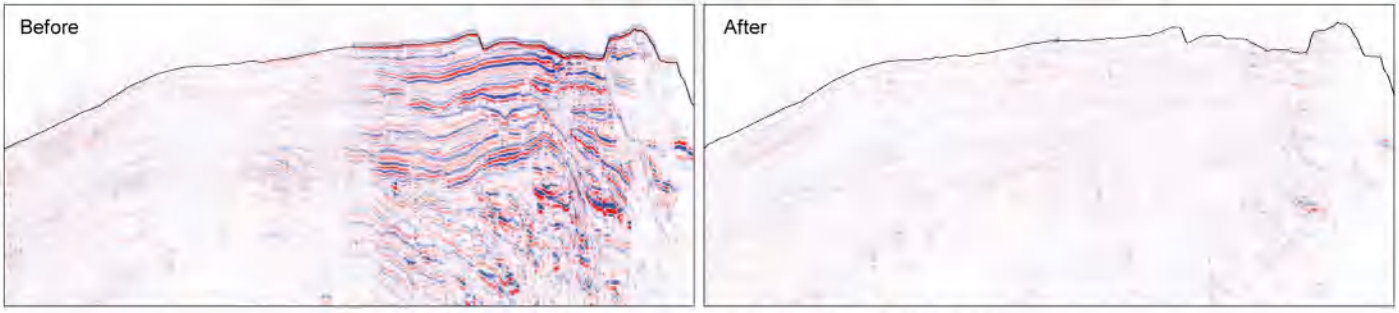
BGP's advanced Ocean Bottom Seismic processing and imaging technologies are systematically aiding our client's understanding of the subsurface. Industry leading pre-processing workflows as well as state-of-the-art Full Waveform Inversion and Impedance inversion algorithms make full use of OBN low-frequency, full-azimuth, ultra-long offset information.

PTC (position, time, clock drift) inversion

With advanced and tailored pre-processing workflows, BGP can address all different types of challenges from shallow to deep water environments.



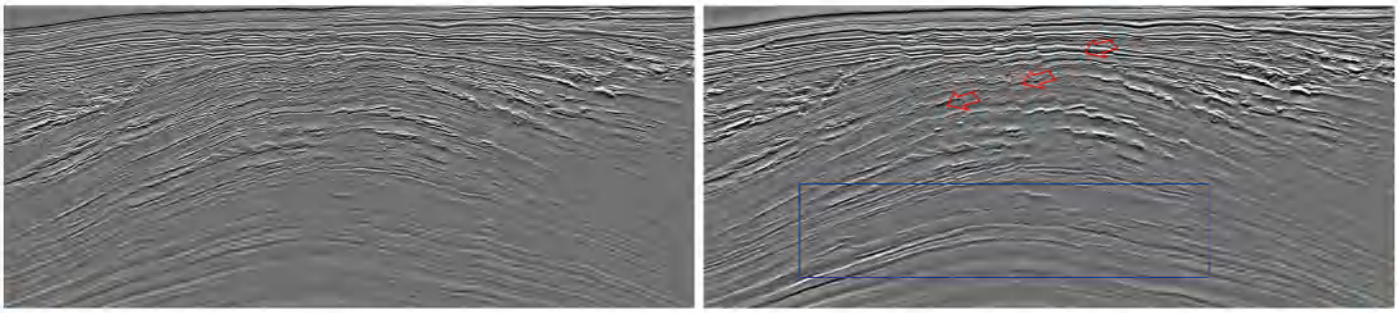
Time difference map before and after PTC



4D difference section before and after PTC inversion

3D directional de-signature

For broadband wavelet processing, we upgrade traditional 1D algorithms to full 3D techniques to break through inherent wavelet directionality limitations. This method better adapts to complex subsurface geological conditions, effectively improving multi-directional spatial consistency of wavelet features.



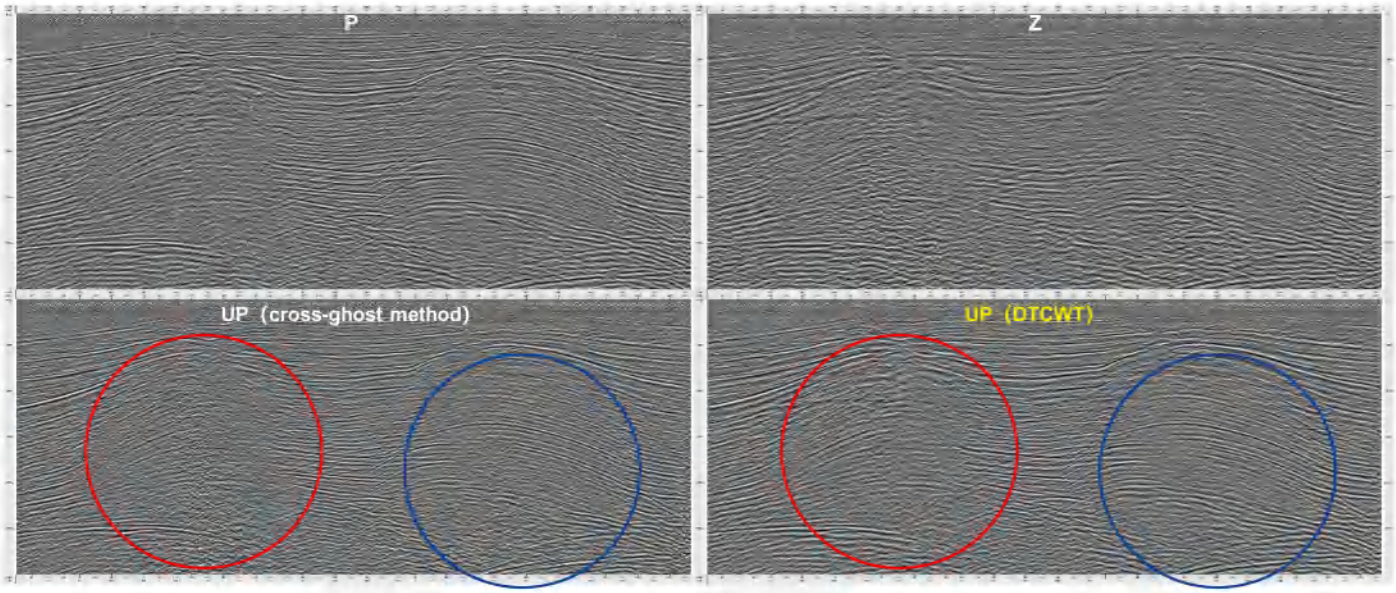
Legacy

Result with 3D directional de-signature

OBN DATA PROCESSING

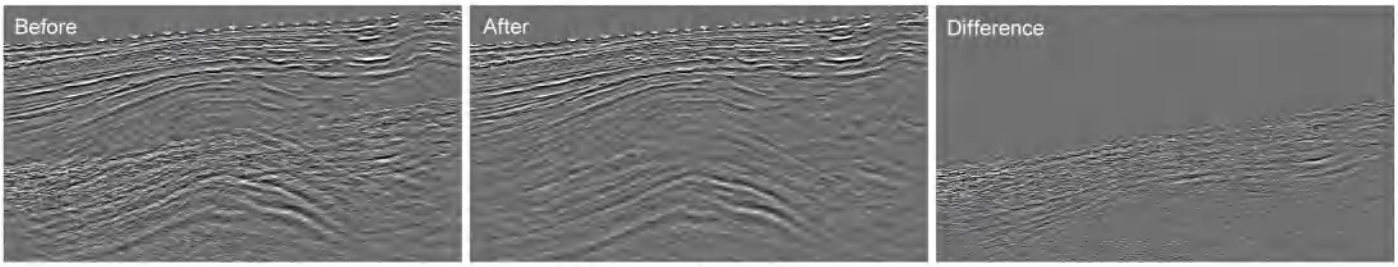
Wavefield separation

The dual-tree complex wavelet transform (DTCWT) is used for wavefield separation. Unlike conventional wavelet methods that lack directional sensitivity, DTCWT possesses strong directional selectivity and multi-scale decomposition capabilities, allowing it to accurately capture the directional characteristics of different wavefields.

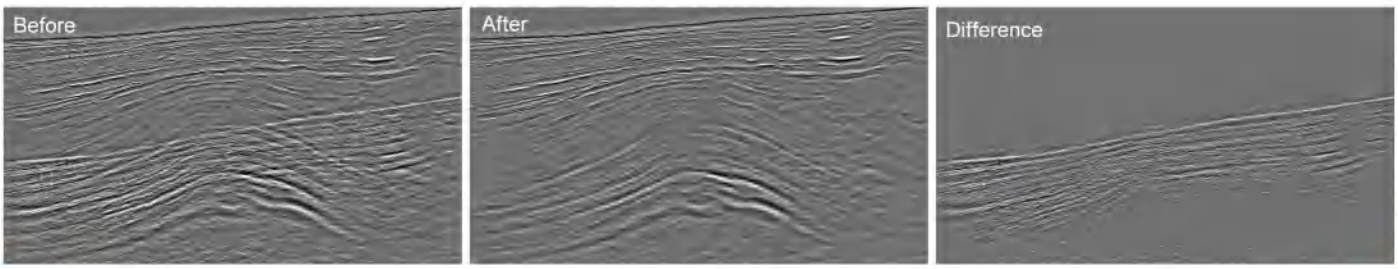


UDD-DDD

Up/Down Deconvolution and Down/Down Deconvolution rely on refined wavefield component decomposition of OBN seismic data. By fully utilizing the propagation differences between upgoing and down-going wavefields, these two techniques can accurately identify and isolate multiple interference components.



UDD-DDD for up-going wave de-multiple



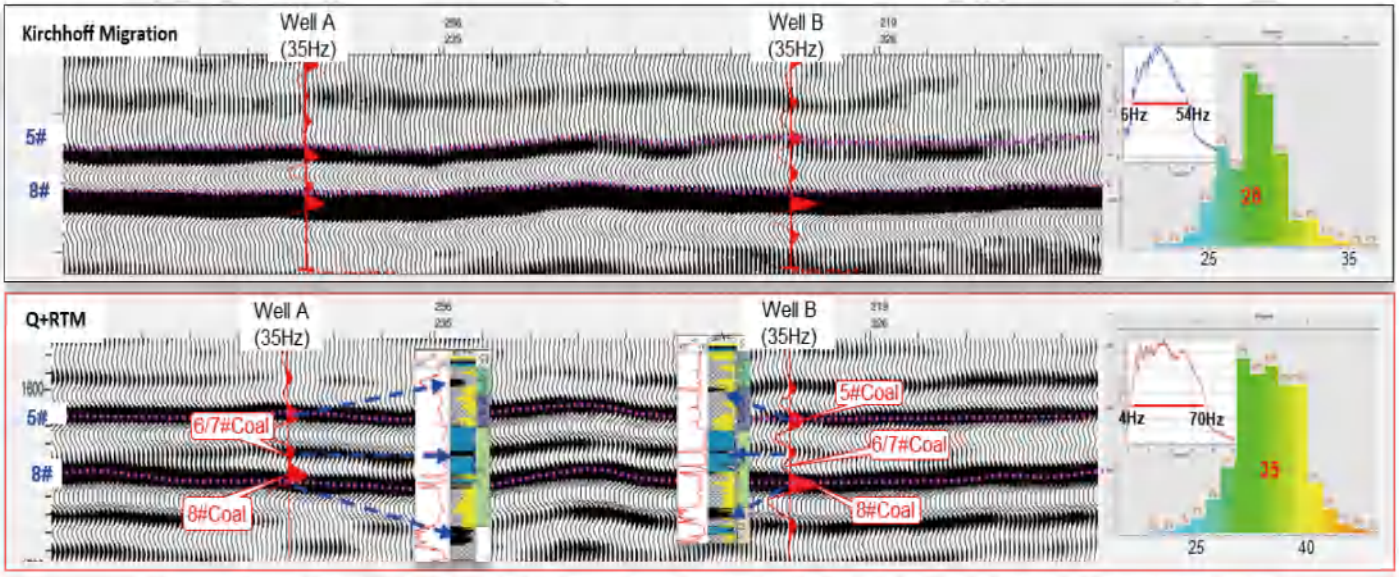
UDD-DDD for down-going wave de-multiple

LAND DATA PROCESSING IN COMPLEX AREA

BGP's advanced land seismic processing and imaging technologies are systematically aiding our client's understanding of the subsurface. Industry leading pre-processing workflows as well as state-of-the-art Full Waveform Inversion and Least-Squares Migration algorithms make full use of land data wide-azimuth, broadband and high-density information to address dual complex geological conditions and High-Fidelity & High-Resolution Seismic Processing challenges.

High-fidelity & high-resolution seismic processing

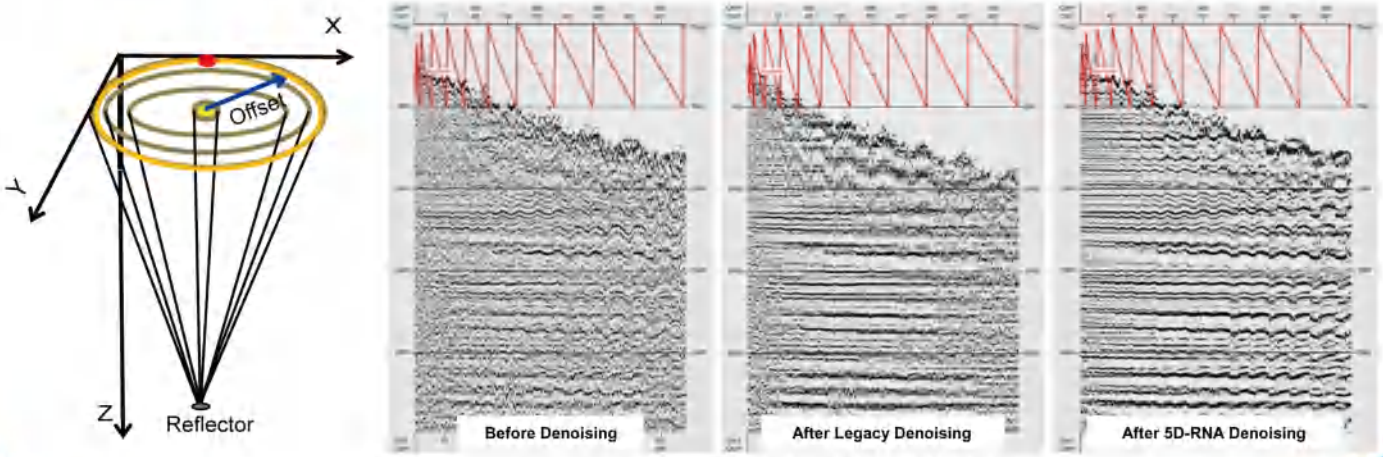
With advanced and customized high-fidelity and high-resolution processing workflows, BGP can address various geophysical challenges in complex lithology conditions.



Comparison of legacy vs BGP PSTM stack sections after high-fidelity & high-resolution processing

5D prestack random noise attenuation

5D-RNA technology suppresses random noise via azimuth dimension, preserves true wavefield, and improves traveltime and amplitude fidelity of prestack gathers.

