BGP's borehole seismic technical solutions to some of the difficulties and challenges in the exploration and development of oilfields

Reservoir static fine description – Zero offset VSP

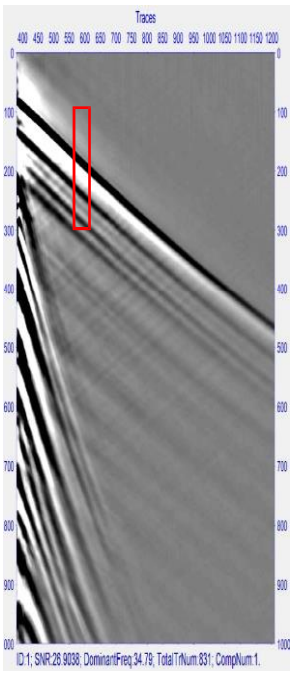
Challenges

Seismic imaging cannot match the geological information due to the lateral anisotropy, existing small faults and the inconsistent reflection characteristics caused by a variety of sedimentary facies; During drilling, there are errors between the actual depth and predicted depth of the target layers; How to identify and eliminate multiples? How to improve the accuracy and resolution of seismic images thr ugh geophysical parameters driven processing?

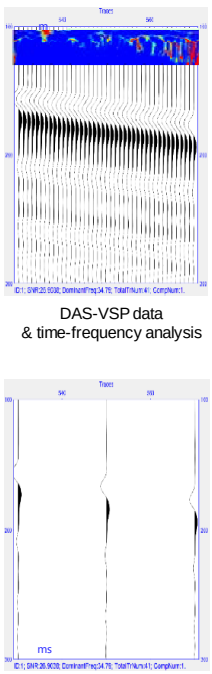
Solution

Zero offset VSP's data recorded by Distributed acoustic sensing (DAS)-VSP or conventional geophones is a bridge between geology, logging and seismic data. The corridor stack of Zero offset VSP can be used to do the calibration at the well site, which makes the seismic data match the drilling logging, and geological information. Accurate time & depth pairs can be extracted from Zero offset VSP, and predict the target layer location by using the accurate velocities and VSP calibration. Multiples can be identified easily in VSP data if it develops in the area. Q factors, TAR values, anisotropic parameters and other geophysical parameters extracted from the VSP data are used to drive surface seismic processing to improve accuracy and resolution. DAS-VSP data with high resolution is beneficial for the velocity analysis of thin layers.

Results

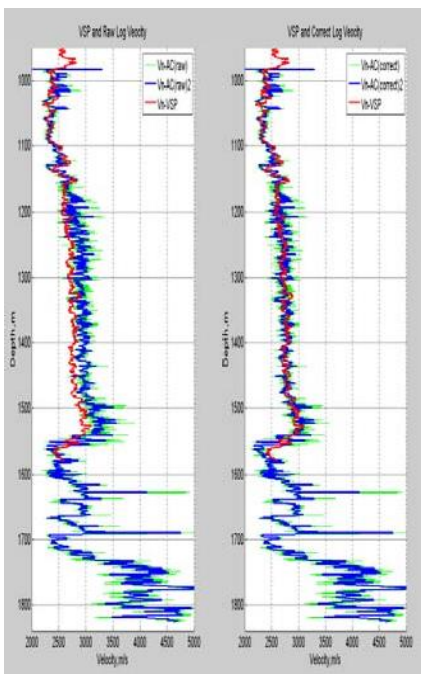


DAS-VSP data

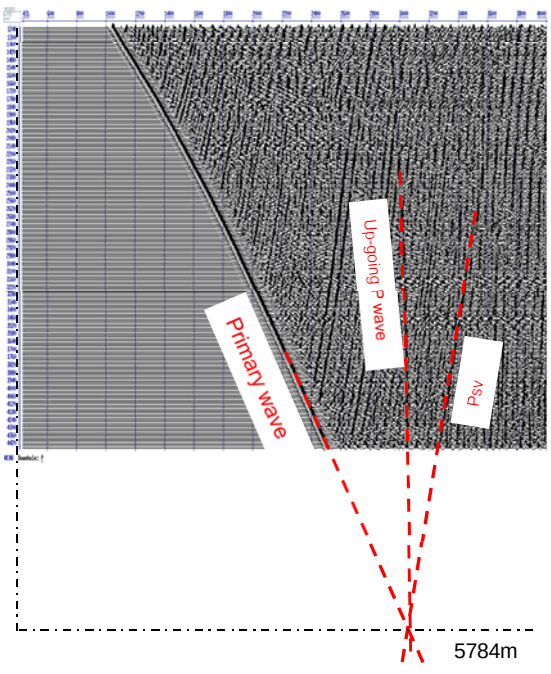


DAS-VSP data
& time-frequency analysis

Conventional geophone
VSP data

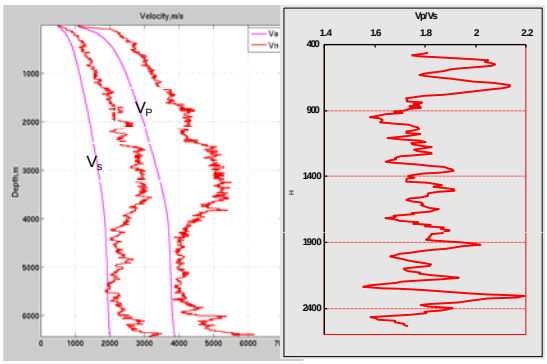


Correction acoustic log with VSP

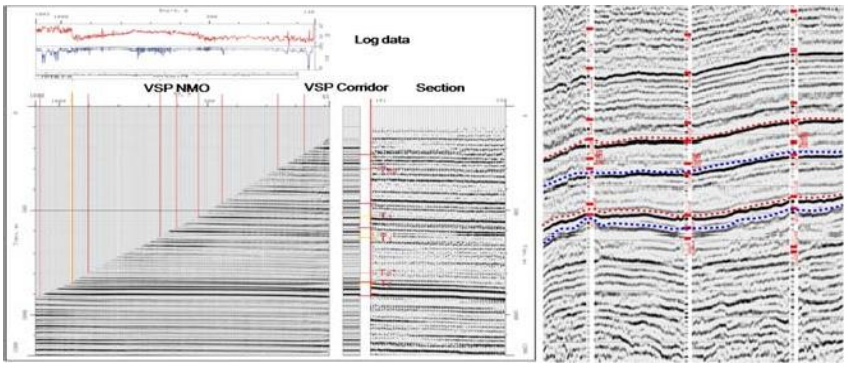


Depth prediction ahead bit

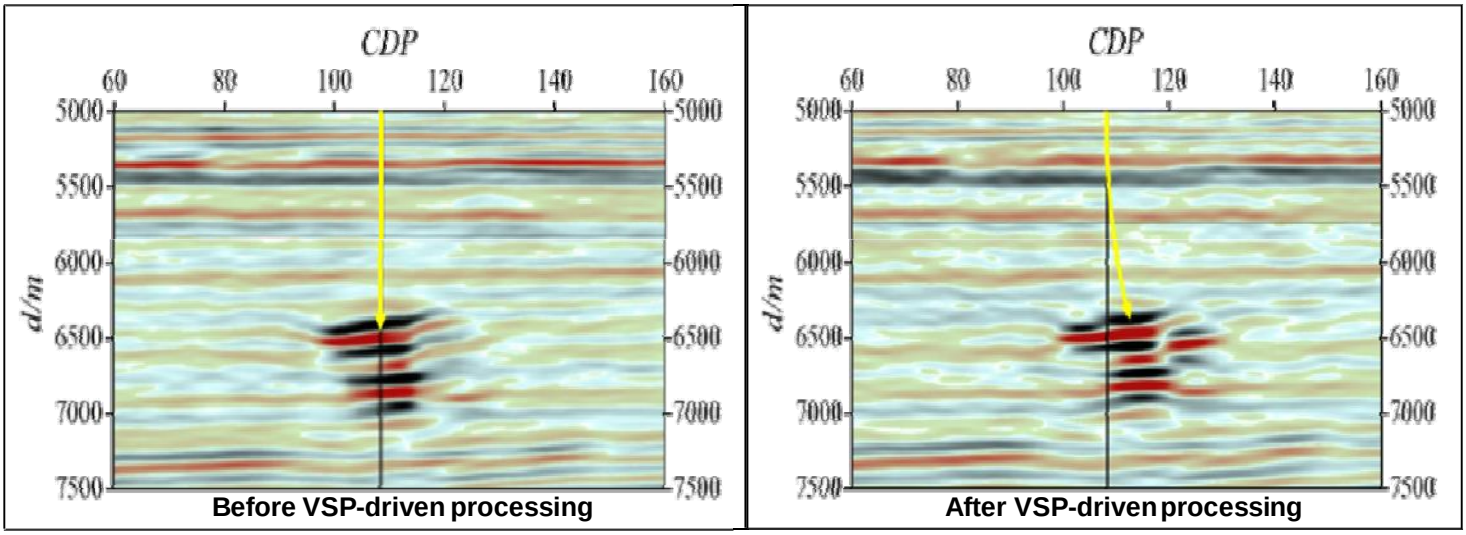
Reservoir static fine description – Zero offset VSP



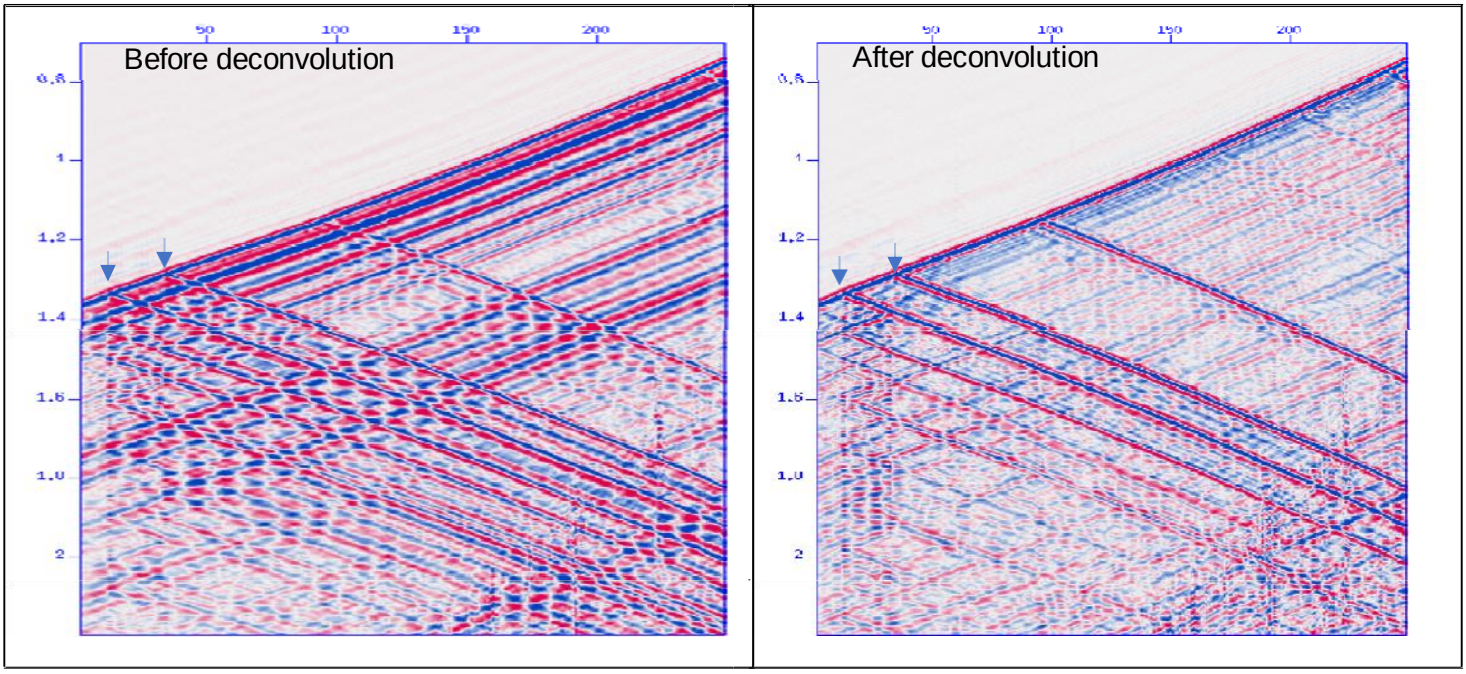
Time to depth relation and velocity



Calibration seismic data with VSP and logging



Driven seismic processing with geophysical parameters extracted from VSP



Multiples identification and attenuation

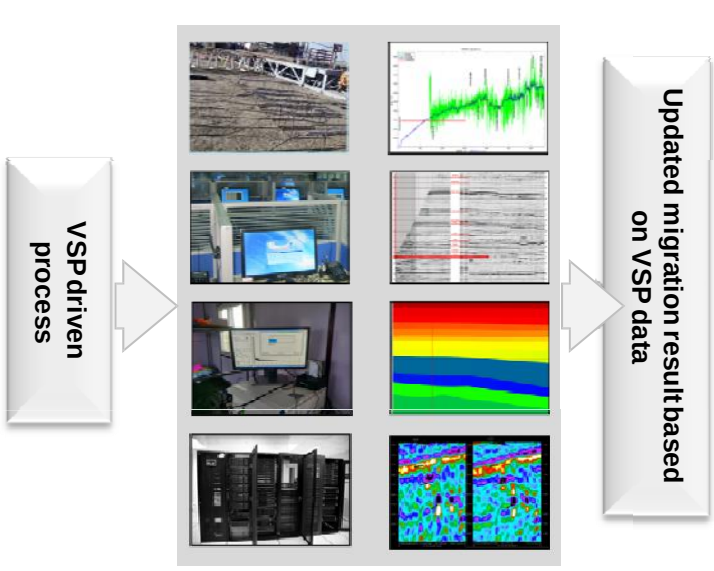
Reservoir static fine description(carbonate)
- Zero-offset VSP guide drilling