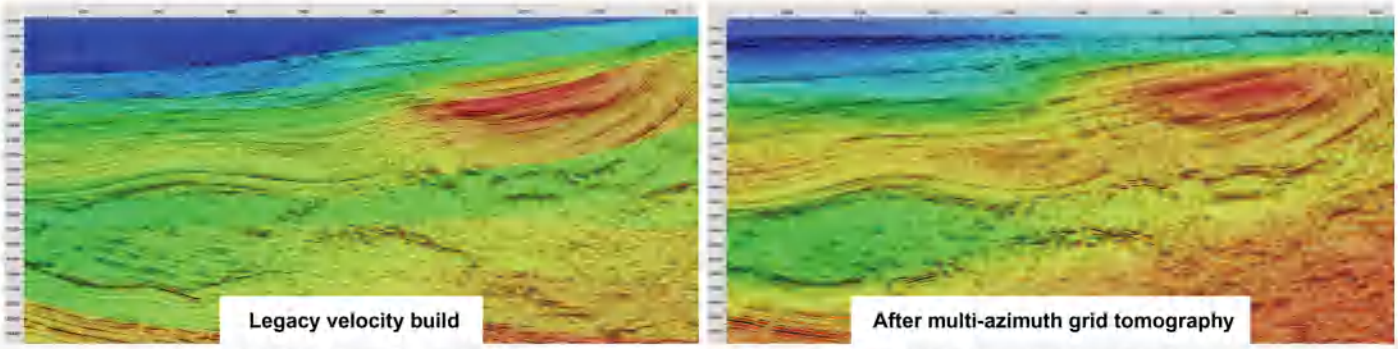


Denoising comparison: legacy method vs BGP 5D-RNA

LAND DATA PROCESSING IN COMPLEX AREA

Multi-azimuth grid tomography

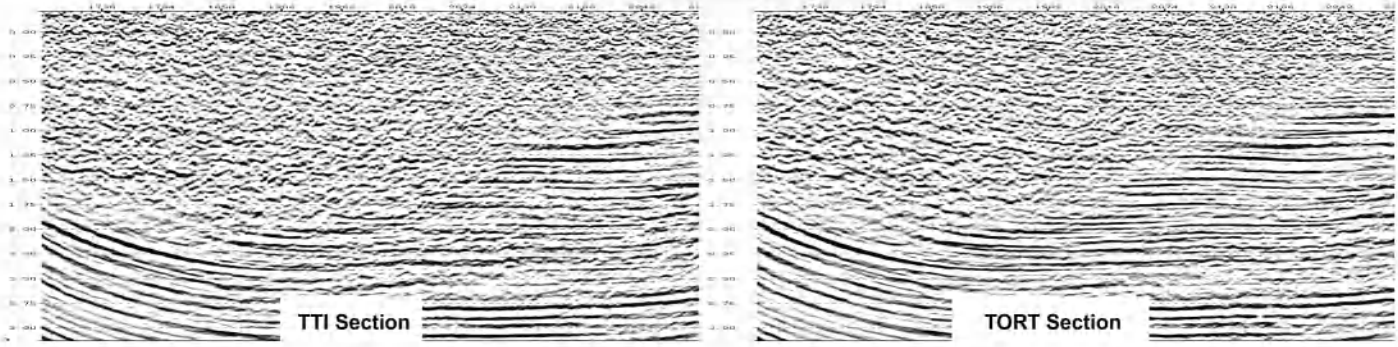
Multi-azimuth grid tomography utilizes wide-azimuth data and azimuth information to raise grid ray density, improving tomography accuracy and stability.



Velocity and section comparison: Legacy method vs BGP multi-azimuth grid tomography

Tilted orthorhombic anisotropy model building and imaging

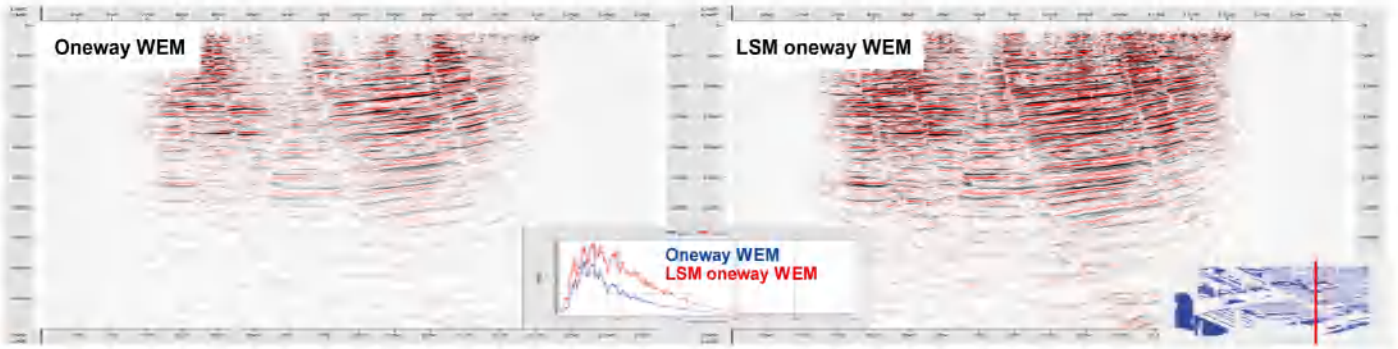
TORT modeling and migration reduces reflection angle distortion from anisotropy and azimuthal variation, improving imaging accuracy in complex geology.



TTI vs TORT imaging result

Least-squares migration

Least-squares migration imaging resolves lithological exploration challenges in complex onshore areas, improving data illumination, resolution, thin reservoir identification and fine sand body characterization.



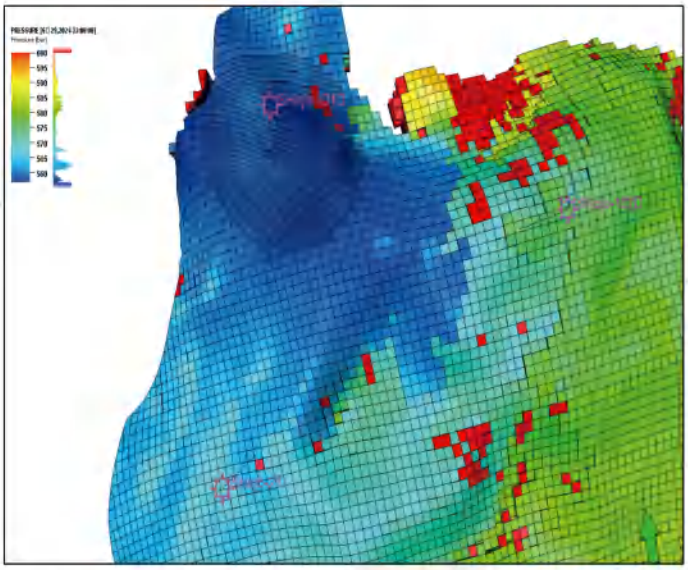
Section comparison: Oneway WEM vs LSM oneway WEM

MODELING AND NUMERICAL SIMULATION OF DUAL-MEDIA RESERVOIRS

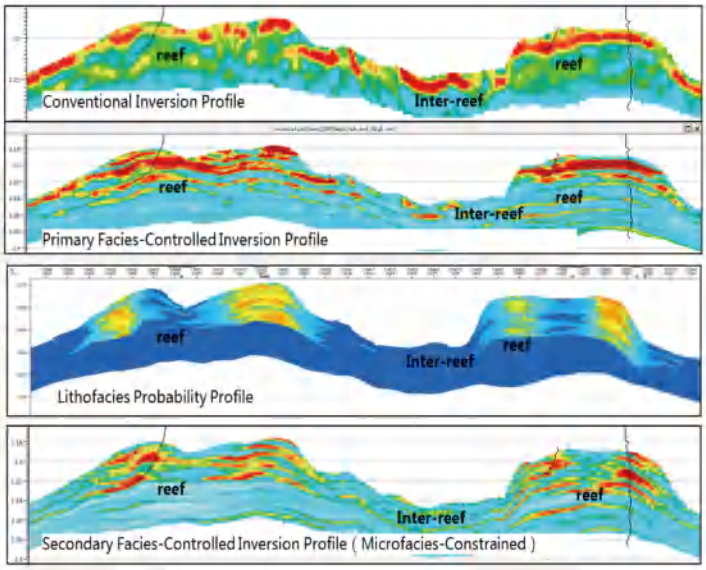
BGP can provide services such as fine Geological Modeling and Numerical Simulation of Dual-Media based on integrated seismic-geology-reservoir development studies.

Reservoir modeling under multi-stage facies-constrained inversion

Reef-shoal microfacies are identified via multivariate attribute analysis, and reservoir architecture is finely characterized using multi-level facies-controlled inversion and production performance.

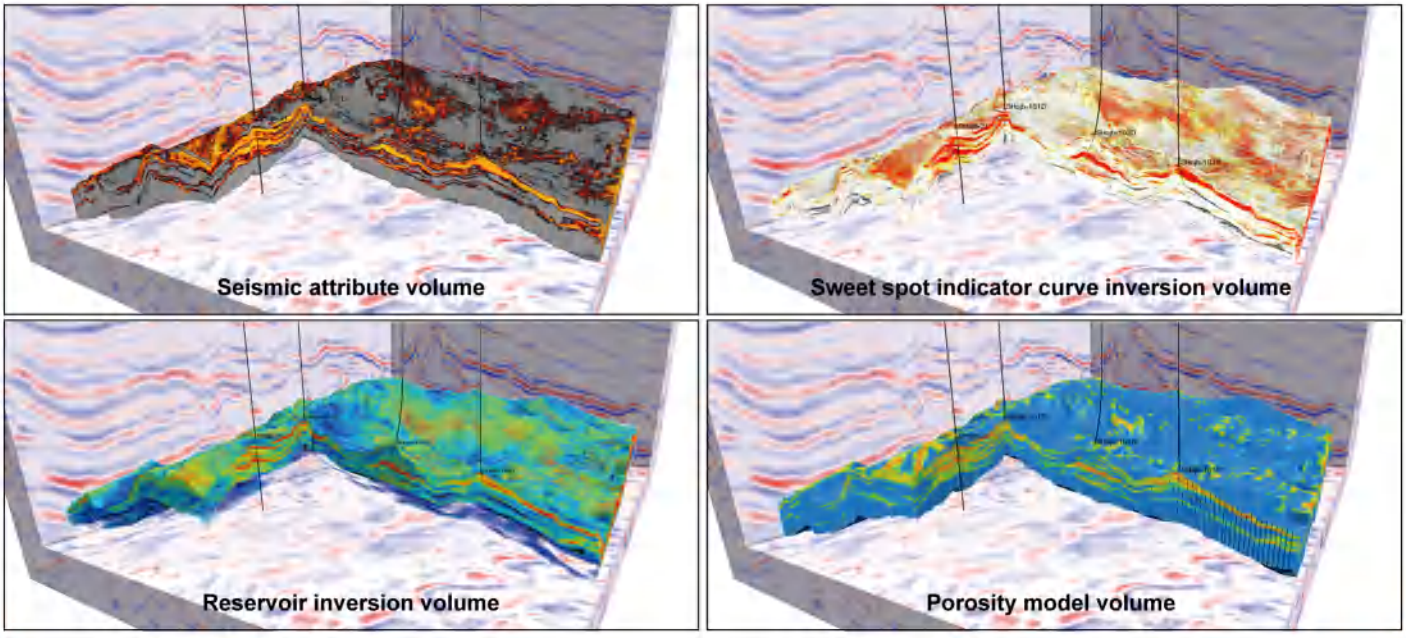


Numerical well test analysis of inter-well connectivity



Multilevel facies-controlled section

High-precision reservoir models are then constructed under multi-parameter constraints from seismic attribute and inversion volumes.

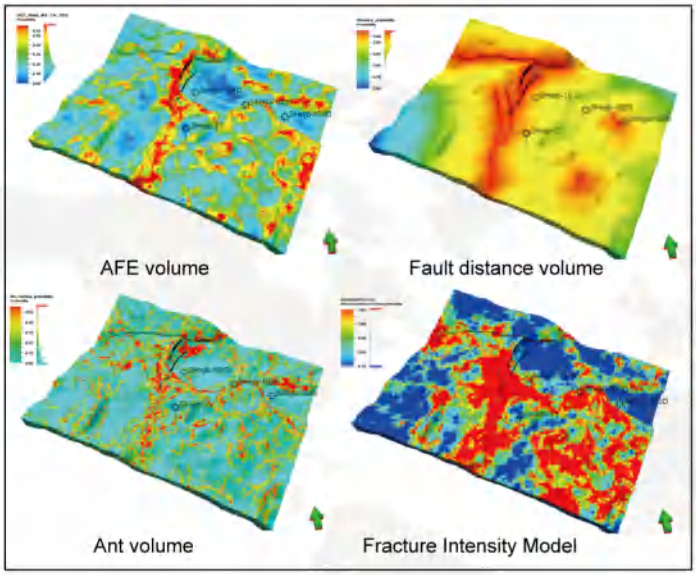


Reservoir modeling with multi-parameter constraints

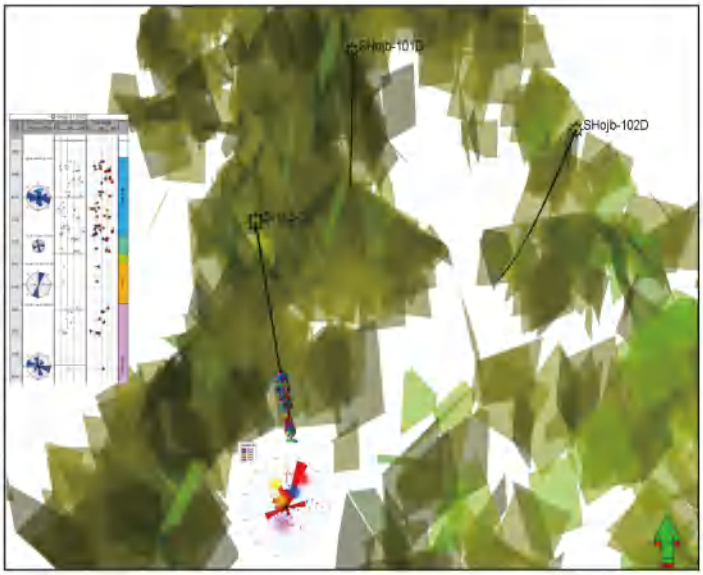
MODELING AND NUMERICAL SIMULATION OF DUAL-MEDIA RESERVOIRS

Innovative prediction of water invasion channels in dual-media reservoirs

A novel fusion method of fracture-sensitive attribute volumes is developed to build a fracture network model, calibrated by fracture effective permeability from PLT and production well tests. This enables coupling and iterative updating with dynamic flow data.

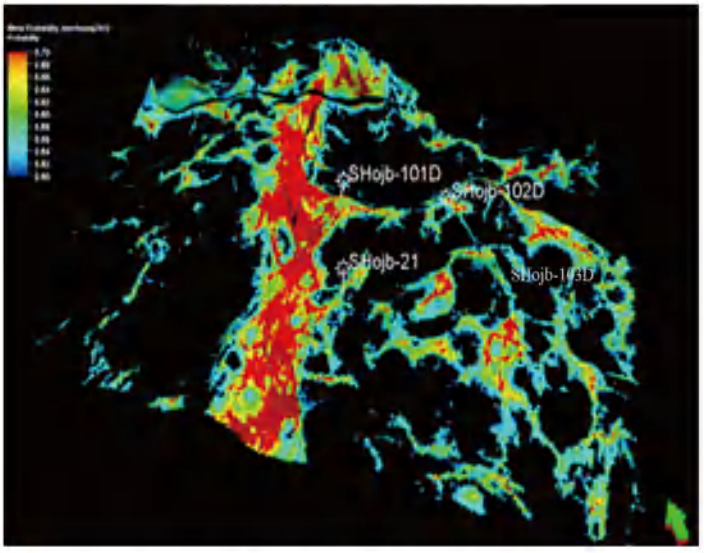


Fracture intensity model by multi-attribute sensitive volumes

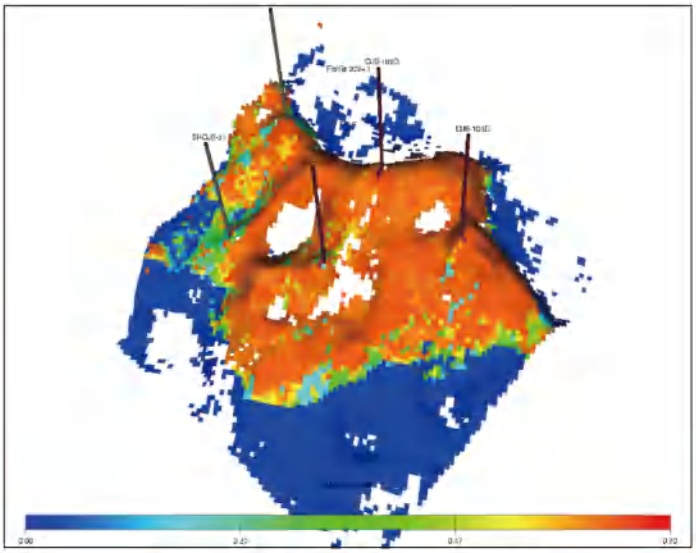


Improved fracture model

Based on reservoir and fracture models, reservoir heterogeneity is quantitatively characterized, water invasion channels in the gas field are delineated, simulating fluid changes and distribution in the gas reservoir, providing guidance for optimization of well placement, water control and management in gas wells and well, enhancing recovery factor.



Water influx channel characterization model



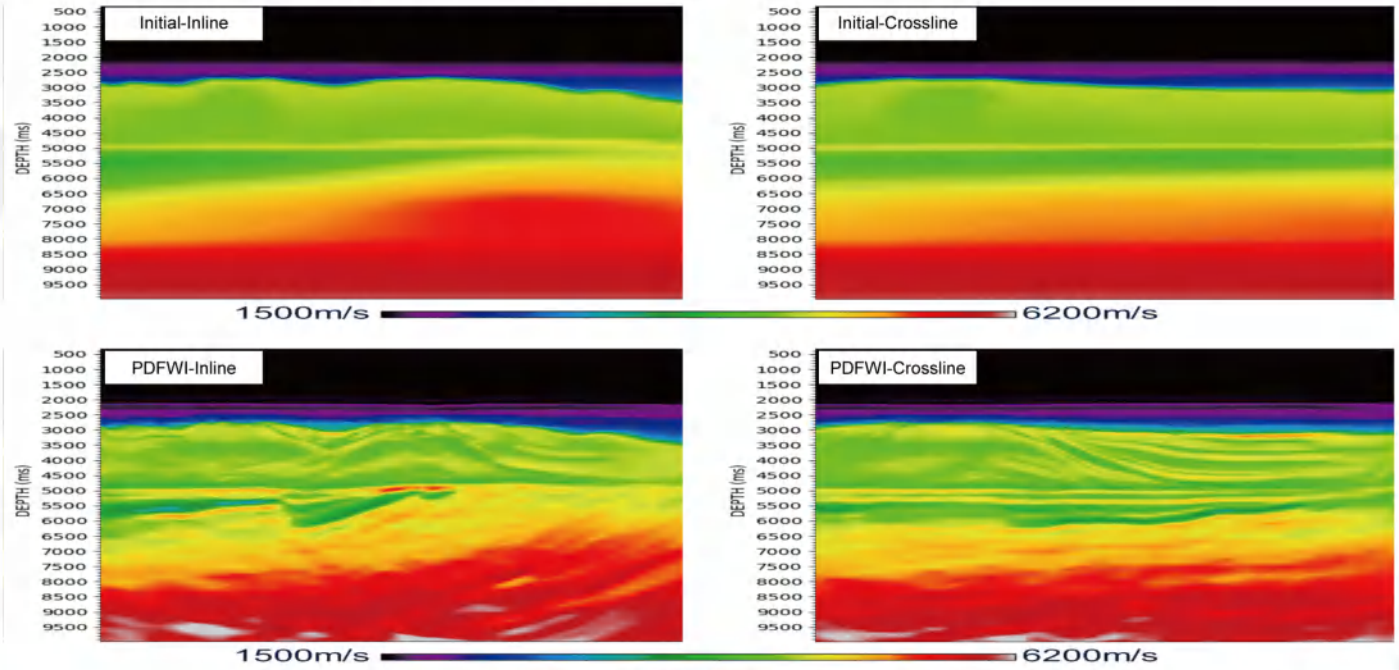
Numerical model of gas saturation

INTEGRATED FWI + FWII SOLUTIONS

BGP offers a comprehensive suite of inversion techniques, including Phase Driven Full Waveform Inversion (PDFWI), multi-parameter Full Waveform Impedance Inversion (FWII), and 4D FWI.

Acoustic PDFWI

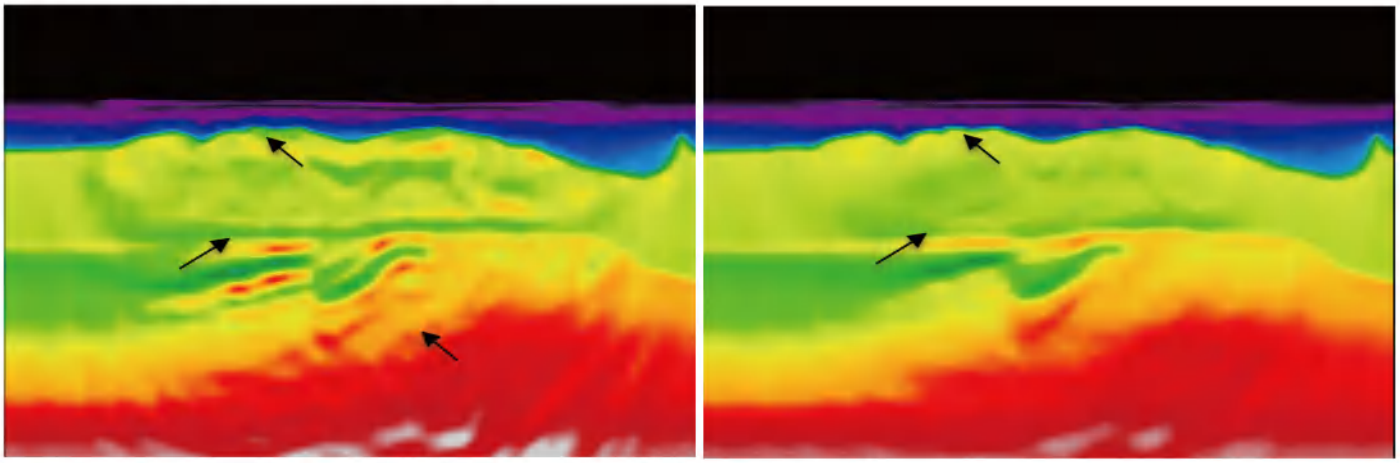
BGP's state-of-the-art PDFWI delivers efficient and high-precision velocity models. After FWI update the resolution has been enhanced and a significant amount of geological information can be observed in the inverted model.



20Hz PDFWI velocity model update

Elastic FWI

Comparison of acoustic and elastic, at low frequencies, EFWI reduces salt-halo effects, sharpens structure within and beneath salt, and substantially suppresses inversion artifacts compared with AFWI.

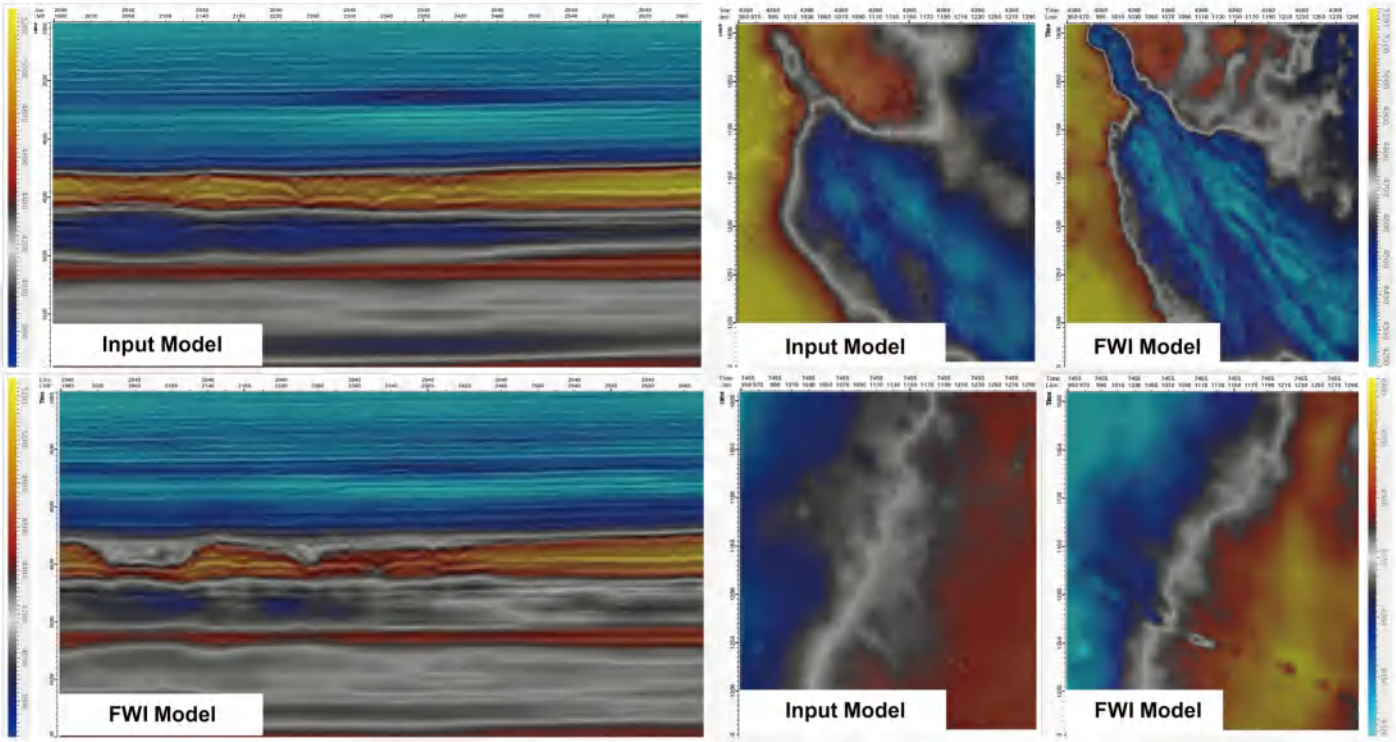


Comparison of acoustic and elastic FWI result

INTEGRATED FWI + FWII SOLUTIONS

Land FWI

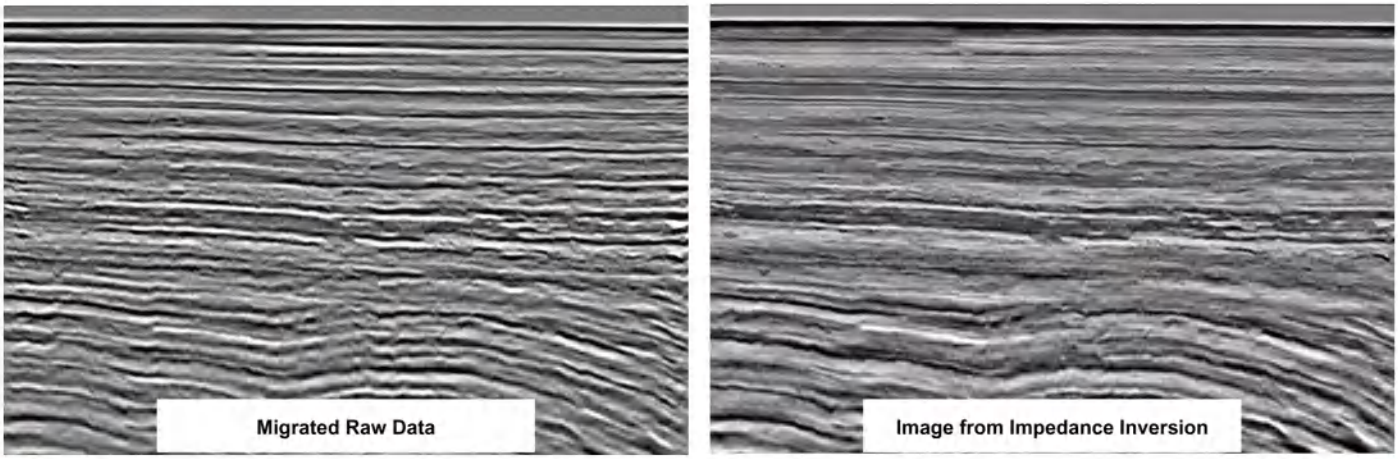
BGP's FWI framework supports ultra-deep imaging in complex geological environments. It adopts anti-cycle skipping algorithms and least-squares optimization to reduce traveltime misfit in data and image domains.



Overlay of velocity, migration profiles and slices before and after Land FWI

Full waveform impedance inversion

FWII inverts the full wavefield to produce the most accurate images bypassing the conventional pre-processing workflow. FWII refines impedance properties, outputting an Inverted Impedance model. From that, we derive the final Reflectivity, which can be used for high-resolution imaging.

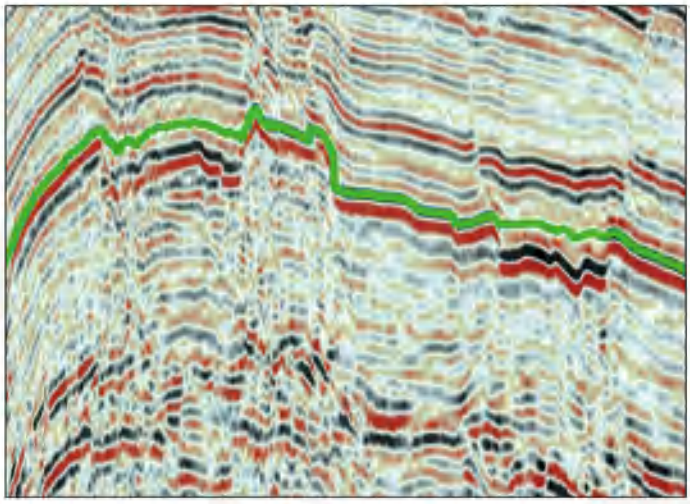


Comparison of RTM and elastic FWII result

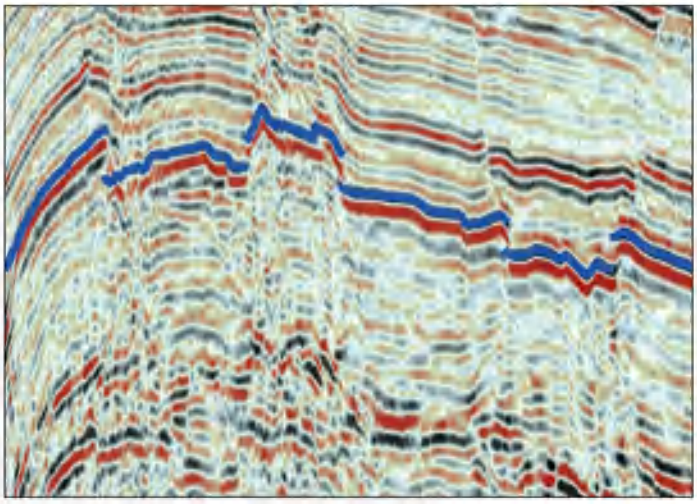
AI INTERPRETATION

AI horizon interpretation

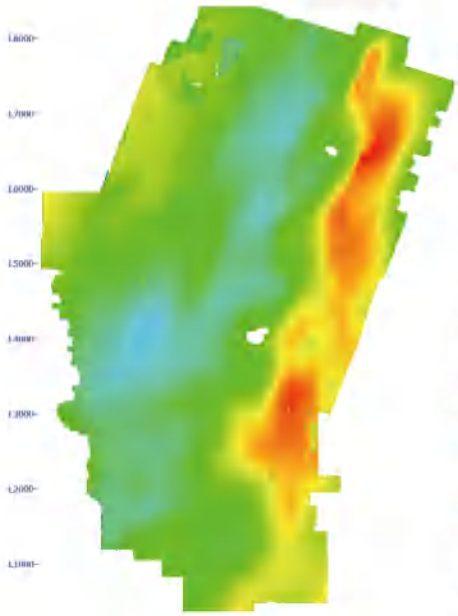
The traditional horizon auto tracking technique is usually based on waveform similarity or spatial density, which is not reliable when the seismic event crosses faults. However, even without fault constraints, the deep learning based horizon auto tracking technique is able to obtain decent results in the fault zone.



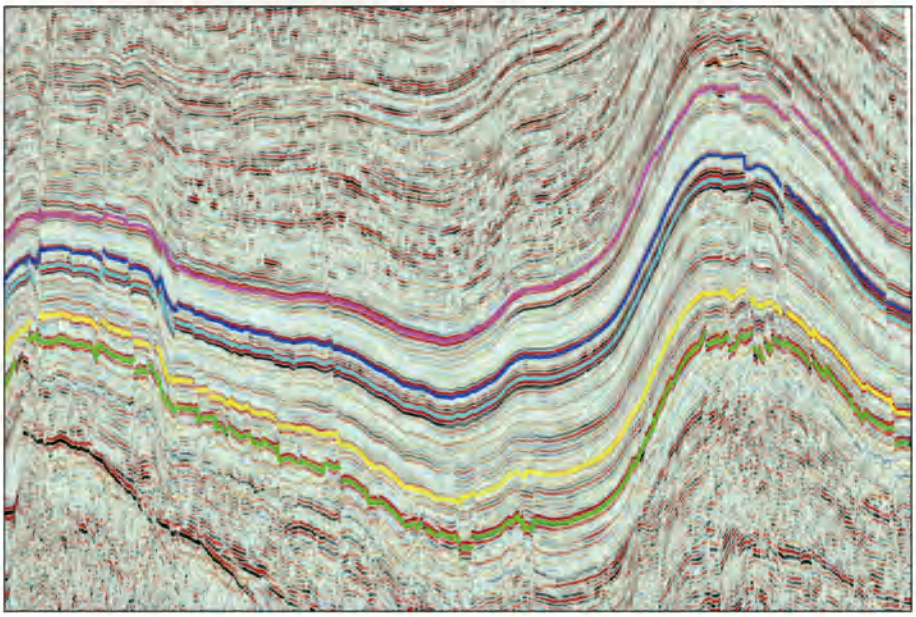
Traditional horizon auto tracking



Deep learning based horizon interpretation



AI horizon tracking



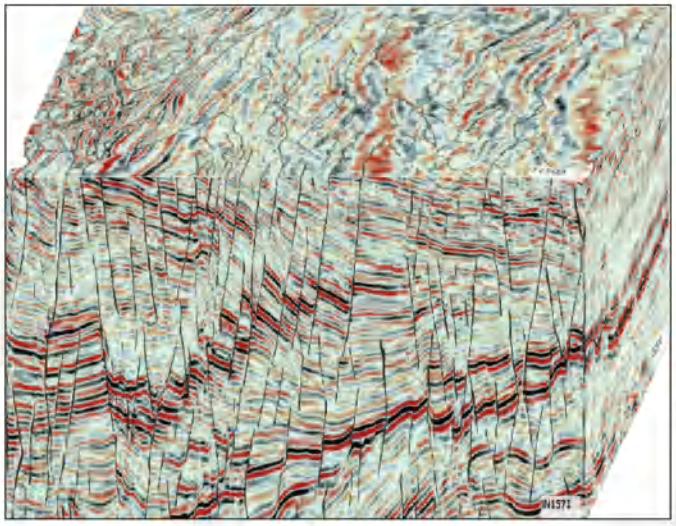
AI multi-horizon tracking

The accuracy and efficiency of Deep learning-based horizon interpretation is promising. The accuracy of AI interpretation of single horizons of a highly faulted data is up to 97%, and the efficiency is greatly improved compared to traditional auto tracking and manual modifications.