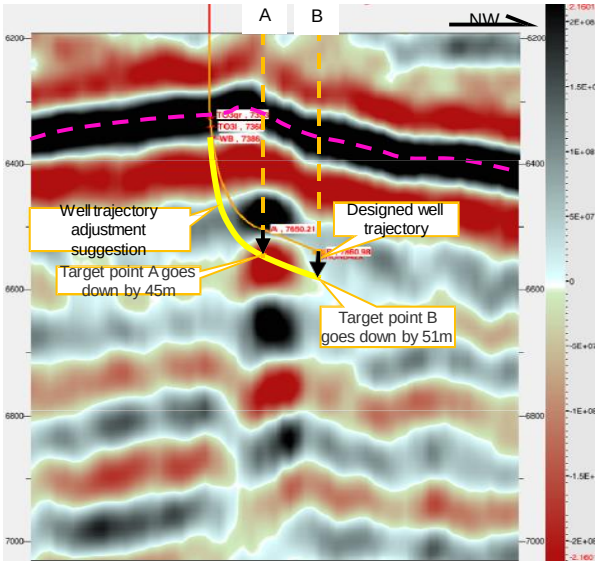
Challenges

For fractured-vuggy carbonate reservoir, as the target becomes gradually complicated, the conventional geophysical methods can not satisfy the exploration and the drilling success rate becomes lower and lower if only based on surface seismic data.

Solution

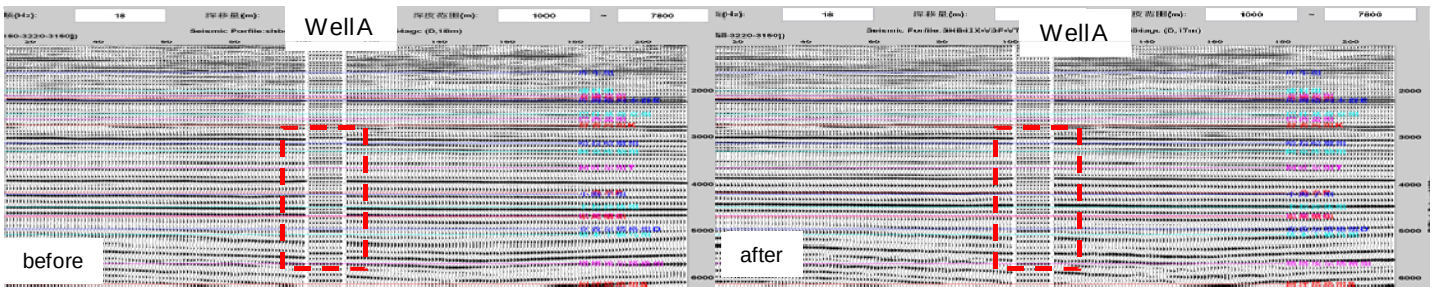
Accurate geophysical parameters extracted from Zer o offset VSP data are used to drive surface seismic processing, predict formation information ahead of bit and provides timely drilling target location to guide the well trajectory adjustment.



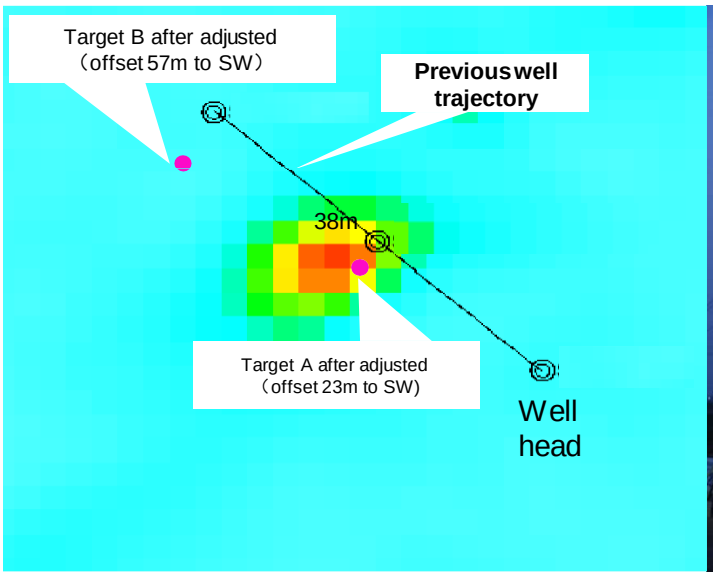


Target adjustment

Results



Depth domain calibration comparison between before and after VSP driven seismic processing



Target locations comparison between before and after VSP driven seismic processing.

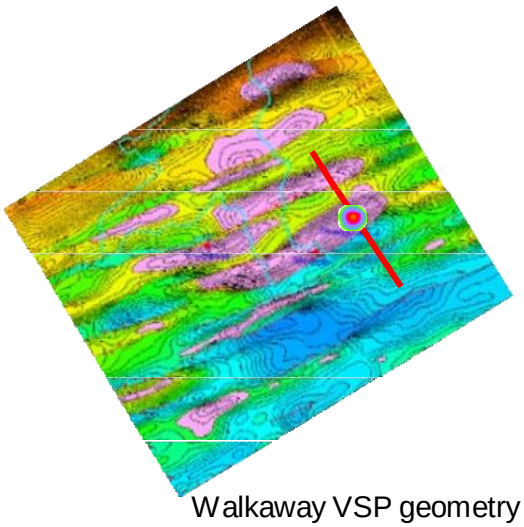
Reservoir static fine description (Deep sandstone)
- Walkaway VSP reservoir identification and prediction

Challenges

For complex lithological reservoirs, it is difficult to identify deep gas bearing sandstone and conventional seismic methods cannot satisfy the exploration.

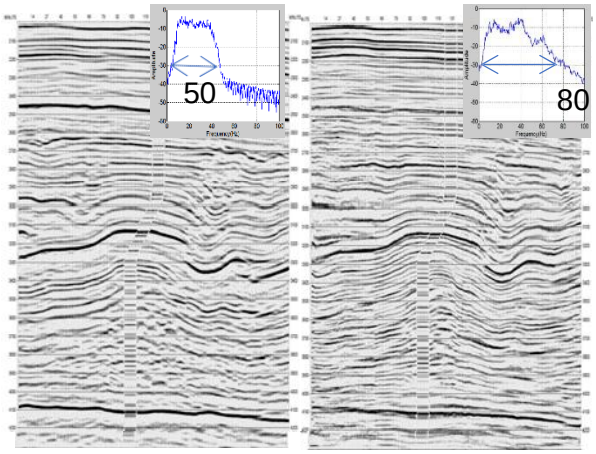
Solution

DAS Walkaway VSP with high-precision image of borehole vicinity structures is combined with attribute analysis to analyze the gas bearing property of the target layers.

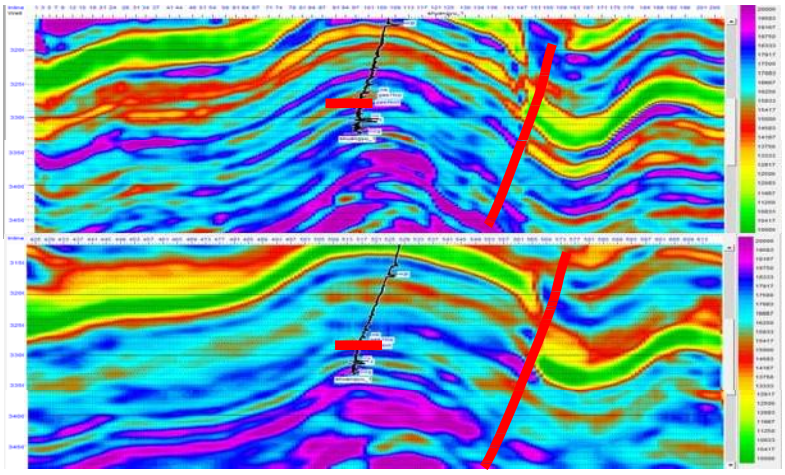


Walkaway VSP geometry

Results



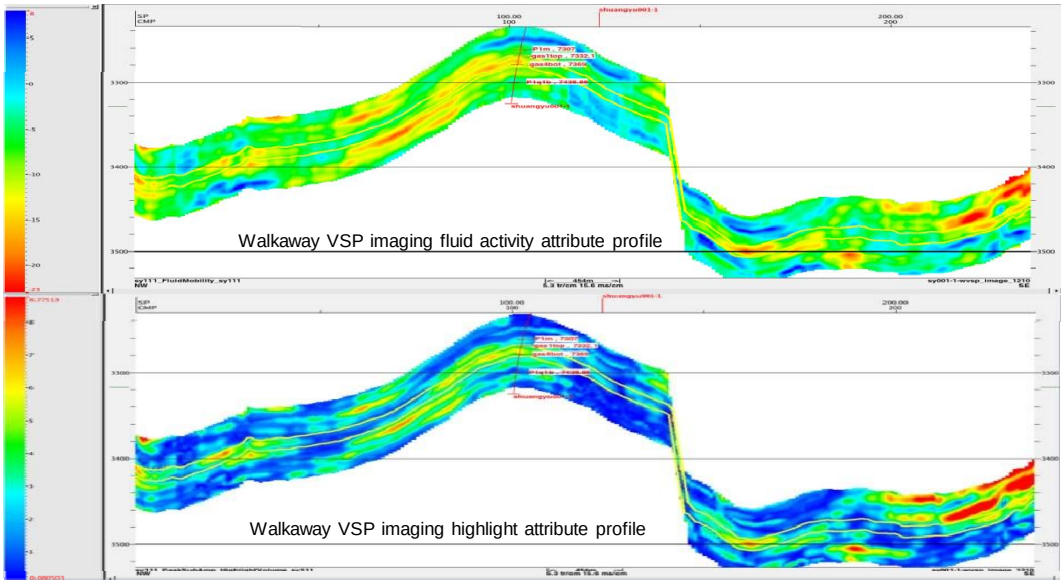
Seismic image (left) and VSP image (right)



Walkaway VSP inversion profile (up) and
Seismic inversion profile(down)

Walkaway VSP imaging profile has high resolution; The vertical variation and horizontal distribution of reservoir impedance in walkaway VSP inversion profile are clear.

The Walkaway VSP imaging highlight attribute profile shows the indicative characteristics of a favorable gas bearing reservoir.



Reservoir distribution and gas bearing anlysis

Reservoir static fine description(Thin sandstone body)
- Walkaway VSP reservoir identification and prediction

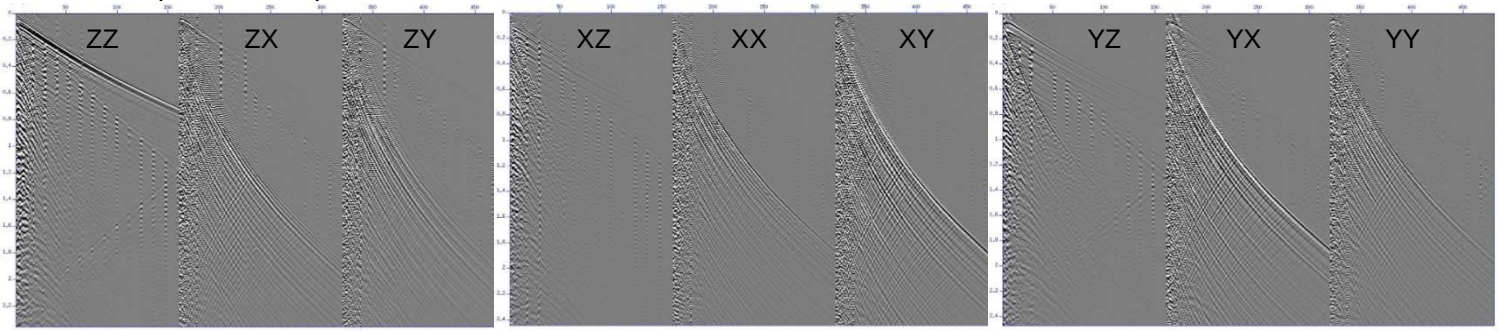
Challenges

For complex lithological reservoirs, it is difficult to identify thin sandstone bodies, especially superimposed sandstone bodies or the sandstone boundary is unclear.