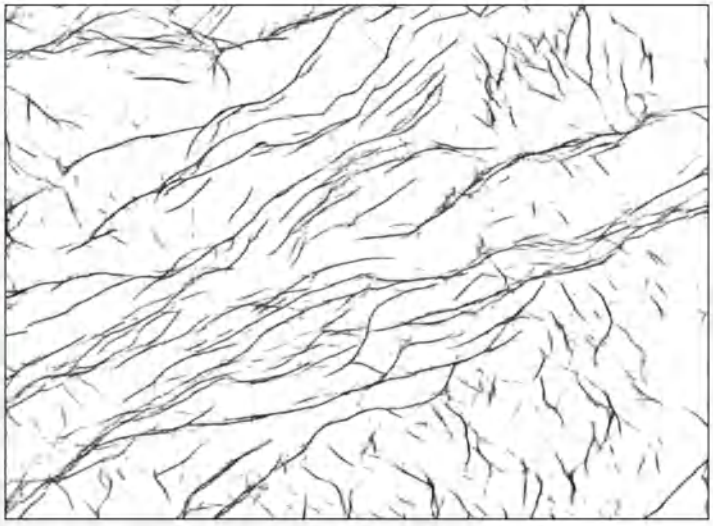
AI INTERPRETATION

AI fault interpretation

In deep learning-based fault interpretation, we apply U-net model and introduce attention mechanism to focus on fault skeleton. So that the fault imaging result is much more clean and continuous than tradition fault attribute.



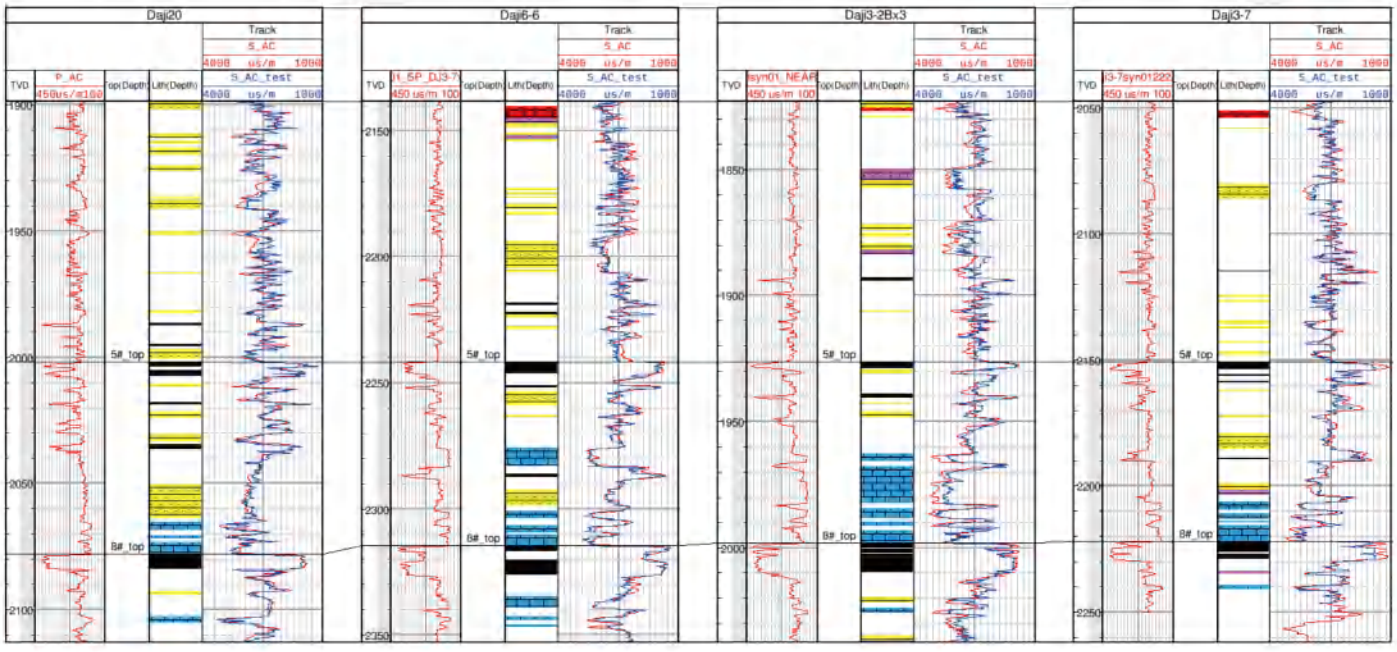
AI fault prediction cube



Slice of AI fault prediction

AI logging interpretation

GeoEast provides AI logging interpretation functions such as AI lithology prediction and AI logging curve prediction. The accuracy of AI prediction is higher than conventional rock physics modeling or empirical fitting.

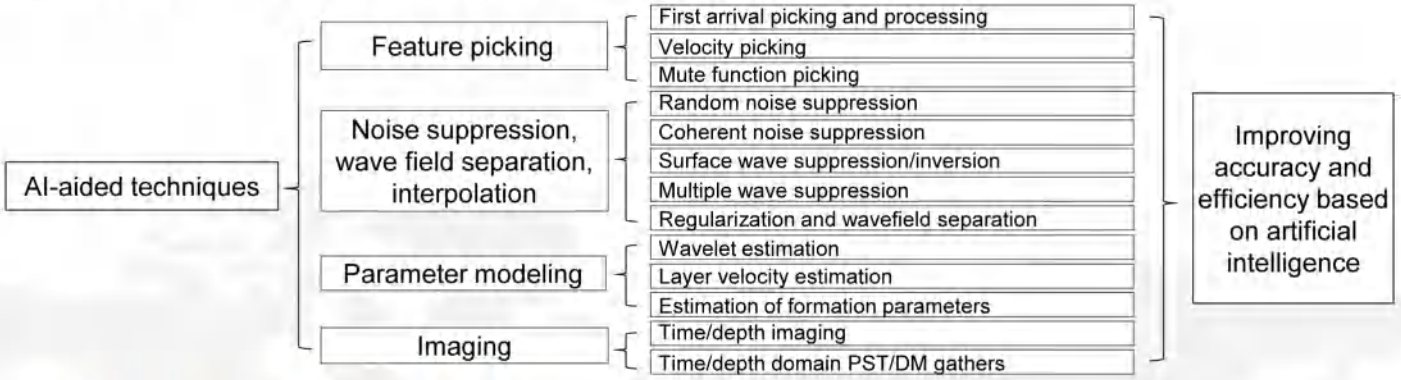


Red: Original curve
Blue: AI predicted curve

AI PROCESSING

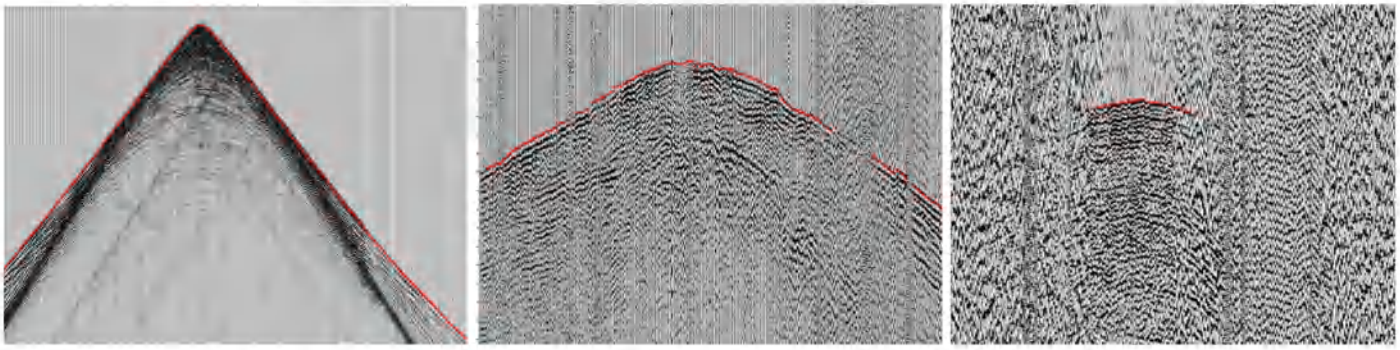
AI-aided seismic data processing

In the oil & gas exploration field, artificial intelligence techniques have been paid increasingly more attention. BGP attaches great importance to the research and development of AI-aided processing technique.



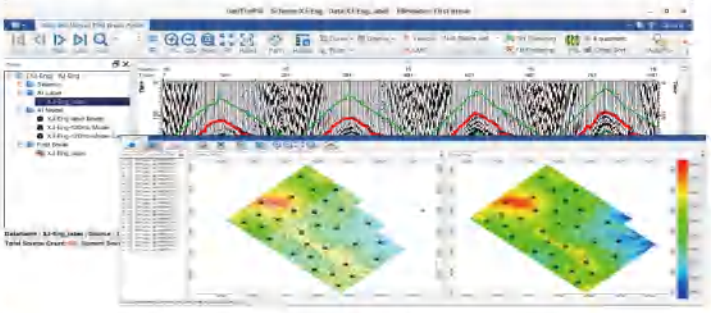
AI first-break picking

GeoEast provides a deep learning-aided first-break picking technique which can efficiently pick data of different S/N levels with very high accuracy. The technique has been applied on lot of processing projects with different S/N levels.

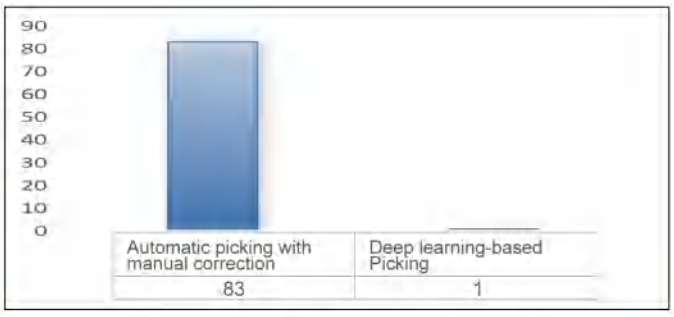


High S/N data | Middle S/N data | Low S/N data

An interactive software package with all the related functions such as label making, model training and first arrival predicting is provided. The package supports CPU/GPU/DCU HPC devices and computational efficiency is more than 80 times higher than that of conventional methods.



Interactive software with full functionality

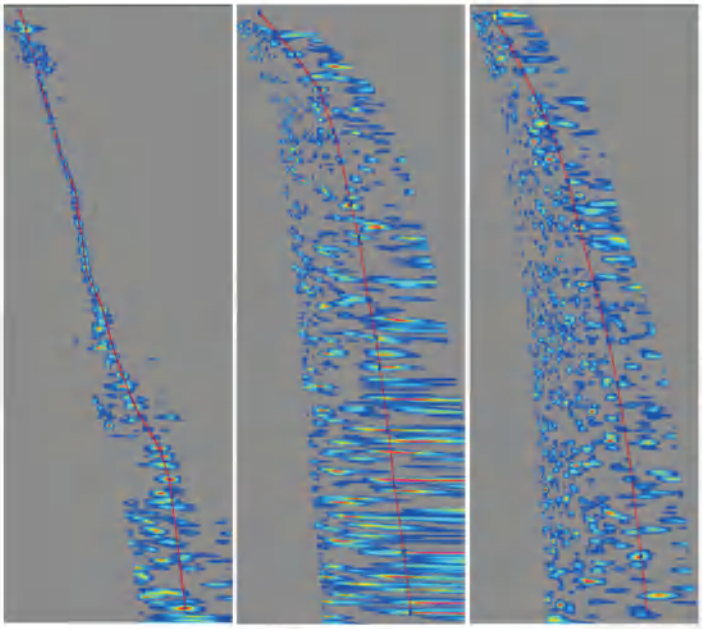


Computational efficiency comparison

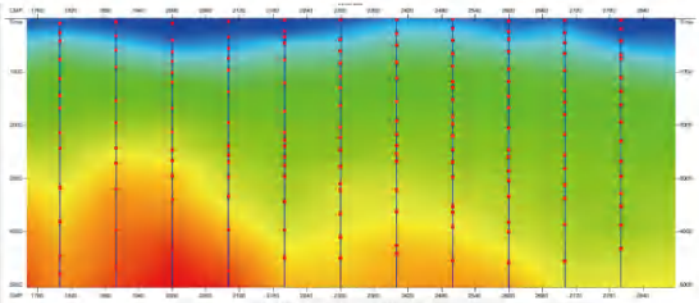
AI PROCESSING

AI velocity picking

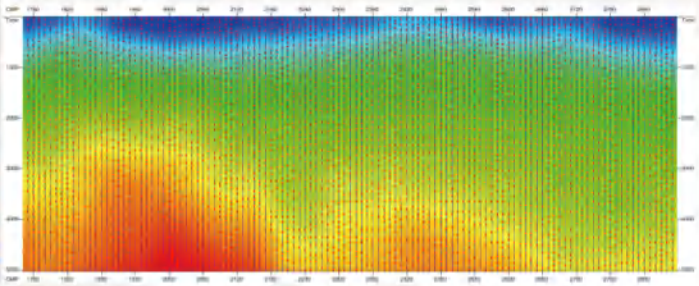
GeoEast provides a deep learning-aided velocity picking technique which can properly handel velocity spectra of different quality and give quality picking results.



Different S/N data

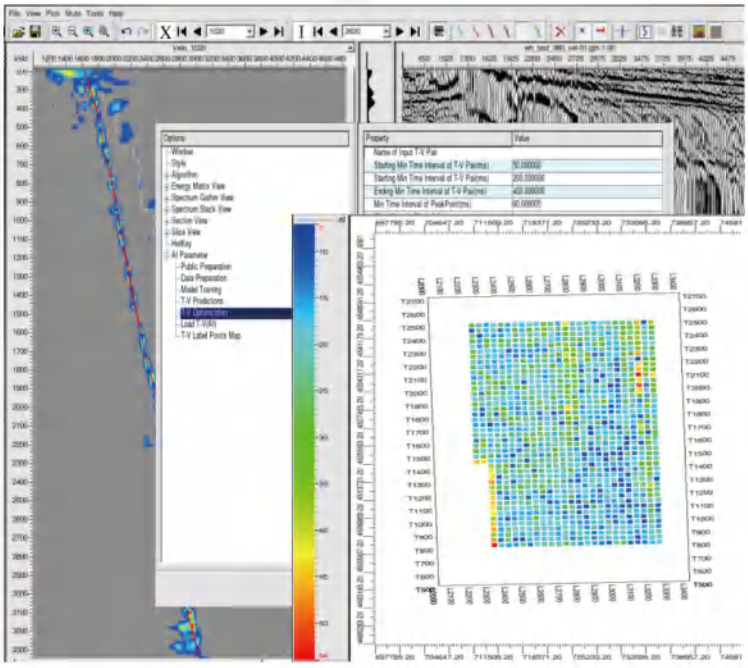


Manual picking

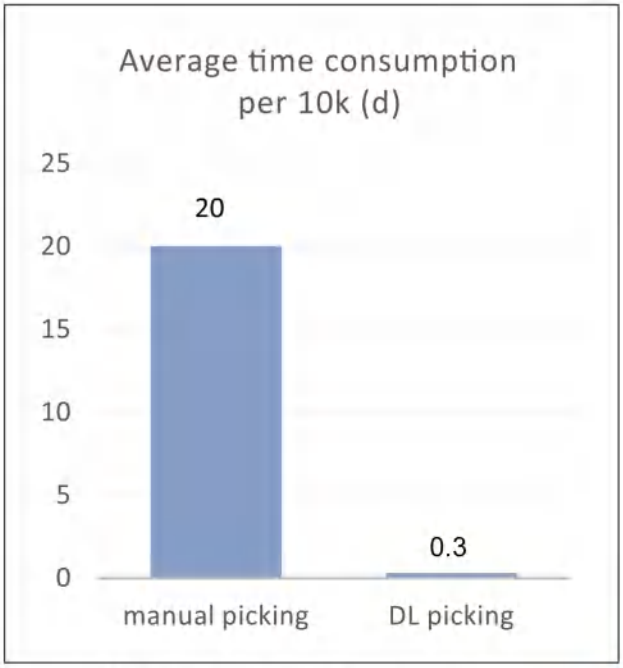


DL picking

Interactive software with full functionality is also developed for label selection, model training, picking prediction, optimization, and quality control. And supports multiple HPC hardware devices, with overall efficiency dozens of times higher than traditional methods.