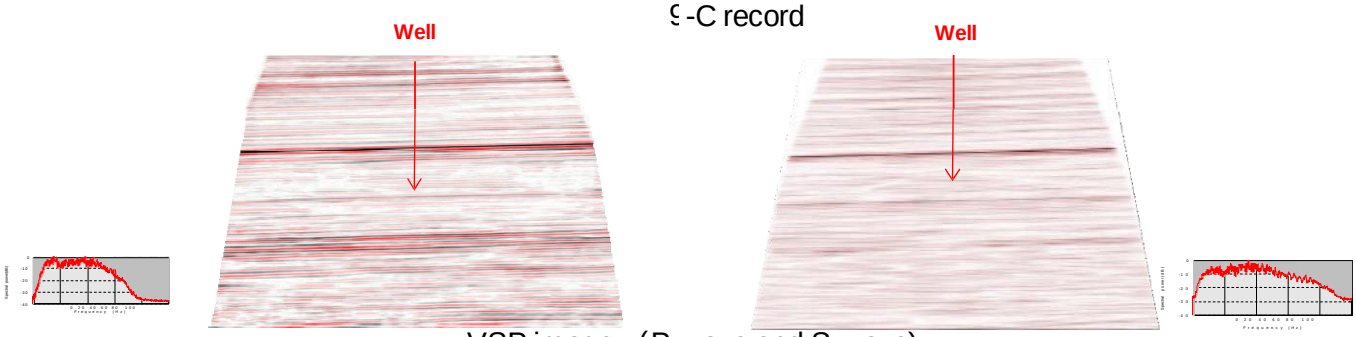
Solution

Walkaway VSP is designed using three kinds of vibrators: P-wave, vertical S-wave and parallel S-wave. The thin sand layers are accurately characterized by the joint inversion of P-wave and S-wave, and the sandstone boundaries are clear, which meet the exploration requirements.

P-wave & S-wave vibrators



9-C record

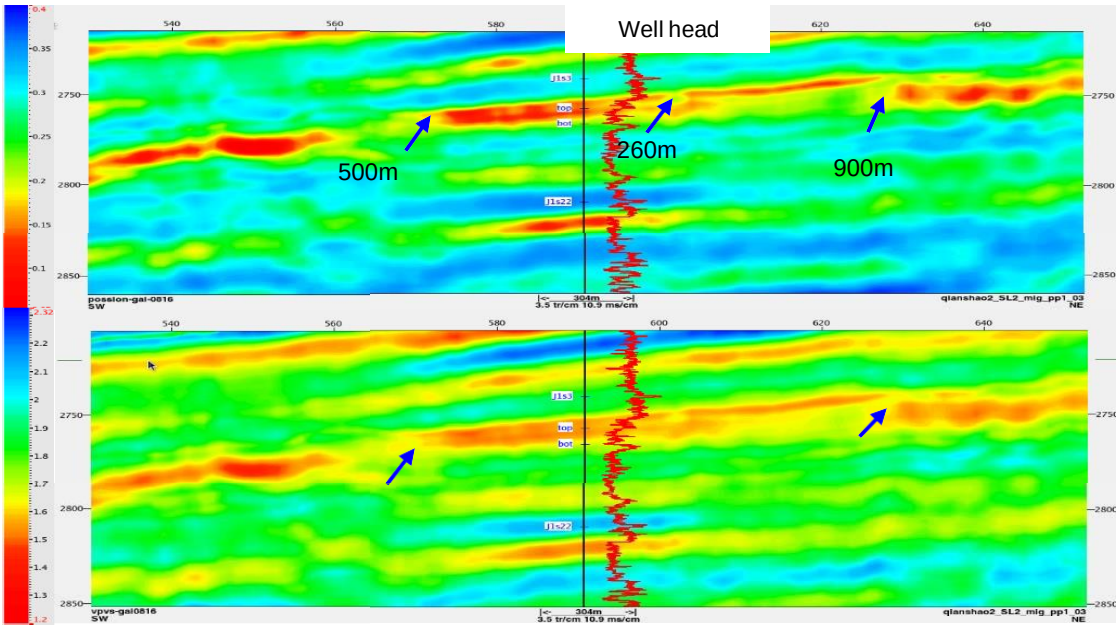


VSP image (P-wave and S-wave)

Results

The P/S wave velocity ratio and Poisson's ratio are oil and gas indication attributes. In this case, they are characterized by low values in the target layers.

And this characteristic extends 900 meters in the northeast direction, and extends about 500 meters in the southwest direction.



Poisson ratio inversion (up) and P/S wave velocity inversion (down)

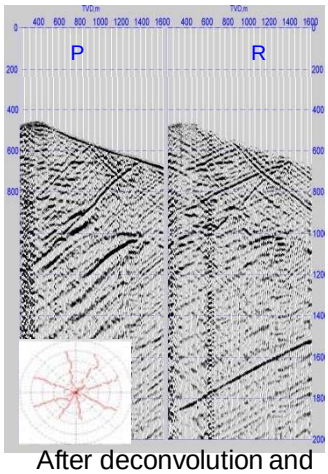
Reservoir static fine description (well trajectory optimization)
- Walkaway VSP guide drilling

Challenges

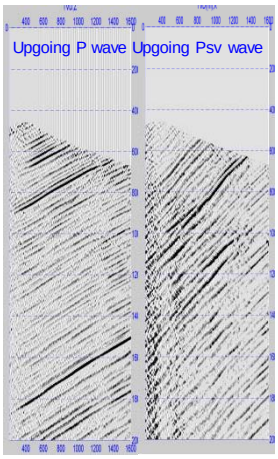
With the development of oil-field productivity construction and drilling technology, more and more horizontal wells are required. However, in some areas there is a lack of seismic data or the well spacings are too big and the reservoir prediction accuracy can not satisfy current horizontal well development.

Solution

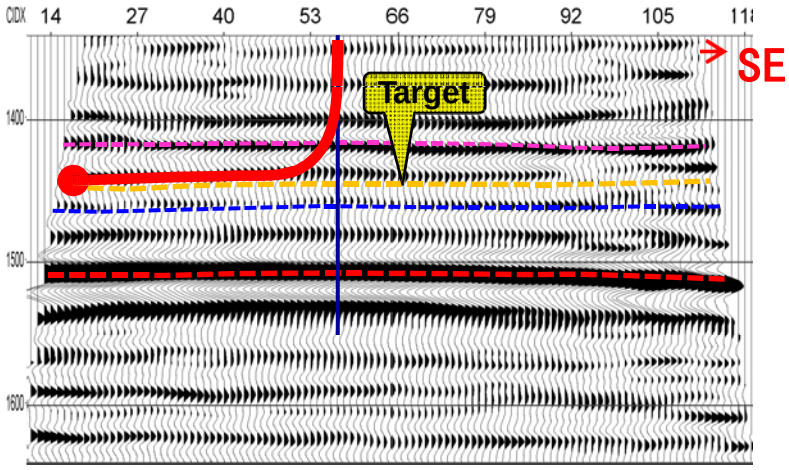
Walkaway VSP recorded by DAS-VSP or using conventional geophones , with one or multiple lines, can effectively avoid the influence of the shallow weathering zone and surface environmental noise. It can finely describe the stratigraphic structure in a certain range, get a clear i age for the regional structure, small faults and thin-layer reservoirs, which can provide accurate key information, such as dip angel, dip direction and small faults, to guide horizontal well trajectory design and optimization.



After deconvolution and remove down going Psv



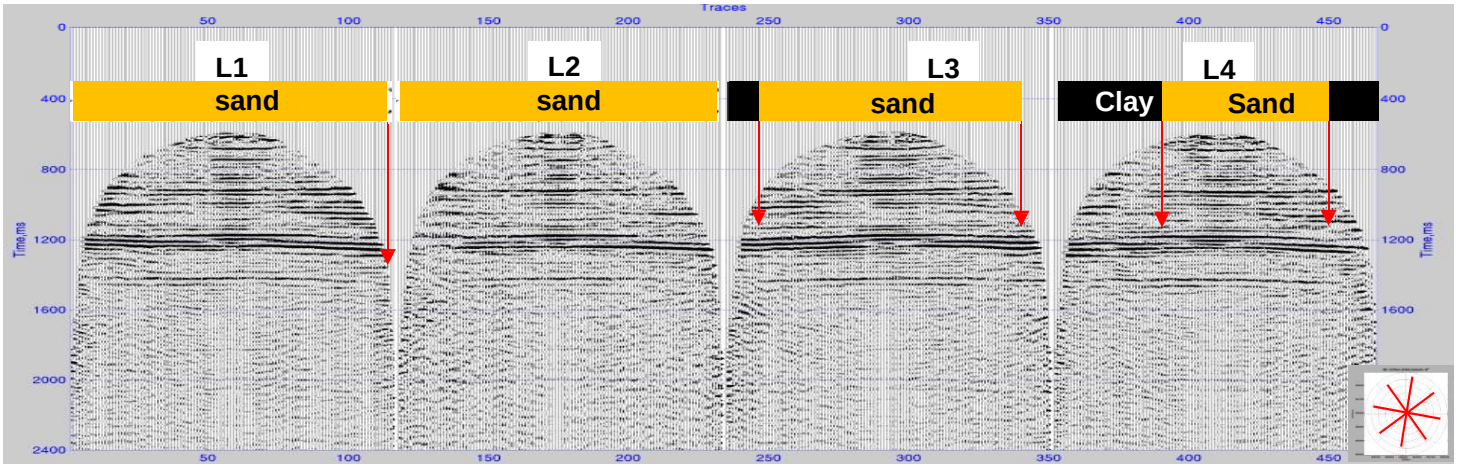
wavefield separation



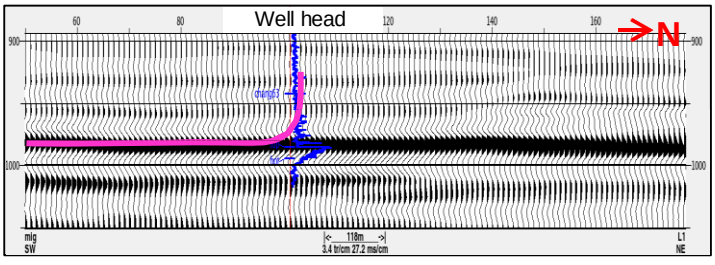
Walkaway VSP guide horizontal well trajectory adjustment

Result

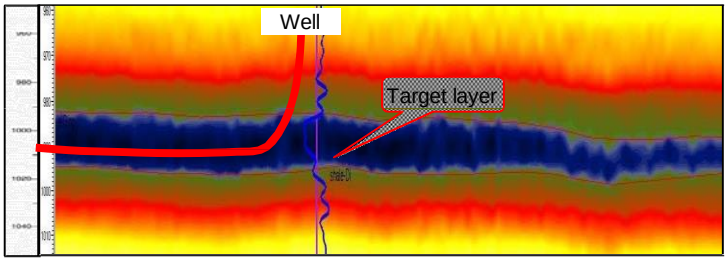
For the thin-layer reservoir areas lacking 3D seismic d ta, the lateral distribution of the reservoir is described by Walkaway VSP imaging. It can effectively help to optimize the wells design for horizontal wells and directory wells and improve the drilling success rate.



Multi-azimuth Walkaway VSP image to identify lateral sand boundary



Reservoir favorable azimuth imaging by Walkaway VSP to identify sand layer lateral distribution



Walkaway VSP guide horizontal well trajectory design

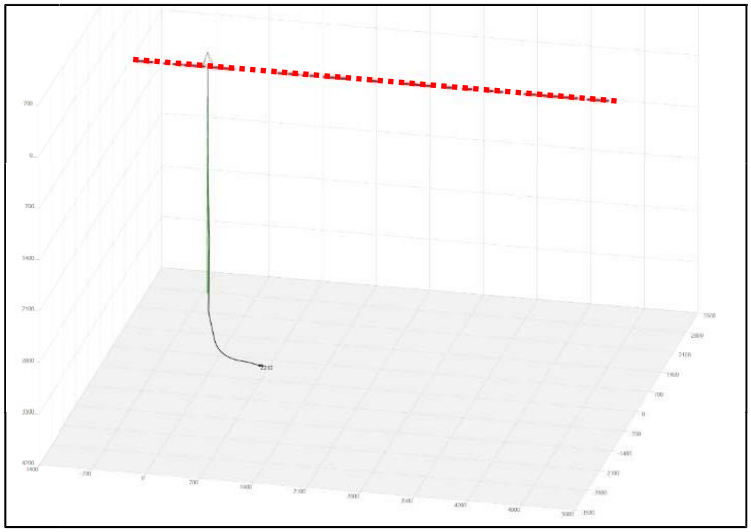
Reservoir static fine description (Shale)
- Walkabove VSP guide drilling

Challenges

For shale gas, it is gradually facing ultra-thin, very shallow or deep shale reservoirs. Conventional seismic methods cannot meet the requirements of horizontal well exploration, so the drill success rate is low based on normal seismic data.