Interactive software with full functionality



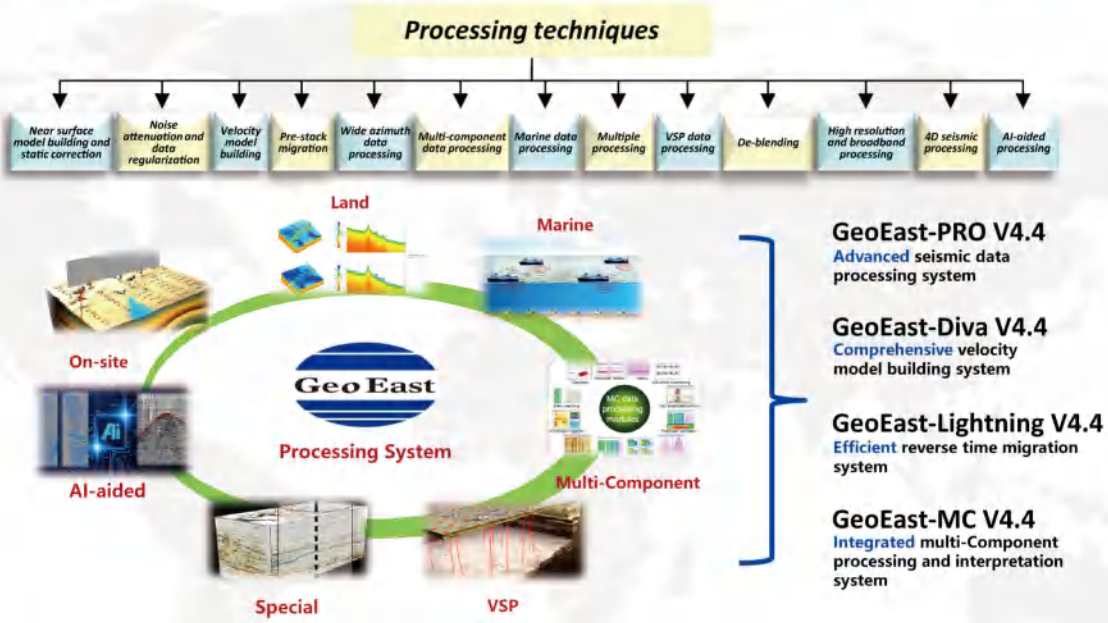
Computational efficiency comparison

GEOEAST - AN INTEGRATED SEISMIC DATA PROCESSING AND INTERPRETATION SOFTWARE SYSTEM

GeoEast is a comprehensive, large-scale geophysical data processing and interpretation software system. It can fully meet the demands of time domain and depth domain processing and interpretation of geophysical data acquired from complex geological and geophysical conditions of both land and marine. It also provides end-to-end solutions for VSP, shear wave, and unconventional data processing.

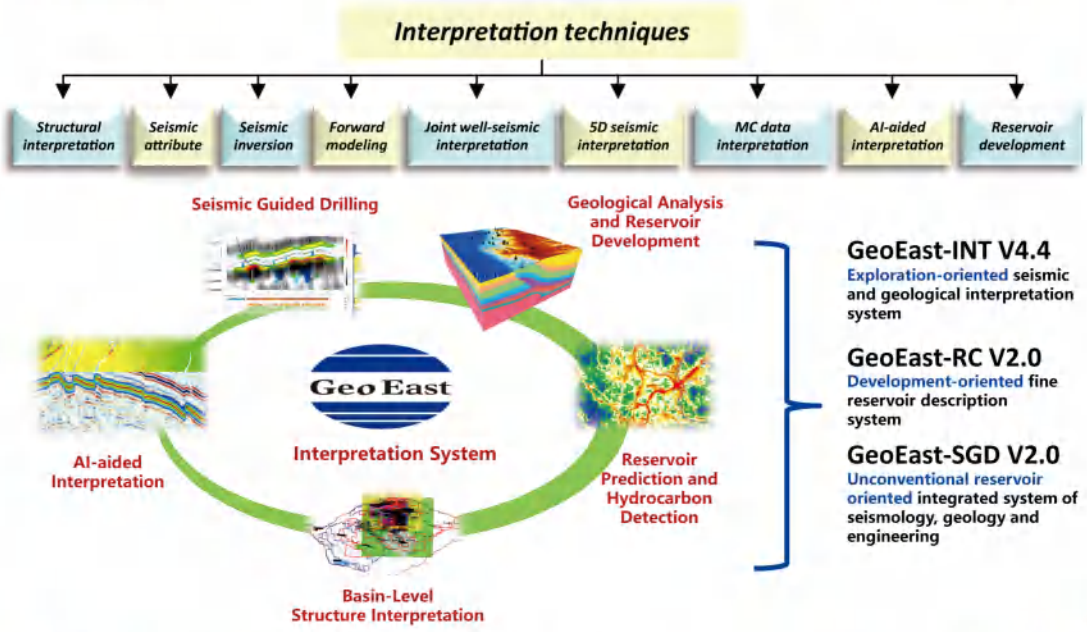
Processing software

■ 7 packages ■ 24 technology series ■ 400+ modules



Interpretation software

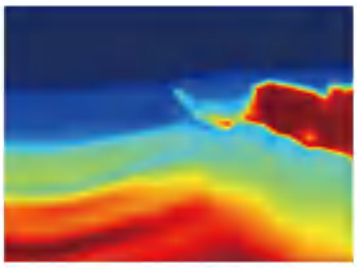
■ 5 packages ■ 21 technology series ■ 400+ modules



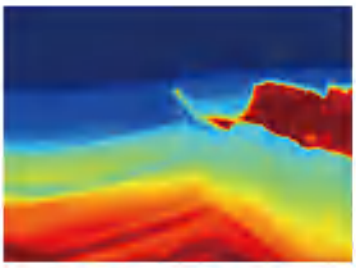
GEOEAST - AN INTEGRATED SEISMIC DATA PROCESSING AND INTERPRETATION SOFTWARE SYSTEM

FWI

Equipped with full waveform inversion technology in time domain, frequency domain, and Laplace domain, it can be used in conjunction with tomography to establish a high-precision velocity model.



Legacy velocity model

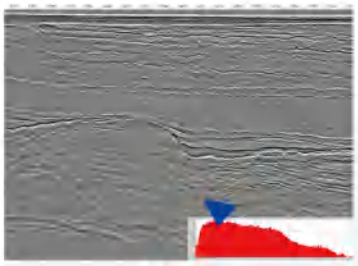


JDFWI inverted velocity model

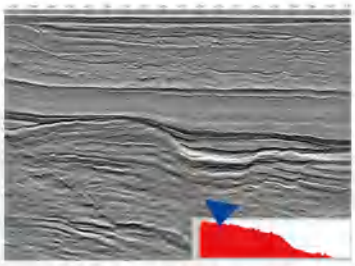
FWI imaging

Expanding low frequencies: Non-linear inversion can generate low frequencies that seismic waves do not possess.

Expanding illumination: Non-reflective waves can cover illumination structures that reflective waves cannot.



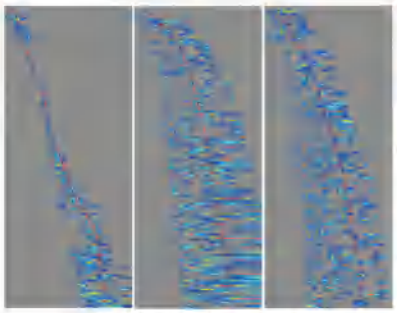
PSDM



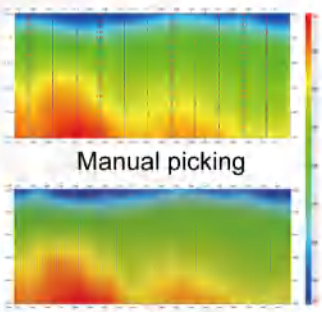
PSDM + FWI imaging

AI processing

GeoEast has developed intelligent processing modules for time-consuming and labor-intensive processes such as first break picking, velocity picking, and noise attenuation. The accuracy and efficiency improved dramatically.



Different S/N data

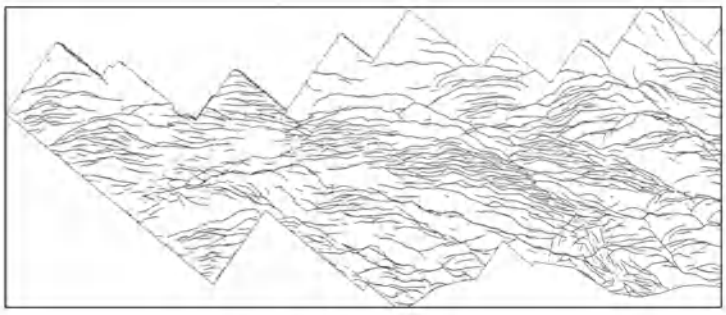


Manual picking

DL picking

AI interpretation

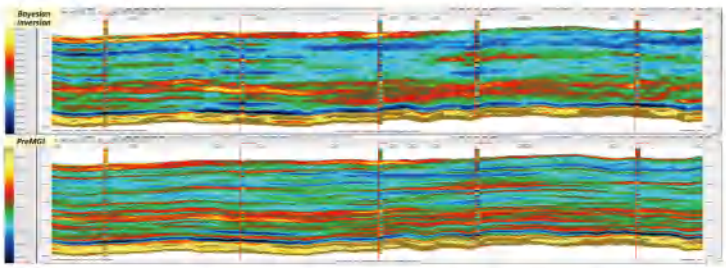
A deep learning-based artificial intelligence neural network has been developed, equipped with a series of intelligent interpretation technologies including horizon interpretation, fault identification, well log curve prediction, well log lithology prediction, and geological body identification.



AI-aid fault prediction

Seismic inversion

GeoEast provides rich pre-stack and post-stack seismic inversion methods and complete workflow, which can meet the needs of reservoir prediction in different stages of exploration and development.



Inverted shear wave impedance

SEISMIC DATA ACQUISITION SOFTWARE SYSTEM

Overview

KLSeis® contains 5 packages: Survey Design, Modeling & Illumination, Statics, Data QC and Marine Acquisition and consists of 33 software modules, it can be used in all terrains such as land, transitional zone and marine, and is suitable for petroleum exploration, coal exploration and geology exploration. It can provide efficient and intelligent solutions to seismic acquisition.

The terrains that can be applied:


Sand dune


Loess plateau


Mountain


Gobi


Transitional zone

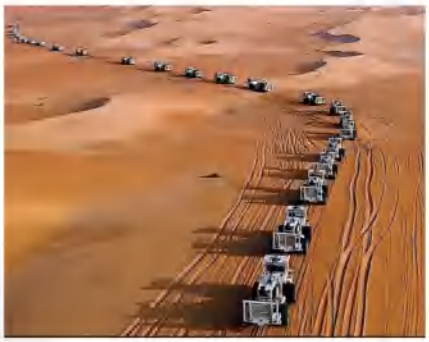

Deep sea

SEISMIC DATA ACQUISITION SOFTWARE SYSTEM

KLSeis

Billion level trace density geometry design & attribute analysis technique

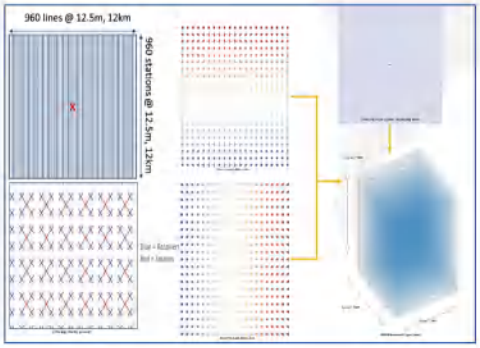
To meet the requirements of ultra-high density projects, the billion level trace density geometry design & attribute analysis technique based on CS(Compressed Sensing) was developed.



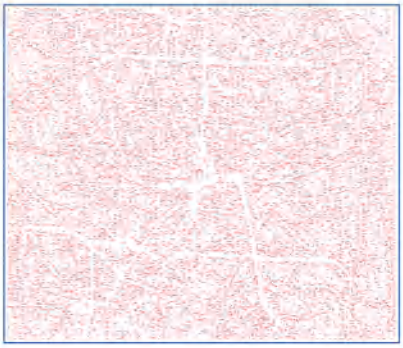
Field operation

Features

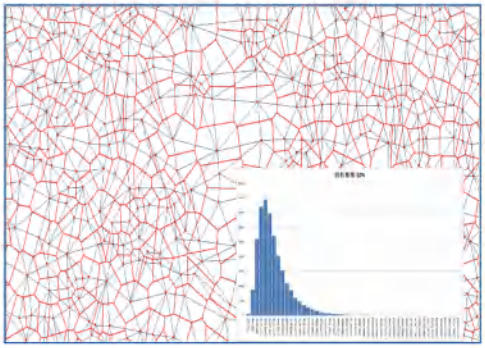
- Bilinear algorithm of rapidly constructing source & receiver relationship based on vector kernel
- Fast import of SPS relationship
- Bin attribute analysis with multidimensional spatial correlation indexing
- Compressed sensing design uniformity evaluation based on Thiessen polygons.
- Detailed workload simulation, performing Zipper design, deployment, and workload statistics