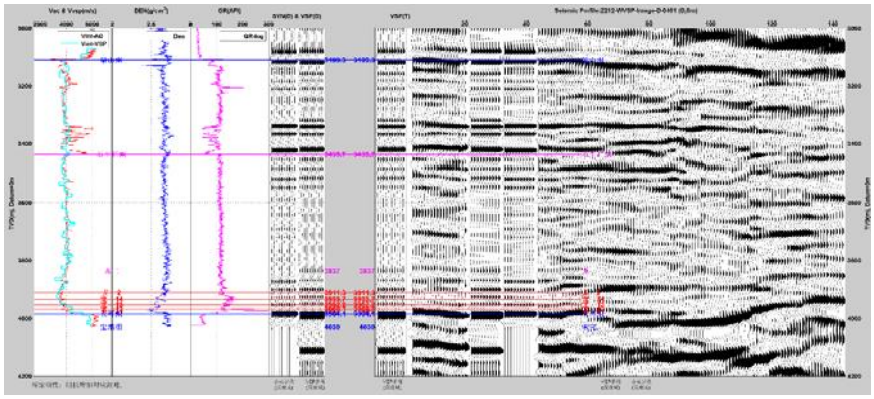
Solution

Walkaway VSP imaging in depth domain is used to clearly map the small structures near the well and horizontal section of the reservoir. Combined with logging information and geological models, the velocity model is updated in real time to provide formation dip predictions.



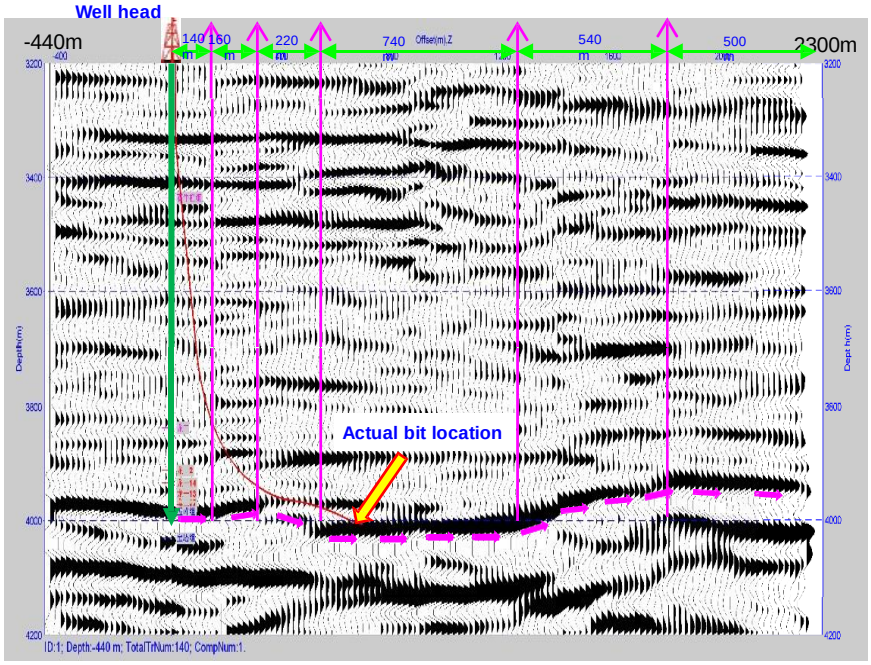
Walkabove VSP geometry

Results



Calibrate the target layers

The target layers in the zero offset VSP corridor stack matches with the same in walkaway VSP image, which validates the accuracy of the target location.



Walkabove-VSP imaging real-time adjustment

VSP data was used to build a velocity model. The logging, geological model and real drilling geology layers information are integrated to constrain the optimization of the velocity model and the imaging is updated accordingly to predict the dip angle of the target layers ahead of the bit.

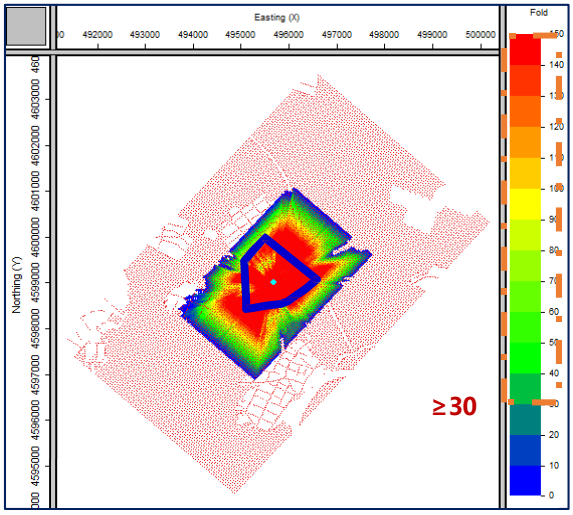
Reservoir static fine description (Complex geological bodies) - 3D VSP imaging

Challenges

During oilfield development, the difficulties, such as micro-amplitude structure identification and the connectivity of oil-bearing sand bodies is unclear and restricts the progress in each time oilfield development.

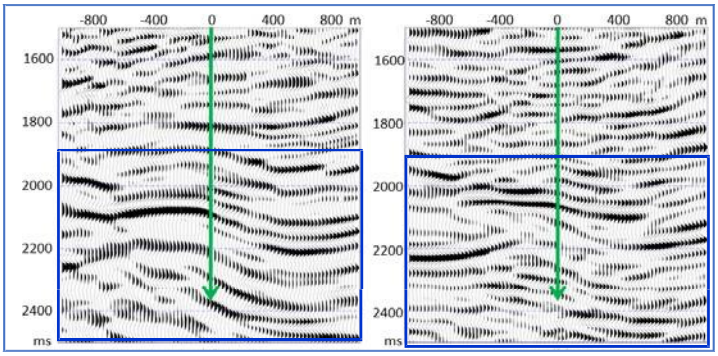
Solution

By deploying optical fiber or large conventional geophone arrays in one or multiple wells (outside the casing for new wells and in the casing for old wells), the structural details are described by high-precision VSP imaging. It can also obtain the low sequence fault and reservoir phase change regulation, which is used for development.

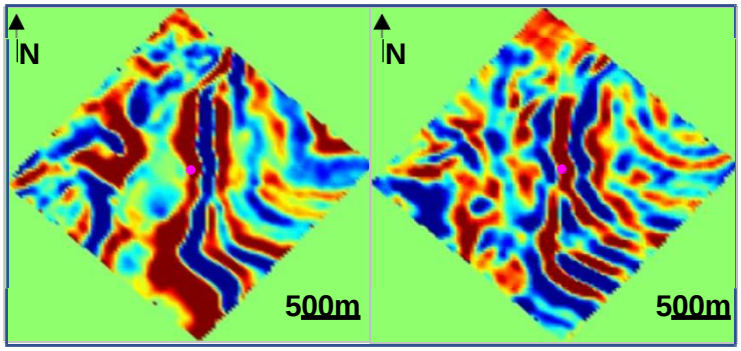


Fold of 3D-VSP

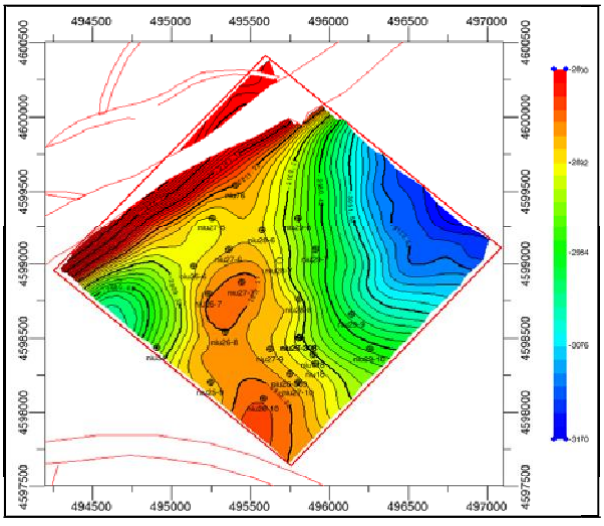
Results



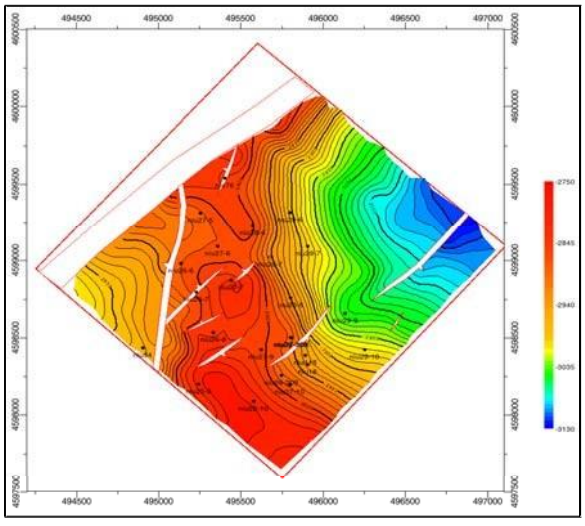
Surface seismic (Inline) **3D VSP (Inline)**



Slice of Surface seismic **Slice of 3D VSP**



Structural map of surface seismic (S1)

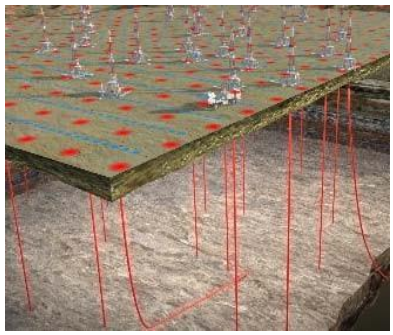


Structural map of 3D VSP (S1)

Reservoir static fine description (Complex geological bodies)
- VSP integrated with surface seismic

Challenges

With the development of oil and gas exploration, demands are extending towards refinement and diversification. With multiple-waves being developed, and seismic imaging accuracy is seriously affected and in some complex areas, the conventional surface seismic can not satisfy the development.



Multi-well DAS VSP integrated with surface seismic

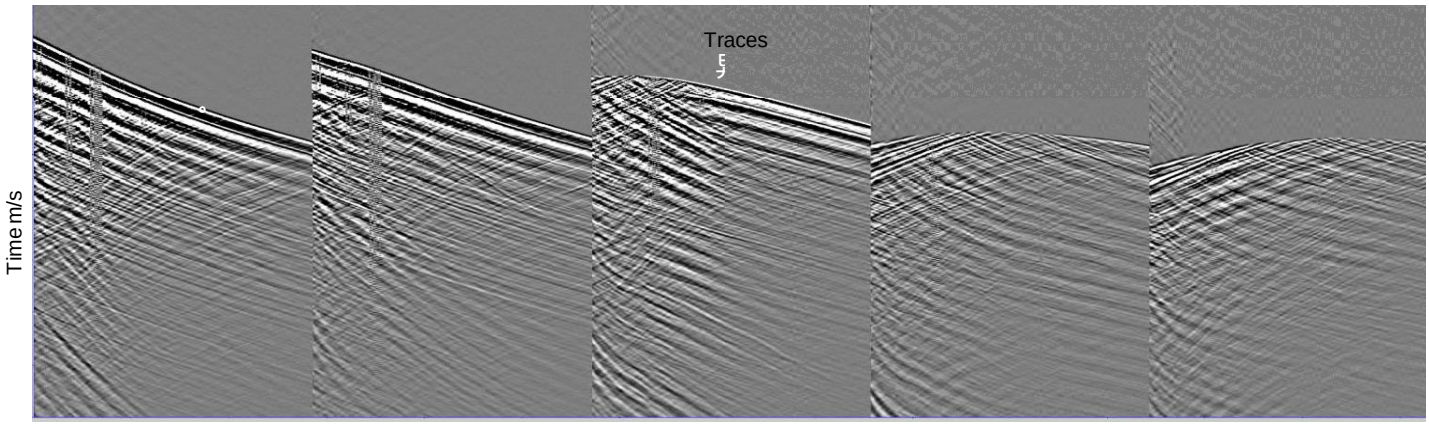
Solution

In the 3D surface seismic area, one or multiple wells are chosen to implement VSP's integrated with surface seismic by using the uDAS ® system. Interval velocities, TAR / Q factor, anisotropic parameters, seismic wavelet, VSP corridor stack, multiples and other related geophysical parameters are extracted from the VSP data to drive the high fidelity and high-resolution processing of surface seismic to improve the seismic image resolution.

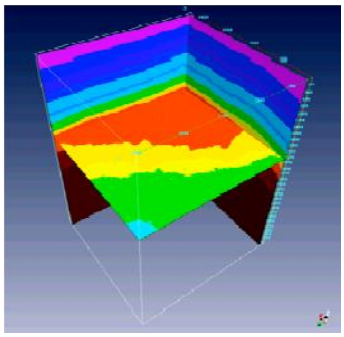
Advantages

Compared with surface seismic, the cost of VSP integrated with surface seismic is low. More accurate geophysical parameters are extracted from the VSP data, such as shallow Q, seismic wavelet, seismic multiples, spatiotemporal variation TAR value, anisotropic parameters & velocities. These combined with geological modeling, optimized velocity fields for PSDM are established, which make the PSDM image more reliable. The result of VSP driven surface seismic processing is with higher fidelity and resolution, which provides reliable data for increasing reservoirs and production in the oilfield.

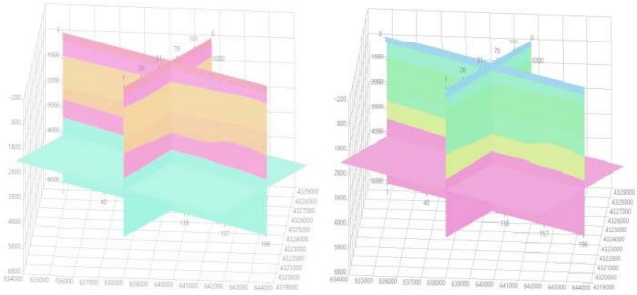
The uDAS VSP technique has advantages of high density, high efficiency, whole well observation and multi well simultaneous observations.



VSP integrated with surface seismic raw data recorded by uDAS® system

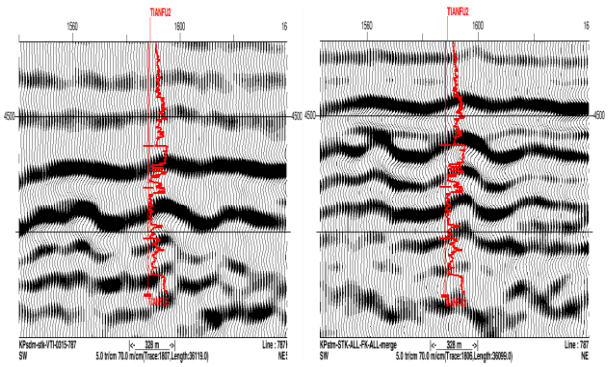


Q model building.

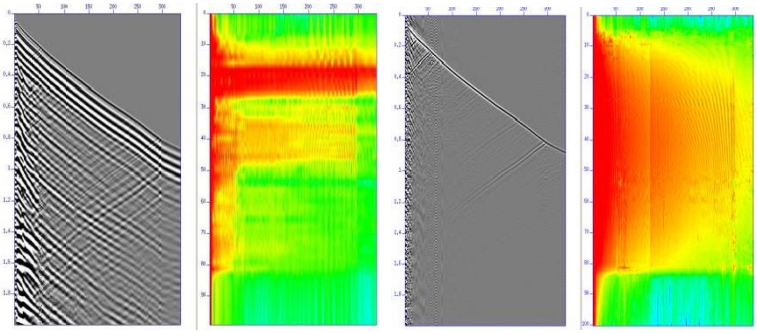


Anisotropic parameters: Epsilon (left), Delta (right)

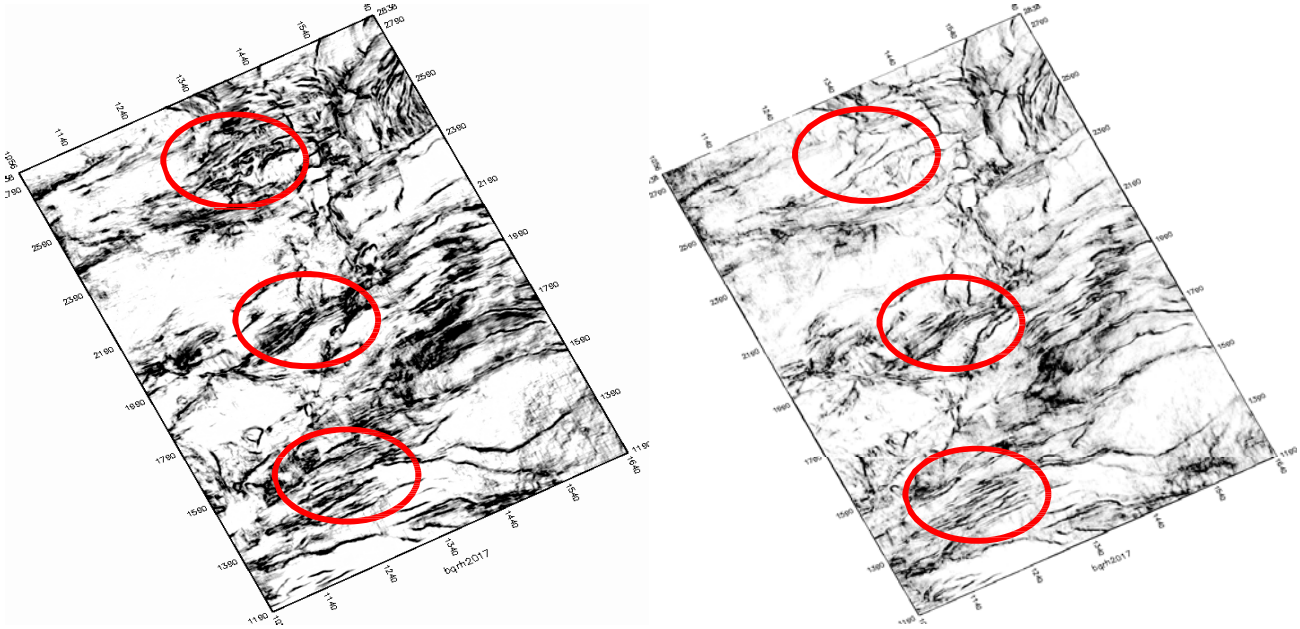
Reservoir static fine description (Complex geological bodies)
- VSP integrated with surface seismic



Conventional PSTM (left), VSP driven PSTM (right)



Seismic wavelet extraction and application
Comparison before(left) and after (right) DECON



DAS VSP integration with surface seismic process results.
Conventional processing (left), VSP driven processing (right)

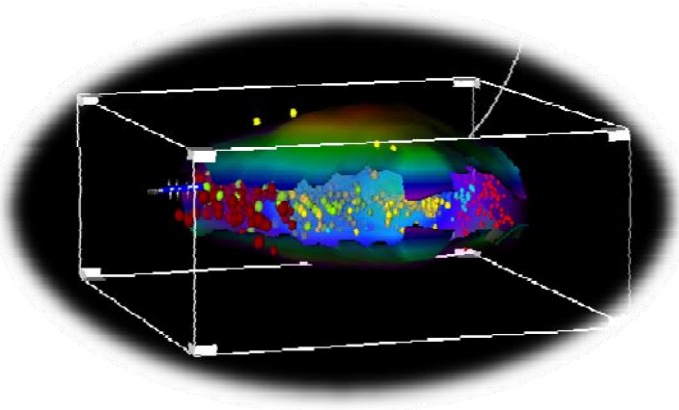
Unconventional oilfield reservoir stimulation
- Real-time micro-seismic monitoring

Challenges

During the development of unconventional oil and gas fields, such as tight sandstone and shale gas, a stimulated reservoir volume is a preferable method to stimulate the reservoir to improve the output of oil and gas. However, how to evaluate the effect of reservoir stimulation, guide fracturing program adjustment on site in real time, reduce engineering risk such as casing deformation and evaluat the artificial fracture network have always been challenges for reservoir stimulation during unconventional oil and gas exploration.

Solution

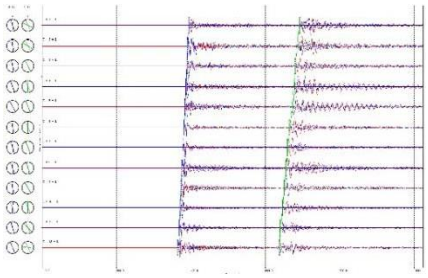
Micro-seismic monitoring is conducted when fracturing and micro-seismic event information can be used to evaluate the fracturing effect and provide data support for fracturing program optimization. Artificial fracture network orientation, length, width, height and in-situ stress direction are calculated by analyzing the attribute characteristics of micro-seismic events, such as spatial distribution, time sequence, magnitude, energy and the relative relationship between existing faults and micro-seismic events. It can calculate the stimulated reservoir volume, evaluate the fracturing , design and adjustment of the fracturing program, especially the real-time adjustment of fluid flow and sand content during fracturing, optimizing the section space and cluster space.



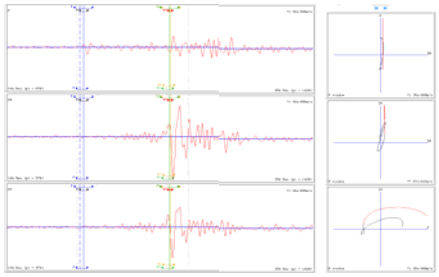
SRV (stimulated Reservoir Voluem) evaluation

Result

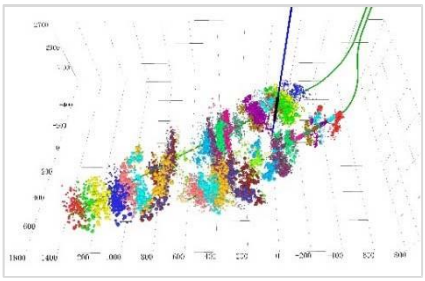
From the continuous data stream, micro-seismic event are identified and the first arrivals of P and S waves are automatically picked up. The source orientation is det rmined by polarization analysis technique and the micro-seismic events are located according to the P&S wave arrival time difference or grid energy scanning.



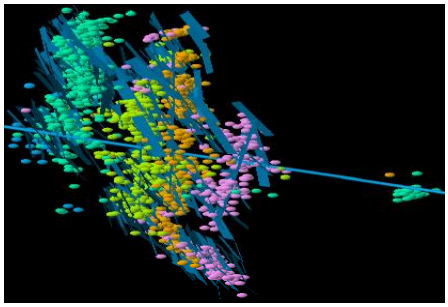
Automatic event identification and arrival time pick-up



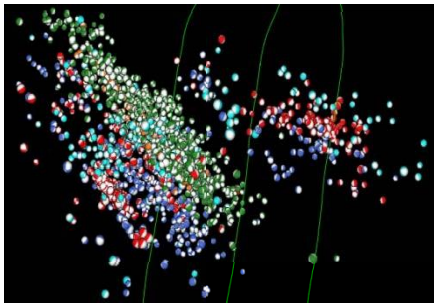
Self-adapt polarization analysis



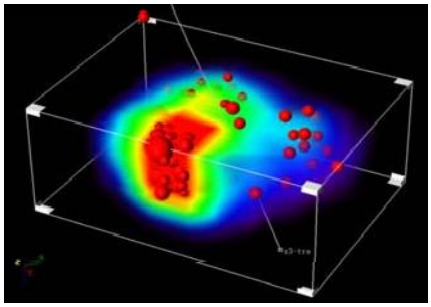
Real-time event location



Fracture morphology



Focal mechanism inversion



SRV

Unconventional oilfield reservoir stimulation
- Geo-engineering integration based on micro-seismic

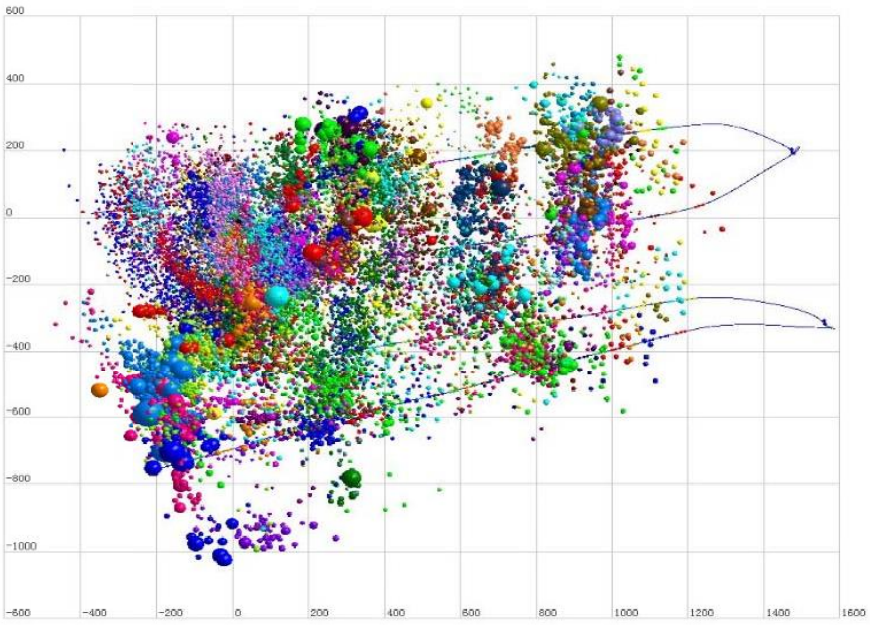
The integrated technique of micro-seismic, geology and engineering comprehensively analyzes and guides the optimization of fractured engineering parameters by using the real-time results of micro-seismic monitoring, surface seismic and geological attributes of the development formation. It can significantly improve the unconventional oil and gas production and efficiency.

Challenges

During unconventional oil and gas development, due to the influence of complex geological conditions such as natural fractures and faults, engineering incidents often occur, such as drilling fluid leakage, low drill success rate, fracturing casing deformation and lack of fracturing effect evaluation, which seriously delays the progress and lowers the efficiency.