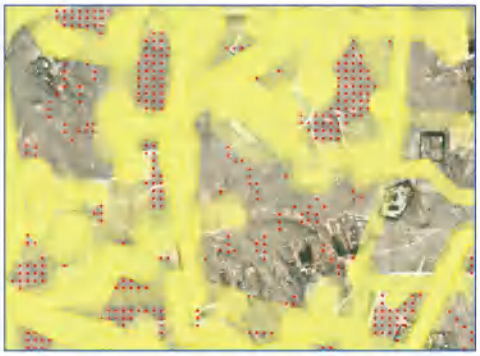
Bin attribute analysis principle



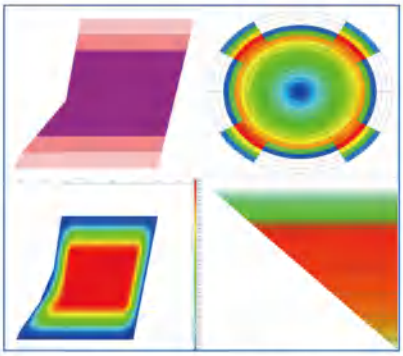
Test source point deployment



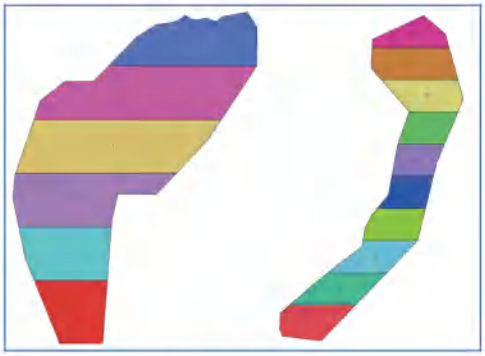
Thiessen polygon deployment



Physical point optimization



Attribute analysis for billion level trace density design



Zipper design

SEISMIC DATA ACQUISITION SOFTWARE SYSTEM

KLSeis

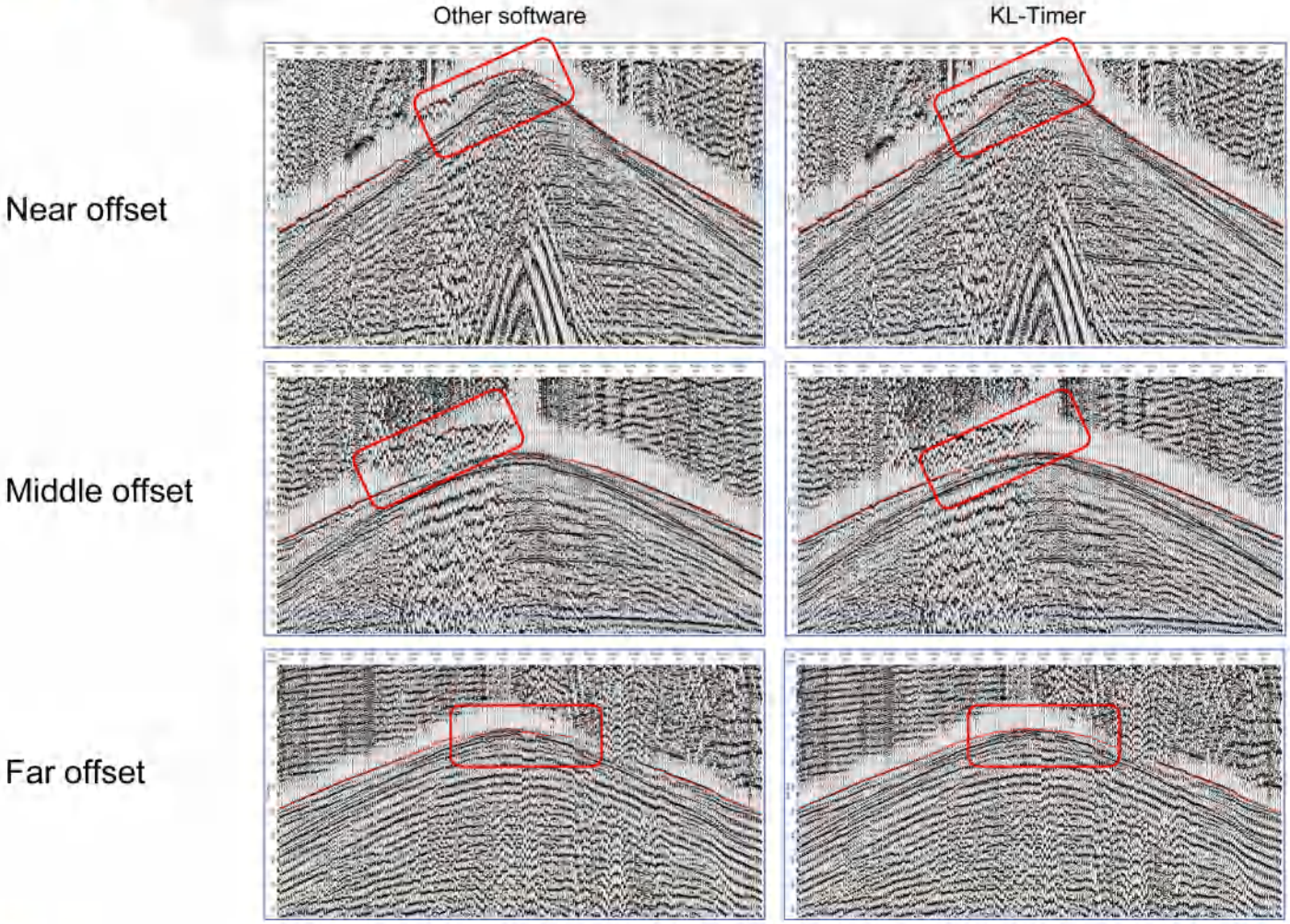
AI first break picker (KL-Timer)

KL-Timer uses seismic data to train and optimize deep network model, and then intelligently and automatically identifies and corrects abnormal first breaks to improve the accuracy and efficiency for auto-picking first breaks of massive data with low signal-to-noise ratio, which can meet the requirements for building velocity model and calculating statics.

Features

- Design multi-domain time-window and define the time-window range of first breaks.
- Intelligently detect first breaks
- Comprehensively identify abnormal first breaks
- Effectively correct abnormal first breaks

Application



SEISMIC DATA ACQUISITION SOFTWARE SYSTEM

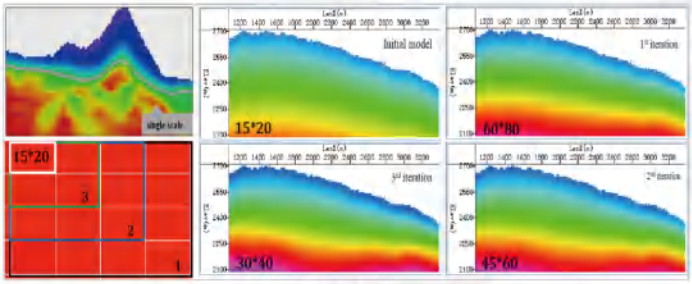
KLSeis

Multi-scale constraint tomography (KL-MCT)

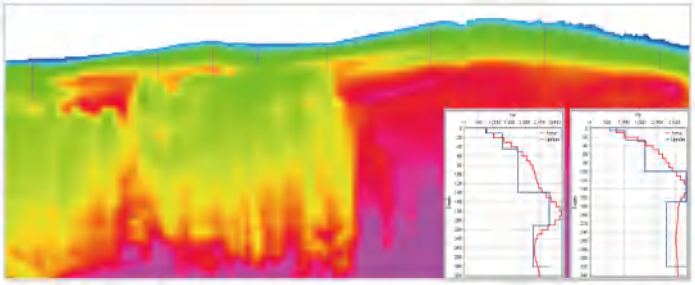
KL-MCT is used to create initial model and body constraint model based on high-precision near-surface investigation results. It utilizes multi-scale tomographic inversion techniques to provide high-precision near-surface model with stable velocity for “actual” surface offset. With the quick increase of data, KL-MCT can create the velocity model from ten billion level traces by one computer.

Features

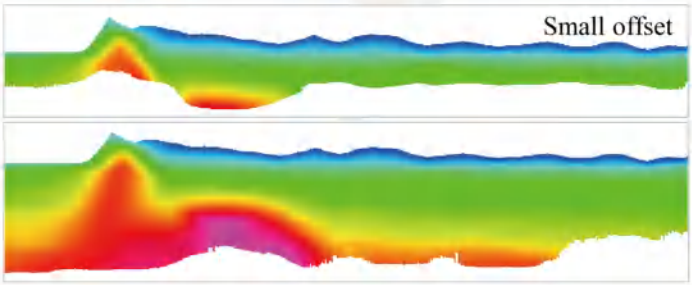
- Efficient tomography inversion calculation
- Tomography inversion technology constrained by sand dune curve
- Second inversion technology based on residual time difference
- Tomography inversion technology constrained by uphole
- Two-step method tomography
- Gradual multi-scale constraint technology



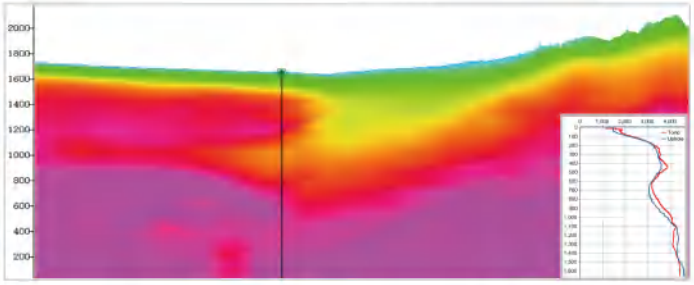
Gradual multi-scale tomography inversion



Uphole-constrained tomography inversion model with reverse velocity

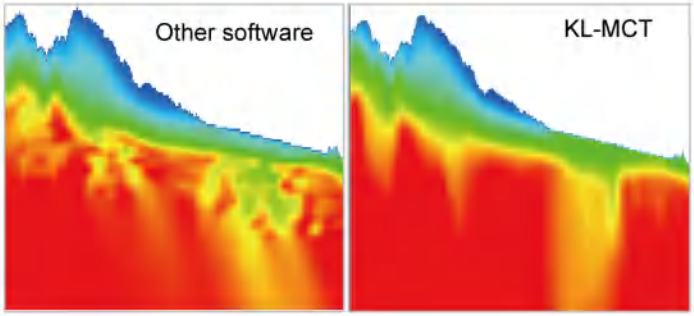


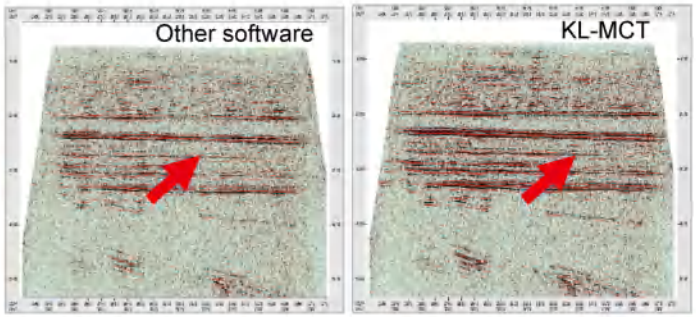
Two-step method tomography



Inversion model constrained by uphole and VSP, its depth: 1500m

Application



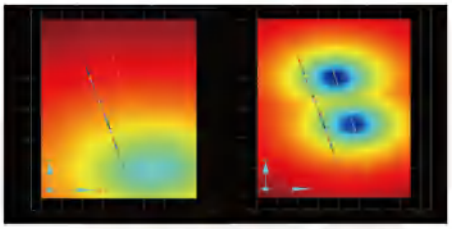


MICRO-SEISMIC MONITORING FOR HYDRAULIC FRACTURING

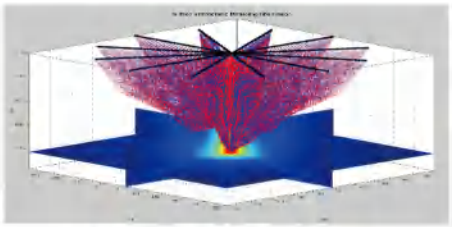
Micro-seismic monitoring technique records seismic waves generated by hydraulic fracturing, maps rock rupturing locations, evaluates fracturing results and guides the optimization of treatment parameters in real time.

Micro-seismic monitoring acquisition

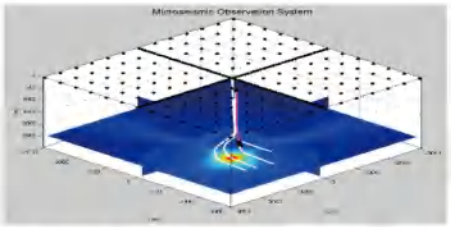
- Micro-seismic feasibility analysis
- Acquisition parameters demonstration
- Micro-seismic event location error prediction



Vertical and horizontal array monitoring



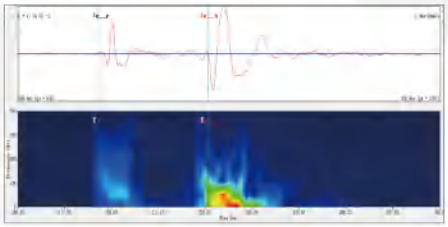
Surface array monitoring



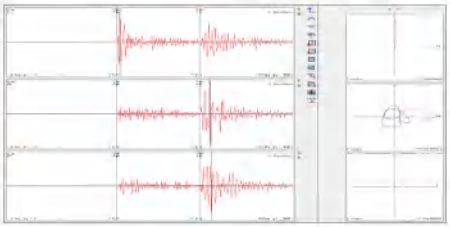
Borehole & surface long term monitoring

Micro-seismic monitoring real-time processing

- Microseismic events identification
- First-break picking of P or S waves
- Polarization analysis
- Mapping microseismic events locations



First-break automatic picking

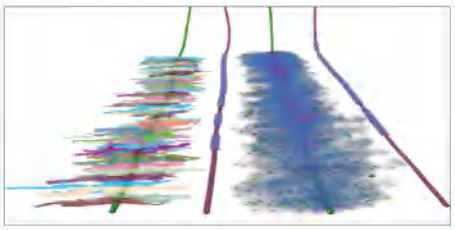


Polarization analysis

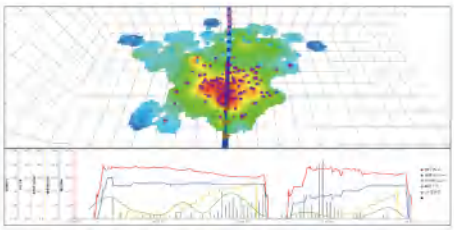
Events location

Micro-seismic monitoring interpretation

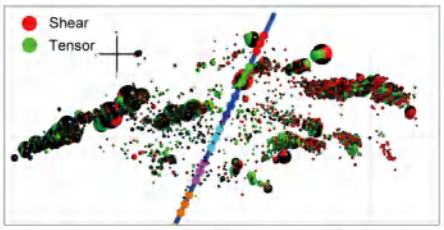
- Describing the dimensions of artificial fractures
- Comprehensive analysis of the fracturing curve
- Reckoning volumes of fractured rocks
- Inverting for local mechanisms



Continuous fracture network



Matching fracturing curve



Focal mechanism inversion

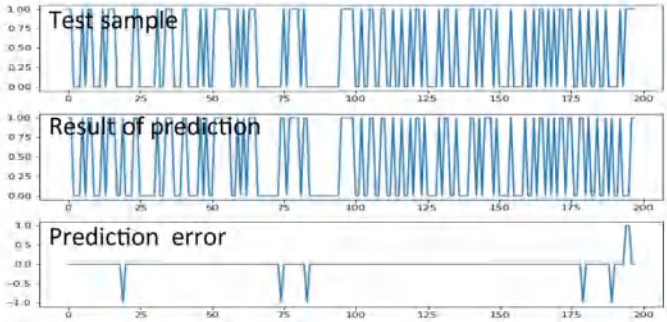
GEO-ENGINEERING INTEGRATION BASED ON MICROSEISMIC

Geo-engineering integration combines geophysical, geological and engineering data with micro-seismic data to predict sweet spots, to guide placements of well locations, to optimize horizontal well trajectory and to reduce engineering risks in advance.

Prediction hydraulic fracturing in advance

Natural fractures are studied by using geophysical, geological, engineering parameters and micro-seismic data to improve drilling efficiency and to optimize wellbore trajectory.

- Seismic attributes enhancement
- Natural fracture prediction
- Casing deformation prediction

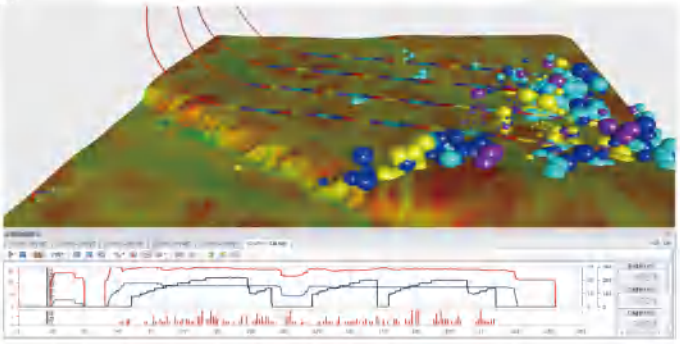


► Casing deformation prediction by using random forest

Real-time forecast and adjustment

With the integration analysis of micro-seismic events with geophysical characteristics and fracturing parameters, an engineering risk mechanism can be established to help optimize the treatment parameters in the field.

- Micro-seismic energy analysis
- Micro-seismic b-value analysis
- Comprehensive analysis of fracturing parameters and micro-seismic events

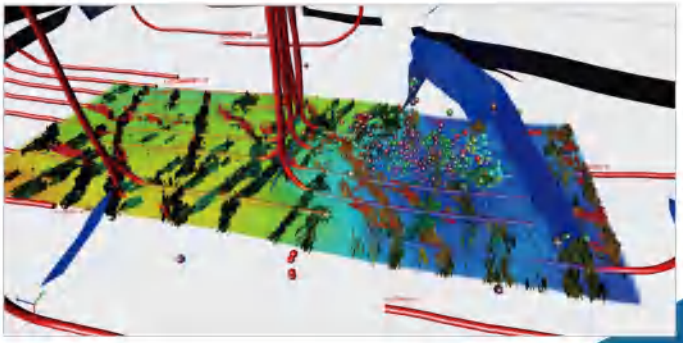


► Overlap display of micro-seismic events , of fracturing parameters and curvature attribute

Post-hydraulic fracture evaluation

Combined with the production information, the sweet spot distributions can be optimized, well trajectories can be adjusted and well spacing for upcoming development reservoir in the vicinity can be determined.