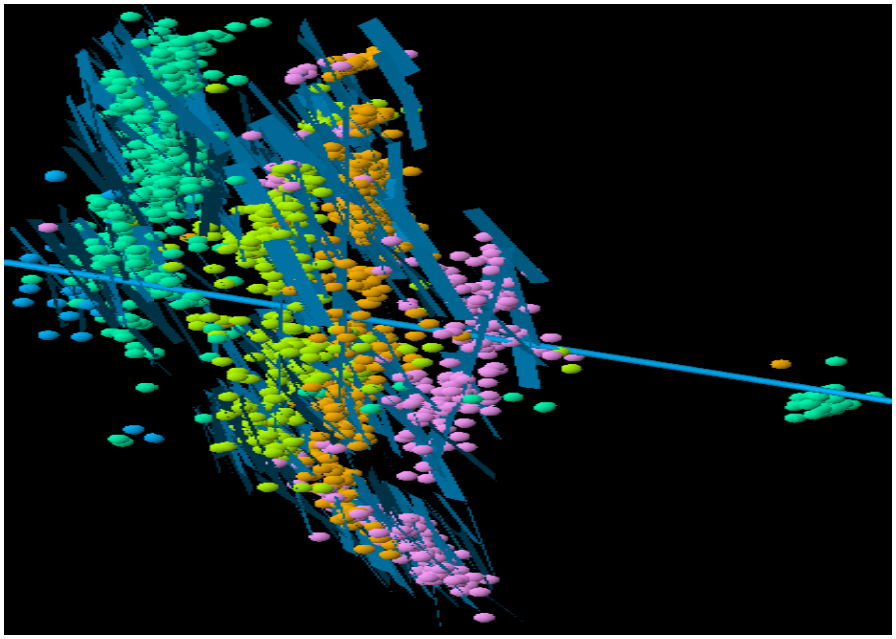
Solution

The unconventional integrated processing technique is used to finely describe the **ant-tracking volume**, curvature and Young's modulus of seismic data, improve the fracture identification rate and sweet spot area optimization, and adjust the horizontal well trajectory and fracturing section space. The micro-seismic monitoring technique is used to display the spatial distribution of the artificial fracture network in real time. By analyzing the temporal and spatial characteristics of micro-seismic events, the casing deformation position is predicted on site, to guide the optimization of fracturing parameters, improve the fracturing effect and reduce engineering risk.



Microseismic events in tight sandstone

By integrating seismic, petrophysical, logging and fracturing engineering data, interactive and comprehensive analysis greatly helps decision-makers to make the right decisions. The micro-seismic monitoring results are displayed in real-time, showing the fracturing effect to make timely adjustments to the engineering parameters and effectively reduces the engineering risk. The micro-seismic monitoring technique based on crawler dragging geophones to horizontal sections improves the positioning accuracy of the artificial fracture network and greatly reduces the cost of multi-well fracturing monitoring on the same platform.



Artificial fracture network

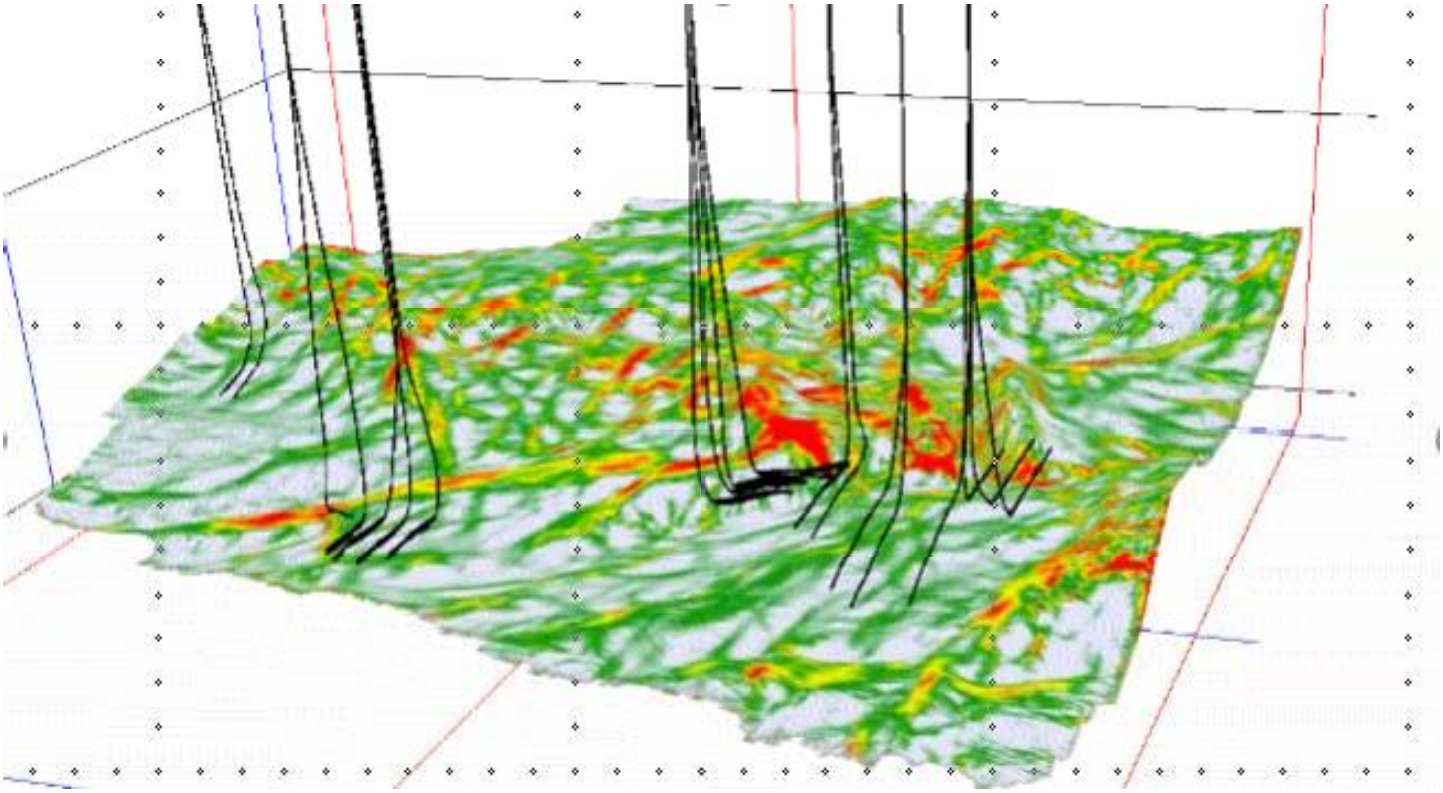
Result

In the development of shale gas and tight sandstone oil and gas in China, the integrated technique of micro-seismic, geology and engineering has greatly improved the effect of hydraulic fracturing and artificial fracture reconstruction, and effectively reduced the engineering risk and development cost.

Unconventional oilfield reservoir stimulation
- Geo-engineering integration based on micro-seismic

Prediction before drilling

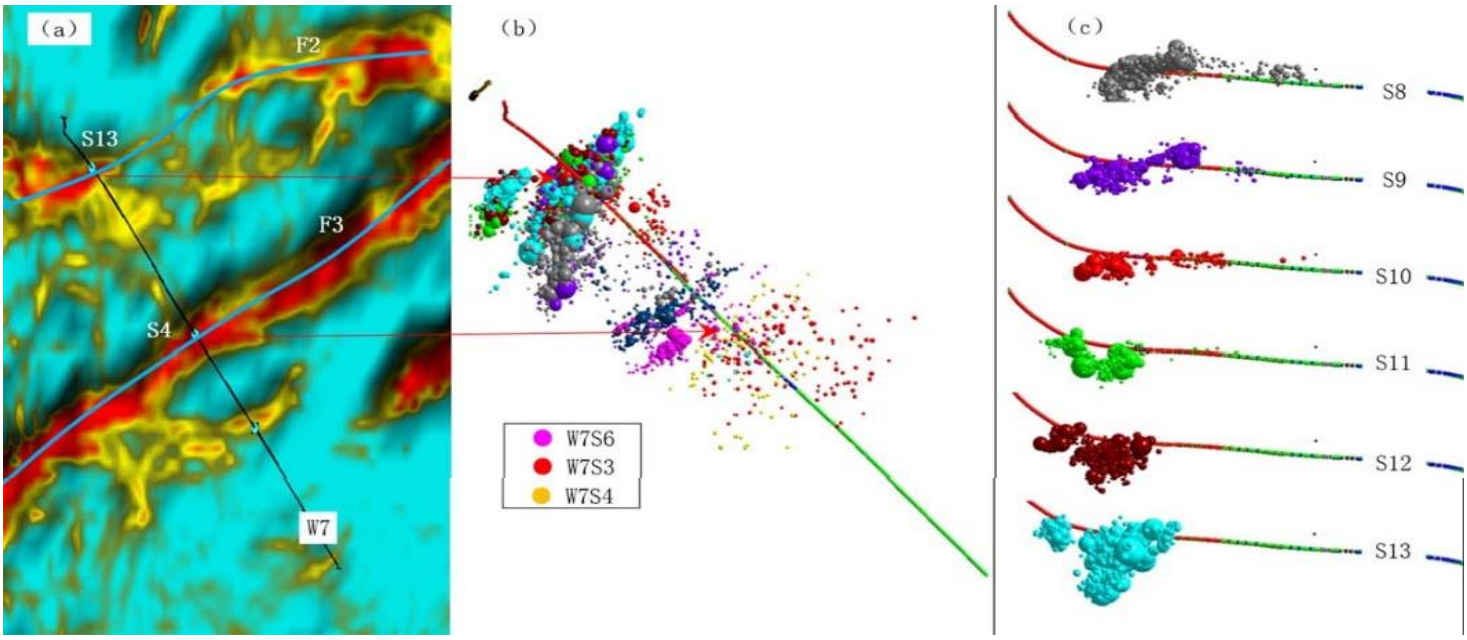
By integrating geophysical results, geological understanding, fracturing operation parameters and micro-seismic events characteristics, comprehensively analyzing the impact of rock physical properties (TOC, formation pressure) and natural cracks on fracturing operation , guides the selection of preferable fracturing areas, optimizes well trajectory design and improves drilling success rates.



Target layer curvature attribute map

Optimization of fracturing parameter and real-time risk early-warning

The artificial fracture network is displayed in real time. The attribute characteristics of micro-seismic events are analyzed on site and the effect of parameter change is evaluated in a timely manner. Combined with geophysical attribute characteristics and fracturing parameters, early warning of engineering risk is enhanced and it can improve the success rate of fracturing.



Casing deformation analysis by integration techniques

Unconventional oilfield reservoir stimulation
- Optical fiber sensing monitoring in the same wellbore

Challenges

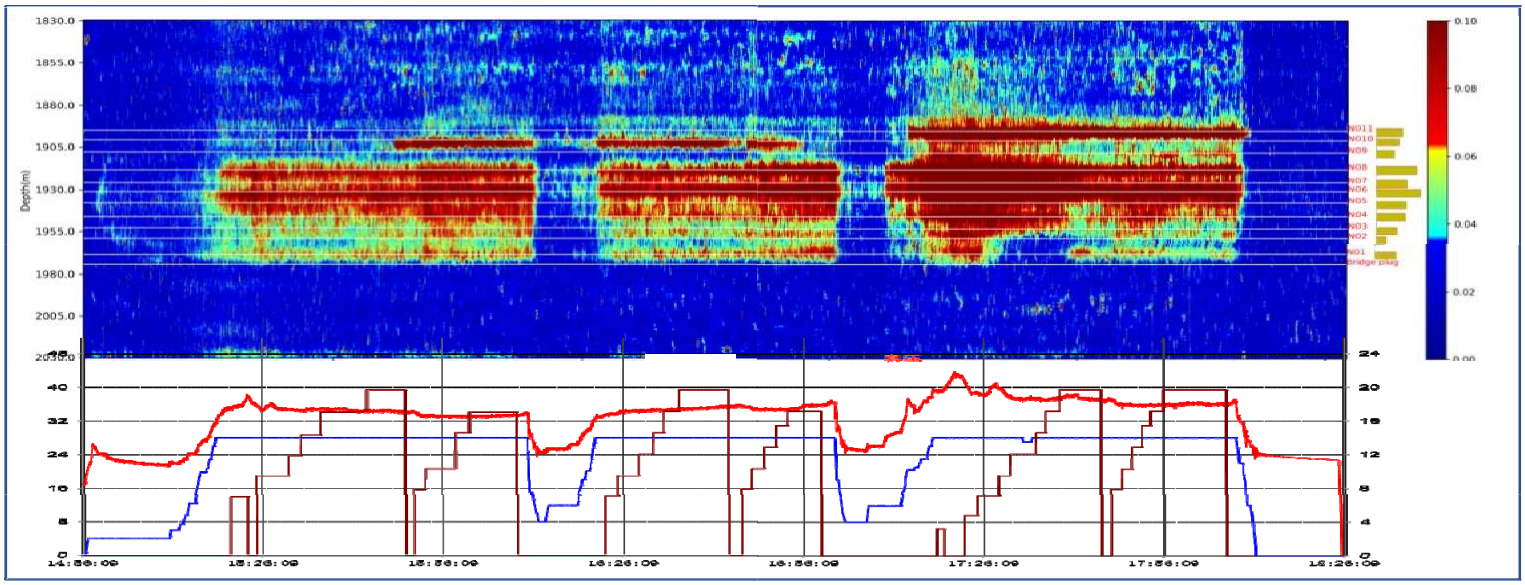
With the continuous development of unconventional oil nd gas, how to optimize fracturing and attenuate noise inter wells becomes more and more important.