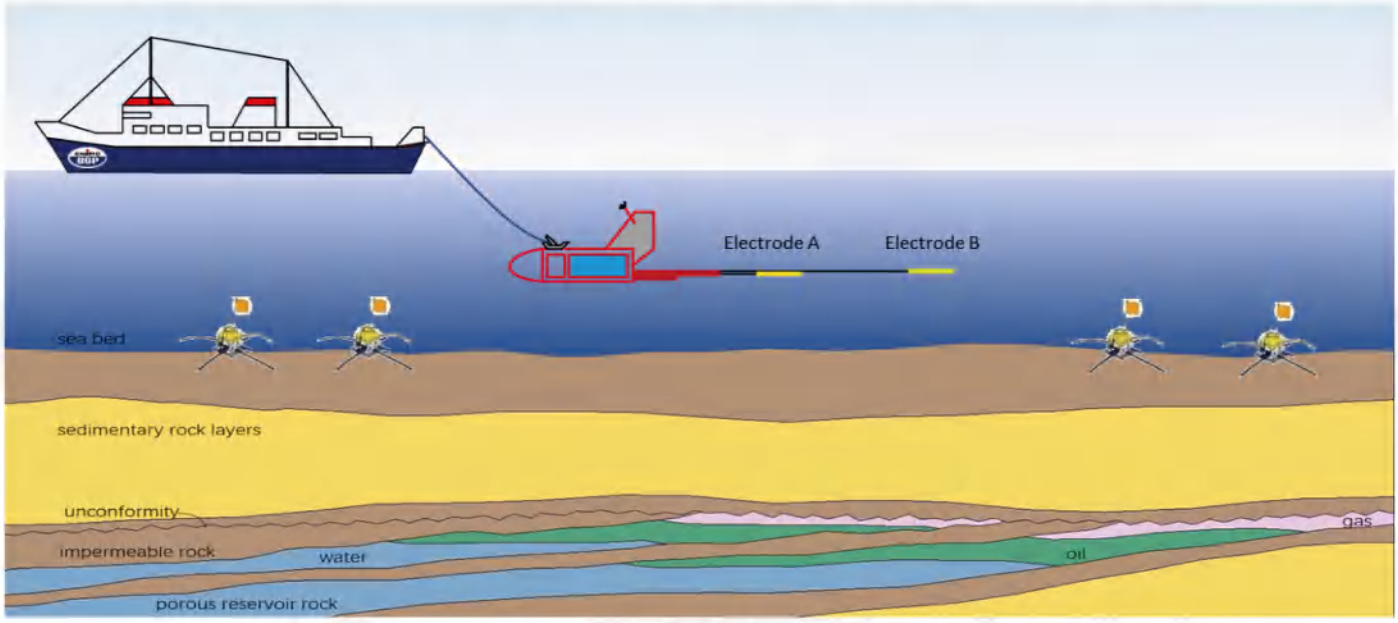
- Artificial fractures integrated interpretation with seismic, gelogical data
- Geomechanics prediction
- Well trajectory optimization



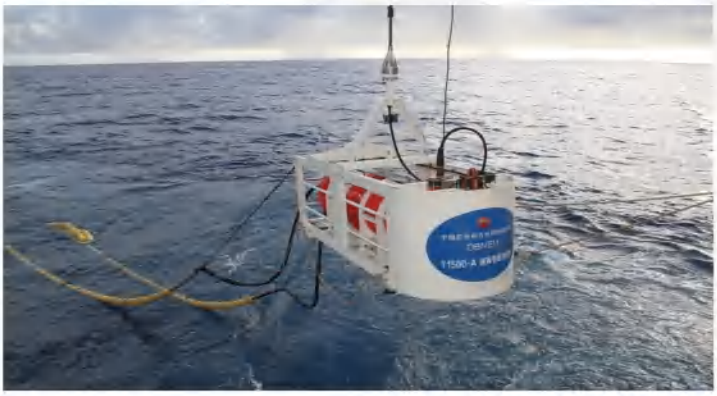
► Overlap display of micro-seismic events with nature fracture

OBNEM SURVEY

OBNEM® (Ocean Bottom Node Electromagnetic) survey plays a remarkable role in marine oil & gas exploration. Since 2018, BGP has developed a series of relevant hardware and software, including high power transmitting systems, long-endurance receivers, reliable monitoring systems and integrated processing modules.

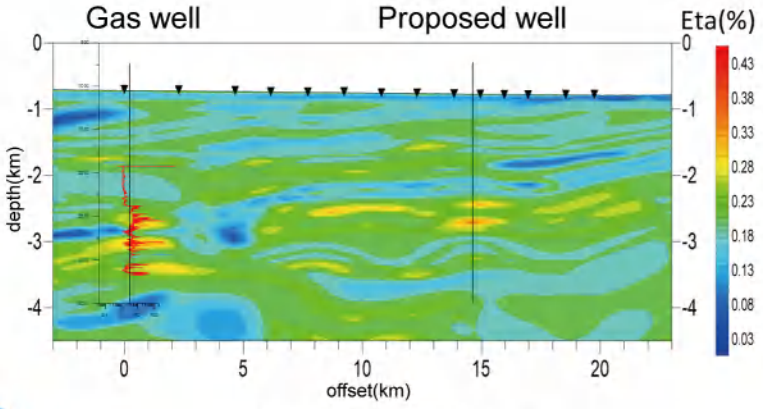


Schematic diagram of OBNEM survey



OBNEM transmitter

OBNEM receiver



IP section from OBNEM

Based on oil/gas bearing structures producing high IP anomalies, high IP anomalies were used to predict the location of oil/gas bearing structures. An OBNEM section is always suggested to cross the proposed well and known oil/gas well if it is available.

OSEIS OCEAN BOTTOM NODE SYSTEM

Introduction

The oSeis Ocean Bottom Node System is a series of omnidirectional four-component wireless seismic nodes for continuous underwater operation, with independent seismic signal sampling, recording and storage. Composed of oSeis nodes, charge/time modules, host storage and system software, it features flexible deployment, high data quality, high efficiency and low cost, including two models tailored for different water depths.

oSeis-SW (Shallow-Water Node): A high-precision shallow-water node acquisition system integrating wireless charging, data downloading and time service, with non-metallic housing, low power consumption and long battery life.

oSeis-DW (Deep-Water Node): A high-precision deep-water node acquisition system with low power consumption and long battery life, equipped with a high-stability MEMS clock for over 200 days of continuous operation.

Type	oSeis-SW	oSeis-DW
Working Depth	500m	3000m
Operating Life	63days @ 2 ms	205days @ 2 ms
Storage Capacity	64 GB	256 GB
Charge Time	<8 hours	<16 hours
Continuous Working Hours	63days@2 ms sample interval	205days@2 ms sample interval
Size	320*262*144 mm	409*358*134mm
Weight	11.4kg (in air) 3kg (in water)	26.2kg (in air) 13.2kg (in water)
Seismic Data Channels	4	
Acquisition Performance	Resolution	32bits
	Pre-gain	0，6，12，18，24，32，36dB
	Sampling Interval	0.25，0.5，1，2ms
	Dynamic Range	125 dB @ 0 dB
	Gain Accuracy	0.5%
Built-in Attitude Sensor	Tilt Inclination ±1.5° Heading±5°	
Hydrophone	Sensitivity 8.9 V/Bar（3.4 Hz @ -3 dB）	
Geophone	15Hz@ -3 dB, 70%damped: Sensitity: 56.8V/m/s (Customizable)	

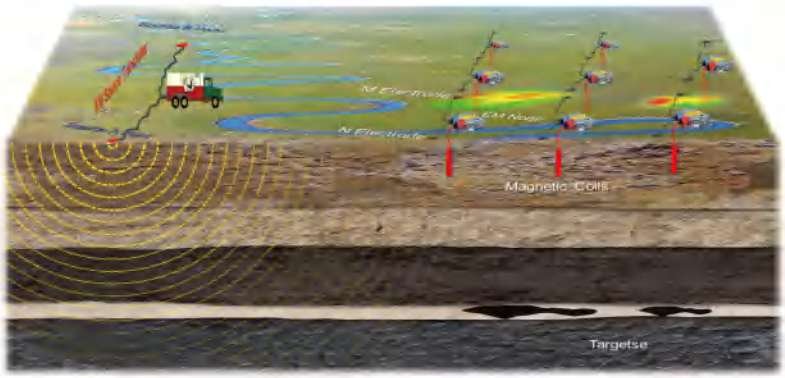
oSeis-SW

oSeis-DW

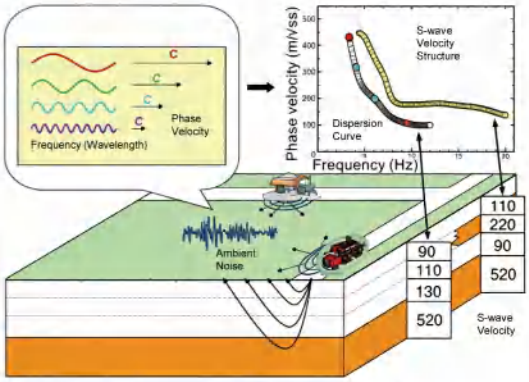
GEOTHERMAL EXPLORATION

Leveraging integrated geophysical surveying—from gravity and magnetics to seismic imaging—BGP has delivered geothermal and groundwater solutions across diverse geological settings, from the volcanic terrains of Iceland to the sedimentary basins of the Middle East and South America.

Proprietary geothermal exploration technique

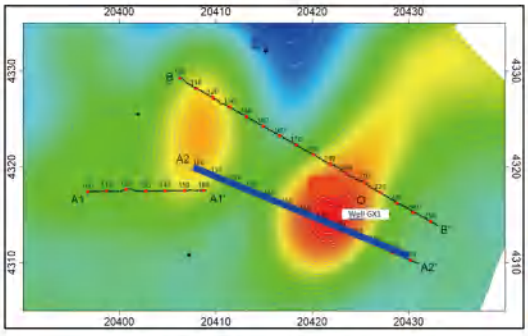


Time-frequency electromagnetic (TFEM)

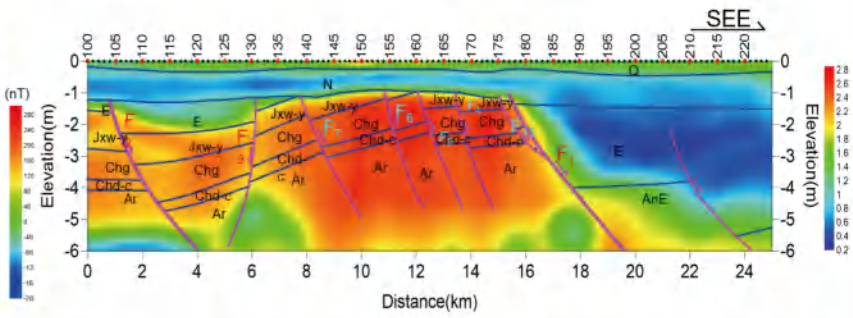


Ambient noise seismic

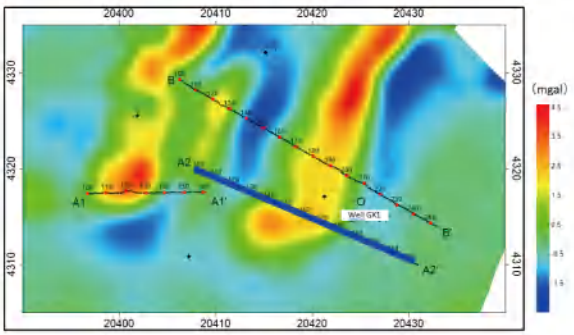
Application



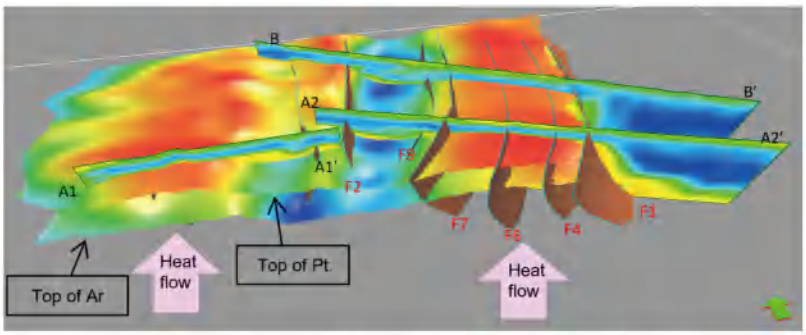
Total magnetic intensity (TMI)



Time-frequency electromagnetic (TFEM) resistivity profile of Line A2-A2′



Residual gravity anomaly



Geological model of Xiong 'An geothermal project

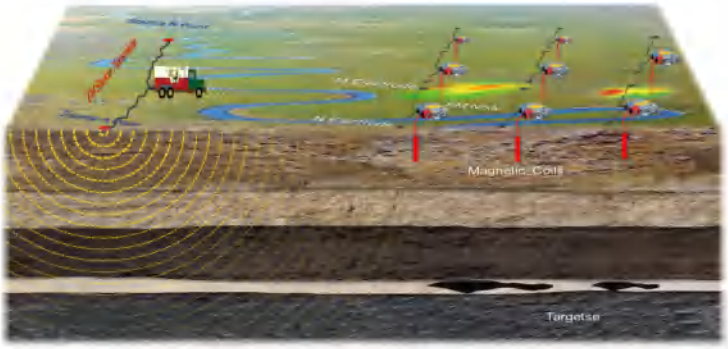
Gravity, magnetic, and TFEM data define the structural and thermal framework:

- Faults = conductive + convective heat pathways
- Shallow intrusions = localized heat sources
- Results guide reservoir prediction and drilling

TIME-FREQUENCY ELECTROMAGNETIC (TFEM)

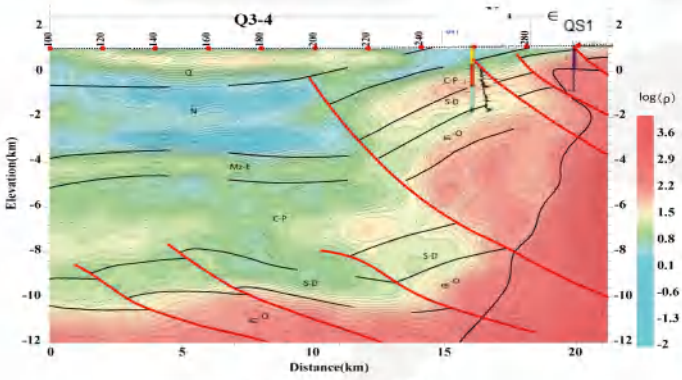
TFEM® method is a controlled source electromagnetic technique through which the EM fields could be acquired in both the frequency and time domains simultaneously. Resistivity and induced polarization anomalies could be measured to study the distribution and burial depth of minerals given that TFEM can penetrate depths beyond 10 kms.

- 27 invention patents
- 29 software copyrights
- 1 registered software trademark
- 3 technical codes
- 12 provincial and ministerial awards

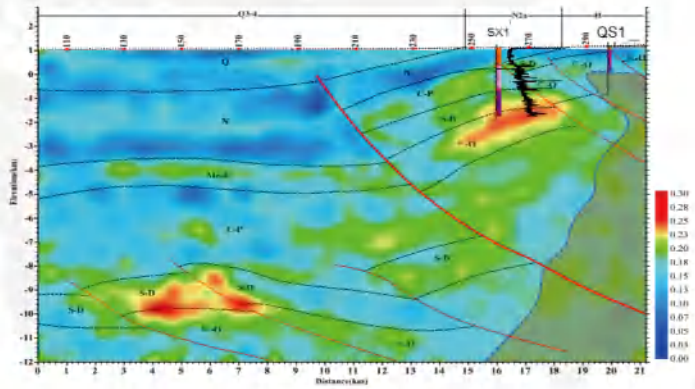


TFEM field operation configuration

Application

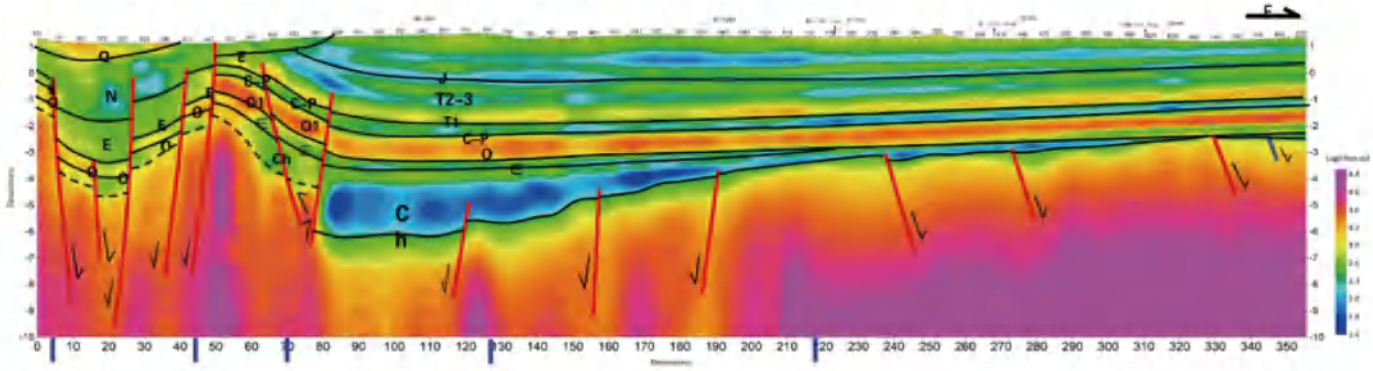


Resistivity profile



Induced polarization profile

Resistivity anomalies have revealed the distribution of hydrocarbon source rocks, while polarization rate anomalies have predicted the hydrocarbon potential of target traps, contributing to the breakthrough at the SX1 well.