Solution

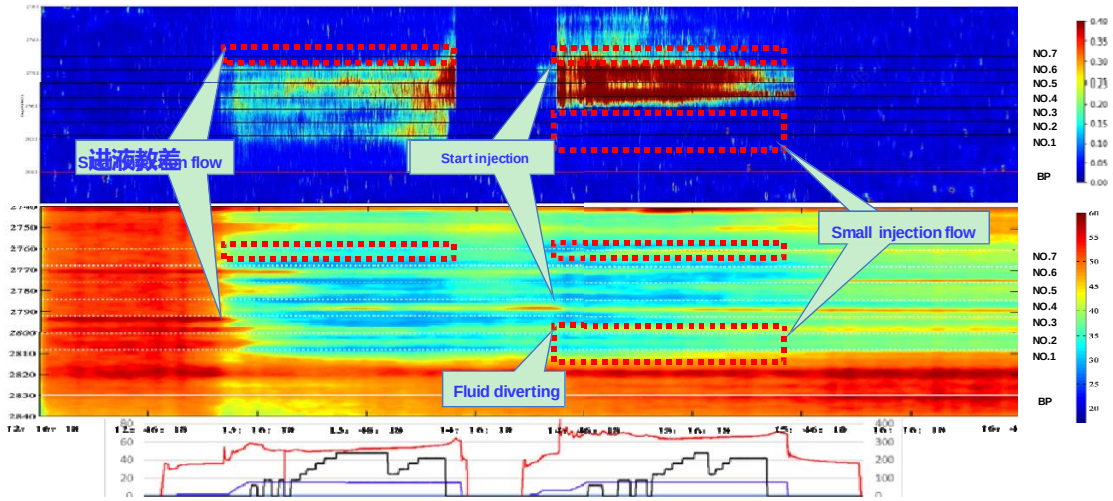
Distributed optical fiber acoustic sensing (DAS) is used to obtain downhole acoustic information. Distributed optical fiber temperature sensing (DTS) is used to obtai downhole temperature. Combination of DAS and DTS can be used to monitor reservoir stimulation progress. It can provide real-time changing regarding fracture opening, fluid injection and sand addition of each fracturing cluster, temporary plugging and guide fracturing operations.

Results

1. Real-time monitoring fluid injection. Establish the relationship between acoustic energy and fluid injection, quantify the sand injection volume of each cluster, d fine the dominant fluid injection cluster and adjust in a timely manner the fluid injection strategy according to the fracturing situation of each cluster.
2. Evaluation of temporary plugging. Compare and analyze the fluid flow status of each cluster before and after temporary plugging. If the temporary blocking failed, adjust the fracturing program immediately.
3. Fracturing effect evaluation. The fracturing effect is evaluated according to the fracture energy of each cluster, the total volume of fluid injected into each cluster, and the temperature falling after fracturing has ended.



DAS fracturing monitoring results



DAS+DTS fracturing monitoring

Unconventional oilfield development
- Fluid production monitoring using optical fiber sensing

Challenges

With the continuous development of unconventional oil and gas, current urgent problems need to be solved. These problems include, how to evaluate production, how to improve efficiency, prolong the life cycle and enhance ultimate recoverable reservoir (EUR), how to identify the location of water/sand and how to prevent sand plugging or gas well flooding.

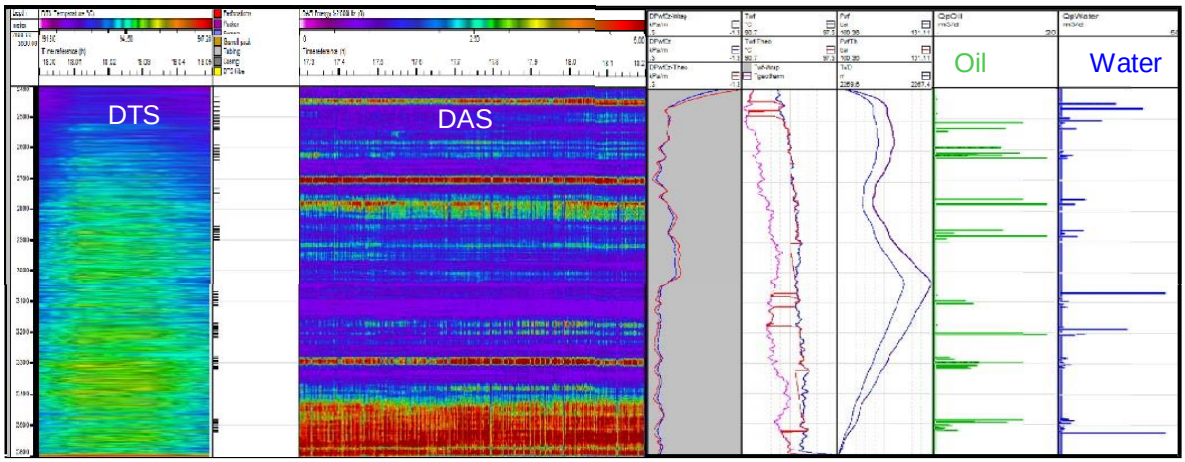
Solution

Monitor and display the fluid production profiling and DAS acoustic energy under different production systems in real time and choose the best production system. Identify the water outlet area according to the temperature change of the whole wellbore and identify the sand production position according to the change of acoustic energy.

Results

1. Evaluate production and optimize production parameters

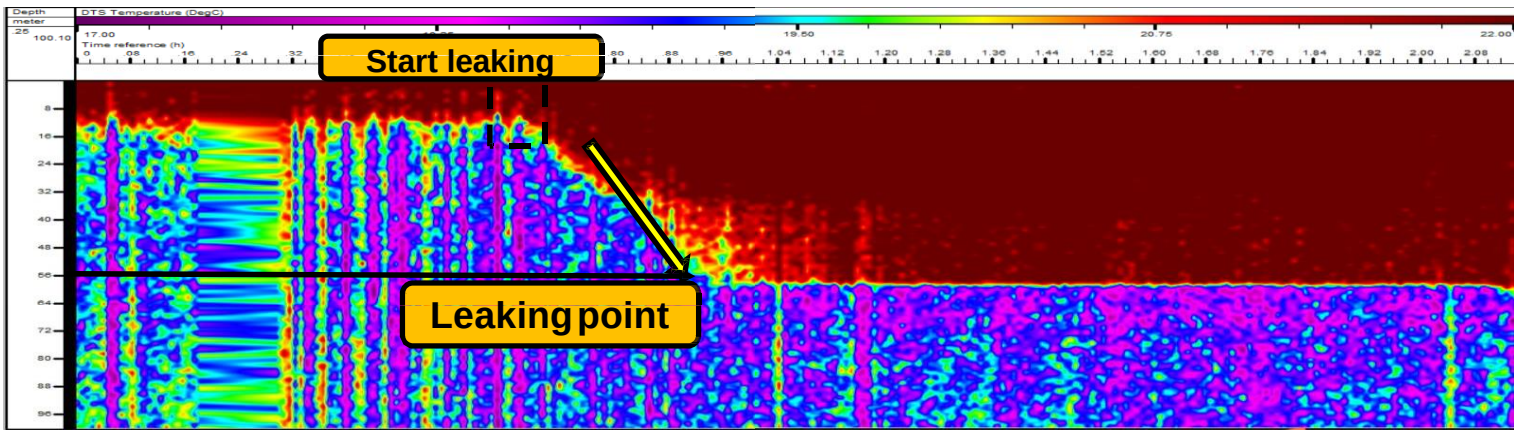
Using DTS to test the fluid production profiling with different production systems, combined with DAS, analyze and verify the acoustic energy of each cluster and choose the best production system.



Fluid production profiling result

2. Water outlet and sand production position monitoring

By analyzing the temperature change of the whole wellbore, the water outlet point is identified, which can provide accurate position for oil & gas wells to block water; The sand production position can be identified by analyzing the whole wellbore acoustic energy changing. The positioning error is less than 3m.



Water outlet monitoring result

Reservoir dynamic monitoring
- Time-lapse DAS walkaway VSP

Challenges

During oilfield development, it is necessary to monitor reservoir and fluid changes and to find and exploit the remaining oil to enhance oil recovery. For oil and gas storage, it is necessary to monitor the status of oil & gas migration and storage.

Solution

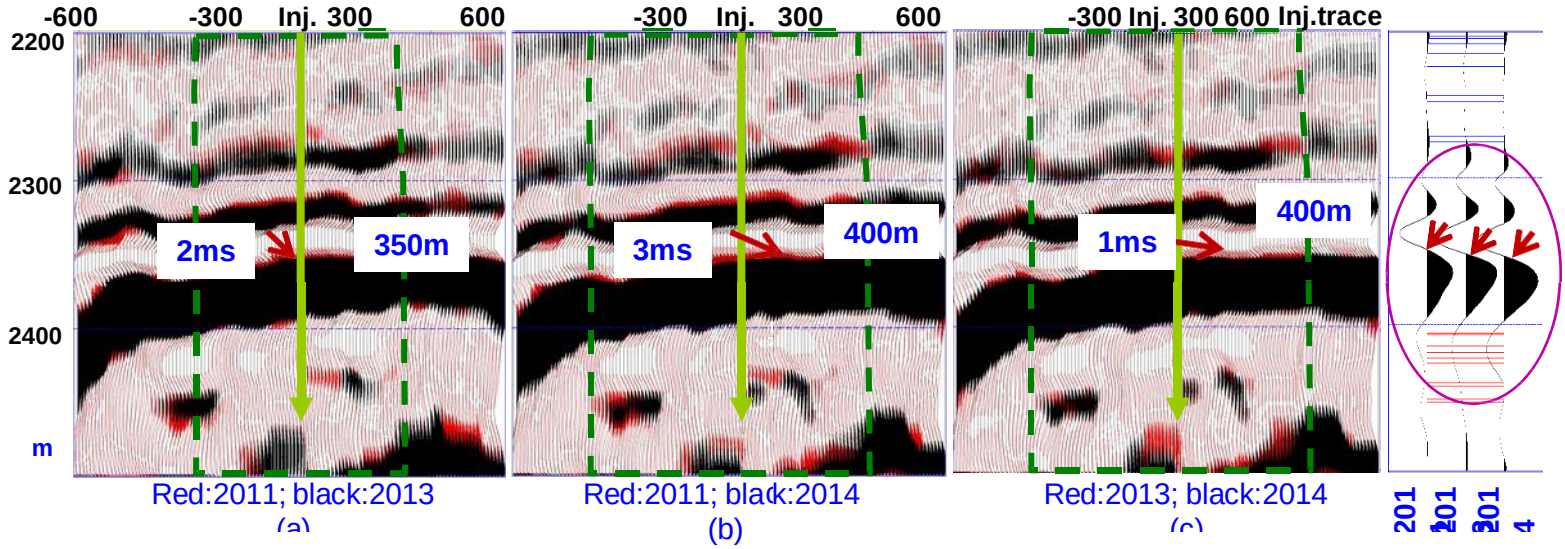
Time-lapse DAS walkway VSP is designed using the uDAS system. It has advantages in consistency and high precision. The different analysis of attribute parameters, such as seismic wave velocity, travel time, amplitude, frequency and wave impedance between different stage data, is used to study the change of fluid status of the reservoir near the wellbore.

By comparing the differences of acquired data in different stages, it reflects the reservoir changes in a certain range around the observation wellbore, which is very important for gas reservoir monitoring, remaining oil finding and recovery improvement. Especially, the application of uDAS with optical fiber cemented outside the case

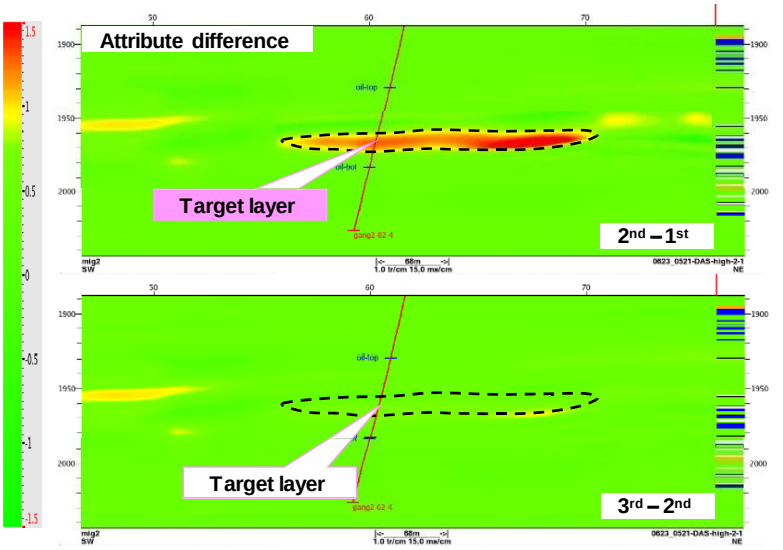
.