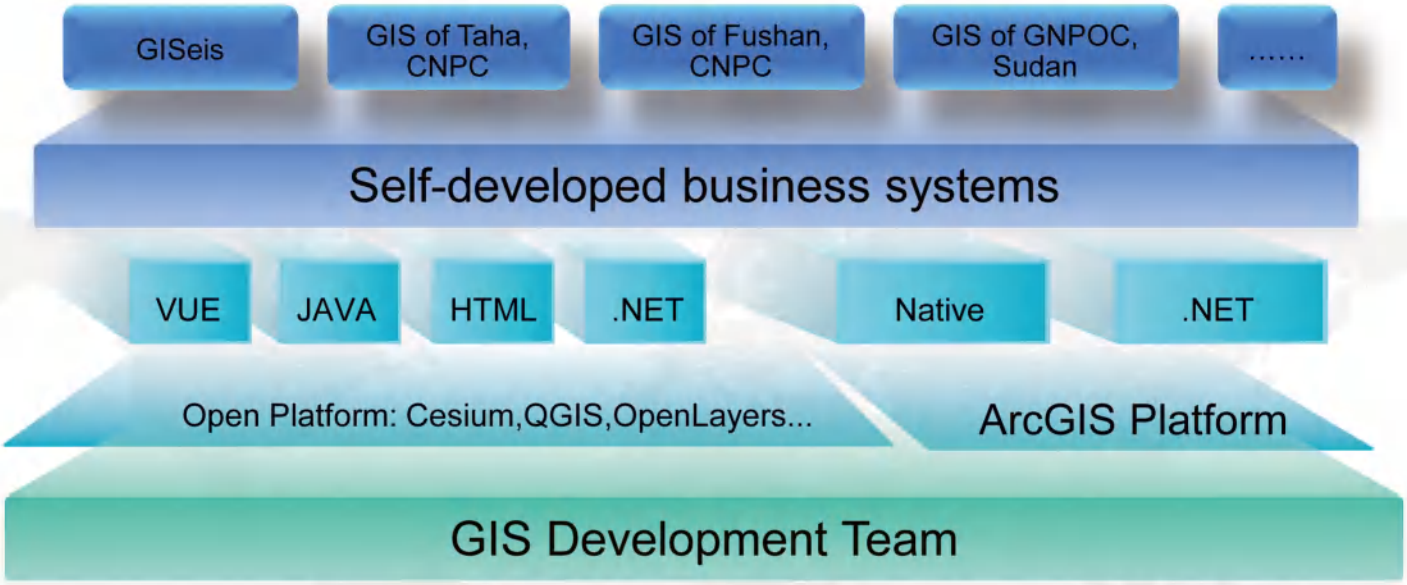


The TFEM result reveals the geological structure of major tectonic units and the distribution of Meso-Neoproterozoic rift, fault systems and Cambrian Strata in the north-eastern part of the basin.

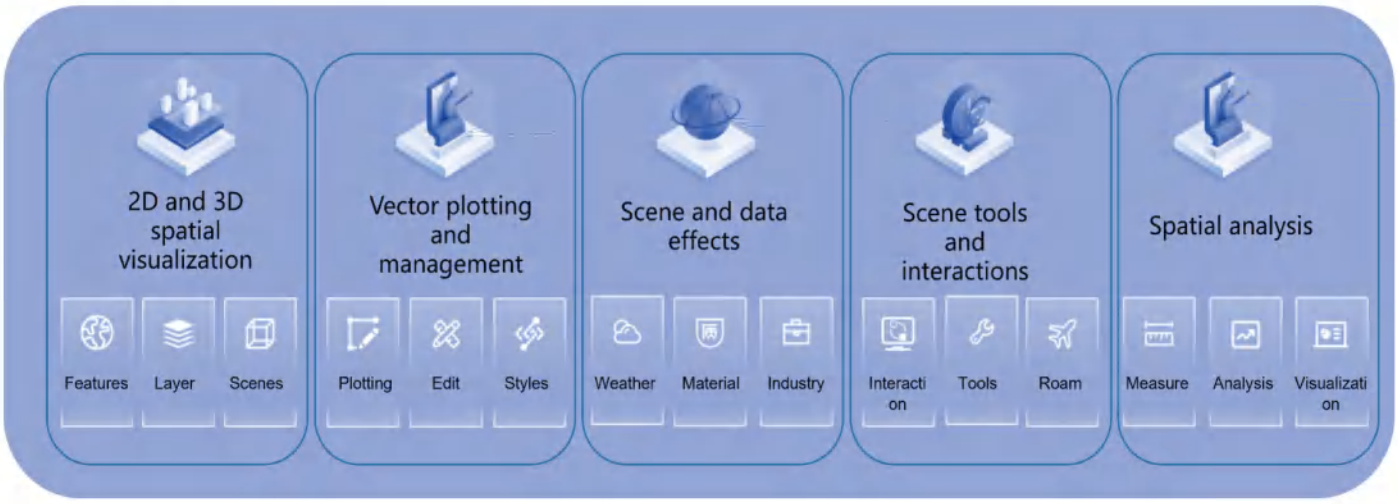
GIS SOLUTION FOR OIL FIELD

Introduction

Continuous product and service innovation: After years of technical evolution, BGP has built a series of self-developed products based on open-source platforms such as QGIS, Cesium as well as commercial platforms such as ArcGIS thereby forming a distinctive technical strengths.



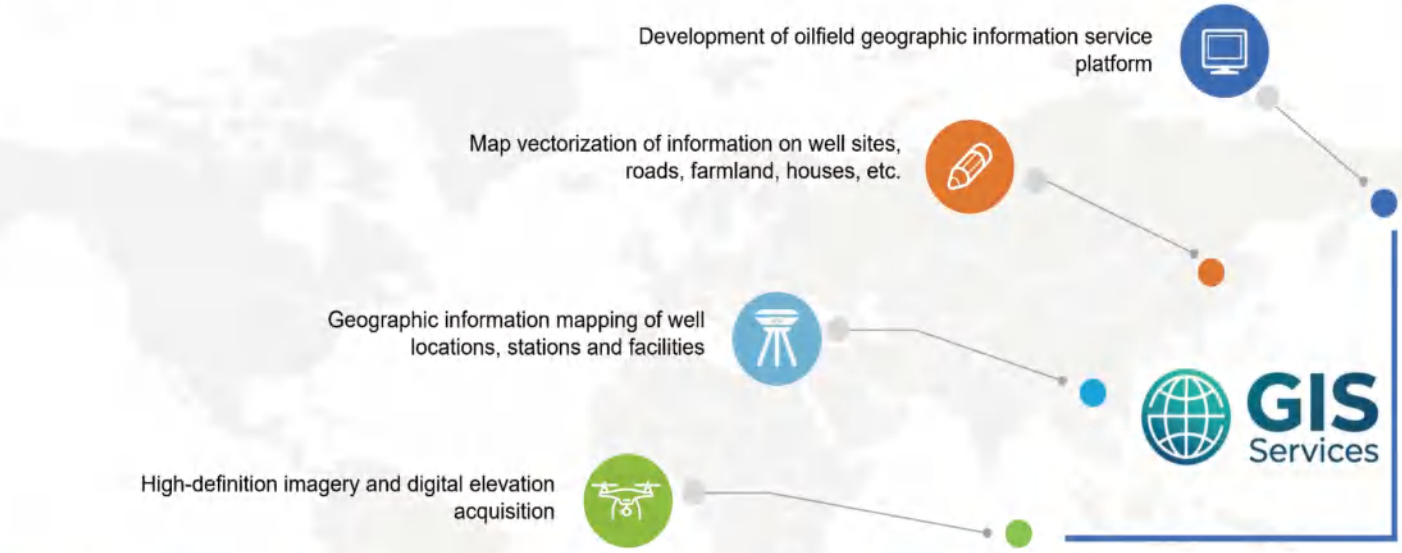
Our capabilities: Agile, efficient digital twin visualization development for enterprises accelerating digital transformation, comprehensive 3D Earth development solutions built from the ground up that empower clients to rapidly master and apply 3D visualization.



GIS SOLUTION FOR OIL FIELD

Solution:
Oil and gas field geographic information platform

BGP comprehensively carries out aerospace and aerial photogrammetry, oilfield geographic information collection, marine surveying and mapping, integrated navigation and positioning, and integrated 2D/3D geographic information platform development, providing customers with continuously innovative products and technical services.



Step1: low-altitude UAV aerial photography

Step2: facility surveying and mapping

Step3: indoor drawing and vectorization

Step4: map visualization and system development

GIS SOLUTION FOR OIL FIELD

Function tools

Includes coordinate positioning, spatial measurement, map marking, bookmark management, layer management and basic image services.

Measuring tools

Bookmark management

Layer management

Imagery and terrain services

Data management

Includes oilfield facilities and equipment such as wells, firefighting, pipelines, electricity, mineral rights, etc., basic data such as water systems, roads, farmland, land cover and geological formations.

Measuring tools

Bookmark management

Layer management

Imagery and terrain services

GIS SOLUTION FOR OIL FIELD

Design management

Based on planning data, the system optimizes well site placement through spatial analysis, with cloud synchronization enabling integrated office-field design workflows.

Navigation service

Using proprietary road data, the system establishes a road topology network and integrates public map resources, enabling seamless navigation between public and internal roads. This provides reliable technical support for field operations, emergency rescue, and related services.

Select a target | Start navigating | Public navigation | Internal navigation

QUANTUM NODAL SYSTEM

Quantum node introduction

Quantum is an all-in-one node designed to simplify field operations to support economical high density, long offset seismic surveys. The node allows deployment using either the internal high sensitivity geophone or an external geophone or marsh phone. Additionally, the node contains an internal GPS for timing and position, internal memory for seismic data storage, Analog-to-Digital converter and battery. The node is a single channel, self-contained acquisition unit. Key features and benefits of the Quantum node are shown in Figure 1, below.

Figure 1 Overview of Quantum node

Data download and charge equipment

Data is stored in internal node memory and downloaded later once source recording has concluded. To accomplish data downloading at large scale, racks are used to contain the node and connect to a data transcription computer. The Transcription computer, running iX Studio software, orchestrates data downloading and data management. Additionally, the internal battery is charged simultaneously with data downloading. Figure 2 shows an example of the standard rack, which accommodates 48 nodes. Racks can be daisy-chained together to achieve the required node processing capacity to support field operations.

Figure 2 Quantum racks

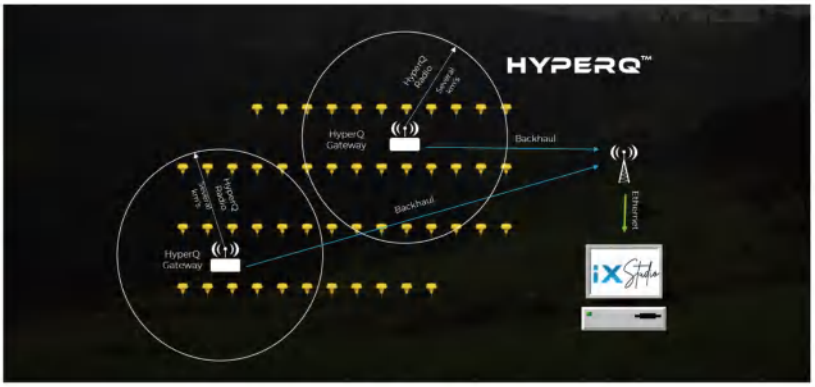


Figure 3 HyperQ long-range QC layout

QC system

One of the key advantages of the Quantum system is support for node field status QC. This can be done either using a handheld tablet via Bluetooth or long-range QC using HyperQ based on LoRa wireless technology or both depending on terrain, contract requirements and contractor preference. Figure 3 shows the layout of HyperQ.

The Quantum system also supports near real-time ambient noise monitoring capability through HyperQ SCANTM. This detects actual noise seen on the ground by using recording Quantum nodes, accounting for wind and other environmental noise sources.

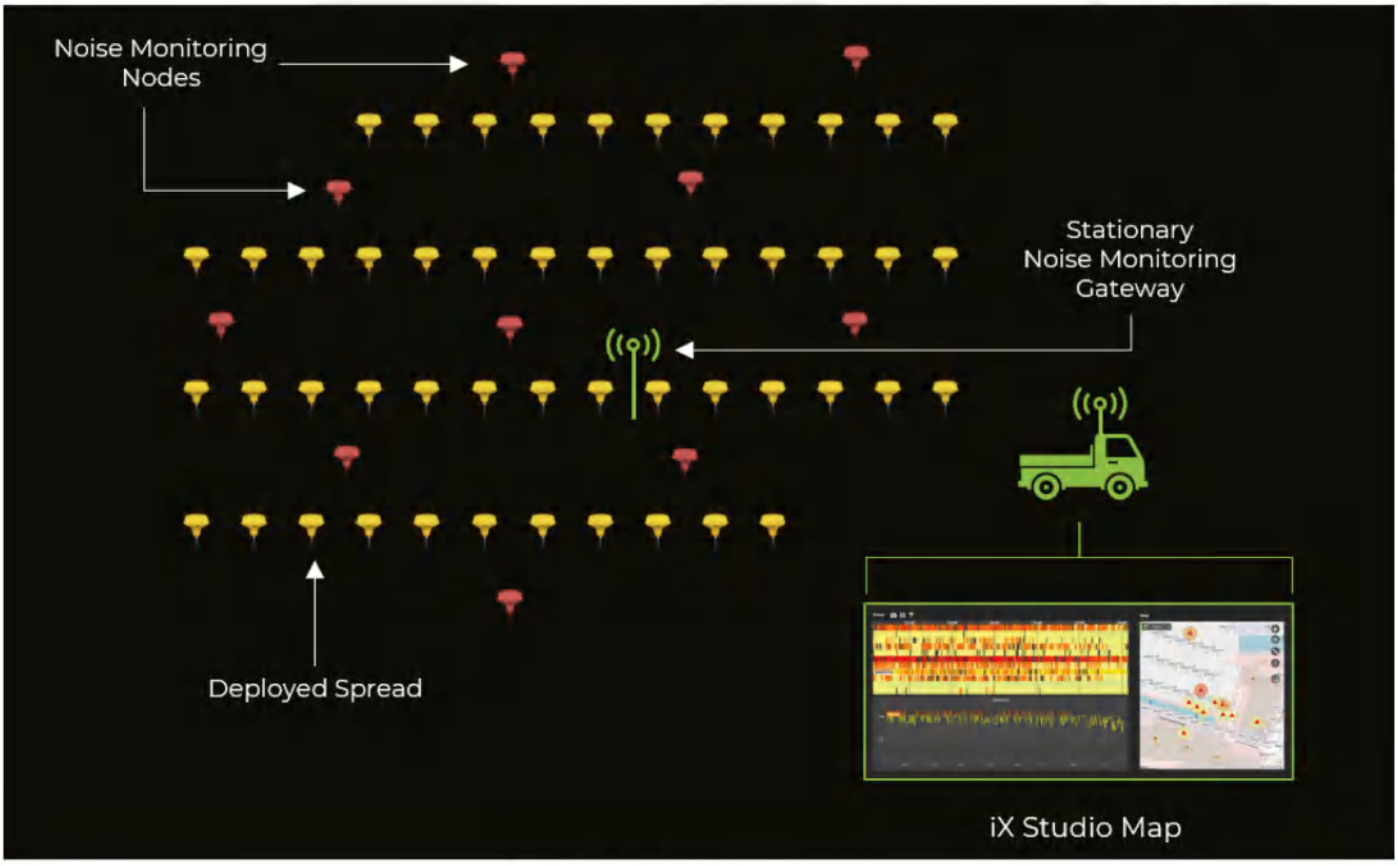


Figure 4 SCAN noise monitoring