Results

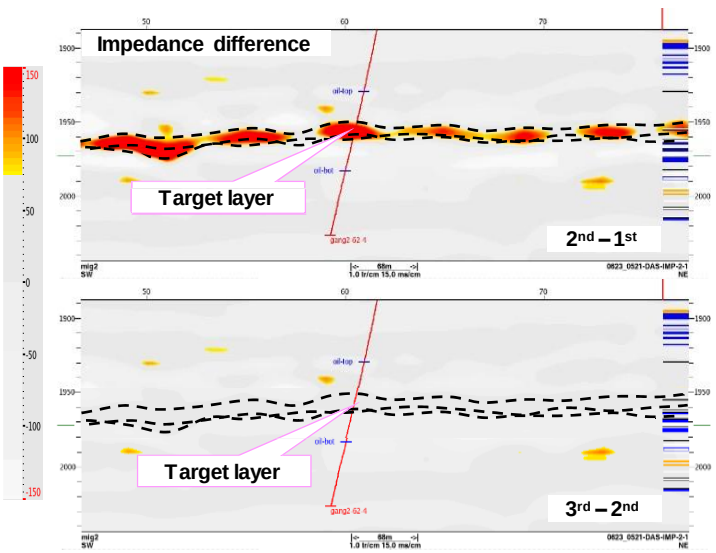
The time-lapse VSP method is firstly applied to the monitoring of the reservoir. Through the comparative analysis of multi-stage seismic attributes and wave impedance inversion profiles, the dynamic characteristics of reservoir fluid are finely described and the shifting direction of reservoir fluid is predicted.



VSP image comparison among different stages



Amplitude attribute differences between different stages



Impedance inversion differences between different stages

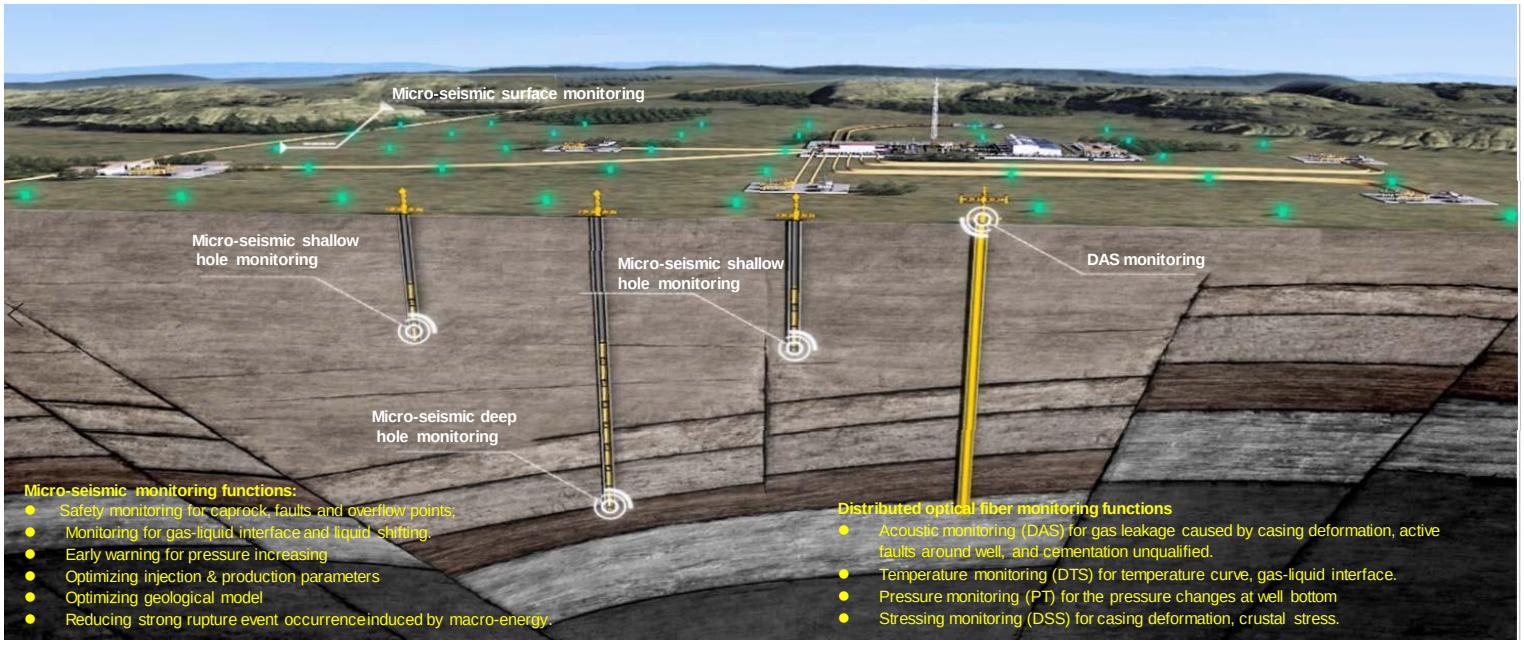
Underground Gas Storage operation
- Micro-seismic and DAS joint monitoring

Challenges

Underground Gas Storage (UGS) accidents are mainly caused by the integrity of geological body and wellhole losing efficacy. During long-term operations, high-pressure reciprocating injection and production leads to periodic disturbances in the in-situ stress fields and then the caprock and wellbore integrity may lose efficacy.

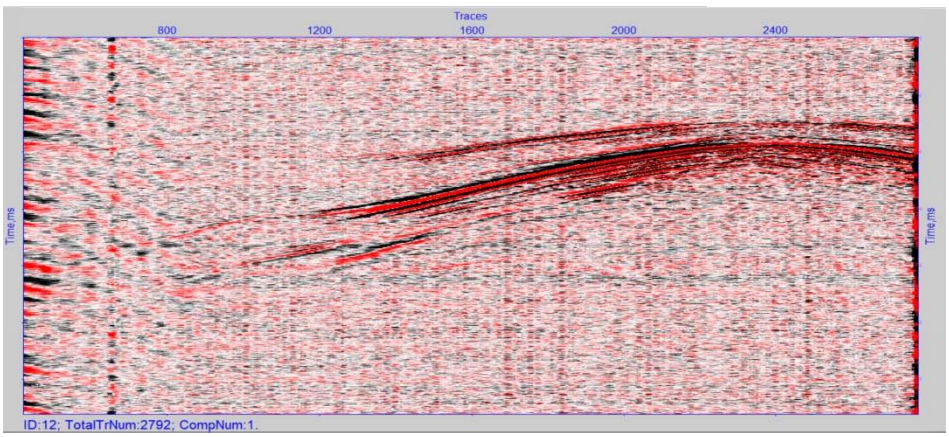
Solutions

The establishment of a safety early warning system provides a solid guarantee for the pressure increasing of the UGS. According to UGS characteristics, micro-seismic and optical fiber joint monitoring is adopted. A micro-seismic monitoring system is deployed to conduct real-time monitoring of the integrity of the geological bodies, and optical fibers are deployed in observation and injection-production wells to conduct real-time monitoring of the wellbore integrity.

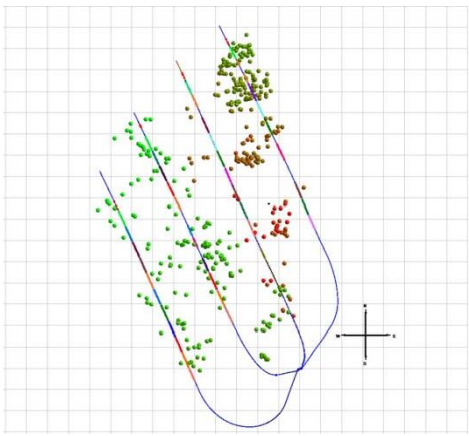


Case study

1. Distributed optical fiber acoustic sensing (DAS) monitoring, receiving fracture signal to analyze the location, strength and other information, provides early warning for the UGS operation.



Raw data with micro-seismic events

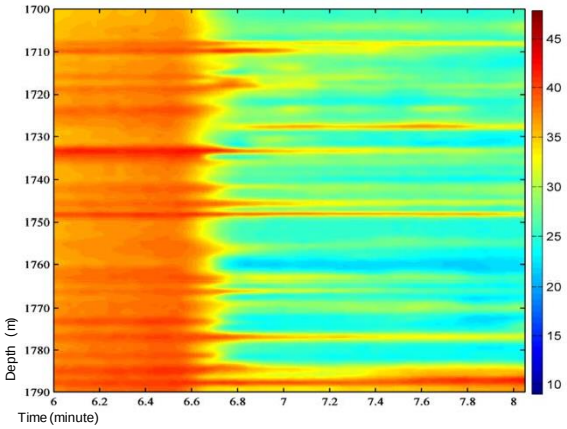


Micro-seismic events

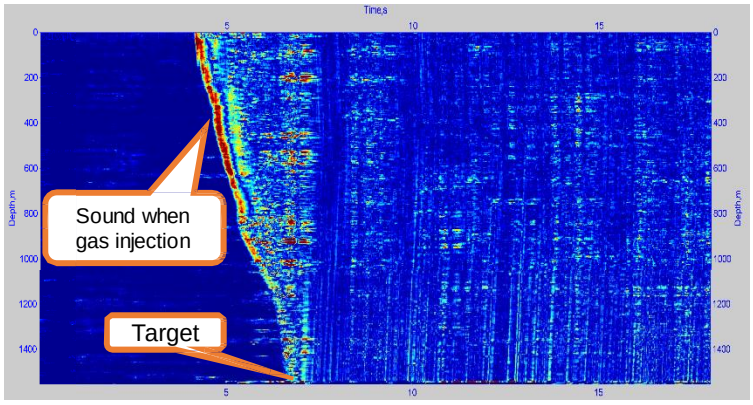
Underground Gas Storage operation
- Micro-seismic and DAS joint monitoring

Case study

2. Distributed temperature sensing (DTS) monitoring to analyze the gas-liquid interface, the temperature before injection and after, the seal performance of packer and optimize injection & production parameters.



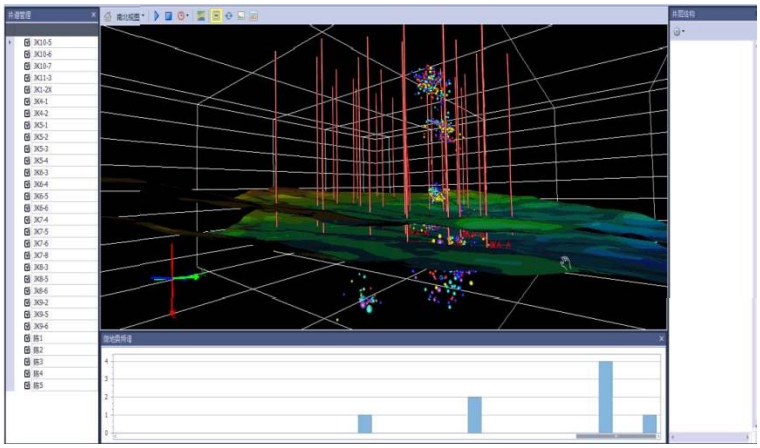
DTS monitoring (gas injection duration)



DAS monitoring (Gas injection duration)

3. Pressure and temperature (PT) monitoring

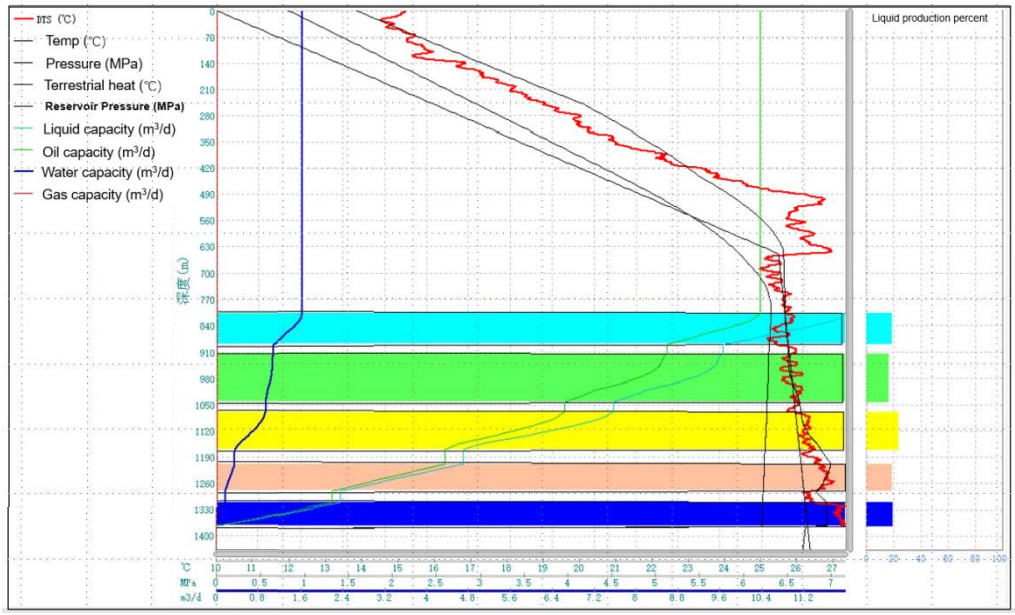
According to the pressure change of each well after gas injection & production, it judges the connection of each well, evaluates the gas diffusion and the secondary gas accumulated pattern.



Wellhole pressure and micro-seismic comprehensively analyze sketch map

4. Distributed stress sensing (DSS) monitoring for formation strain from multi-well, to analyze stress changes in work areas, provide early warning.

5. DTS+ DAS+ PT injection & production section, comprehensively analyzes the gas-liquid interface, and optimizes injection & production parameters.



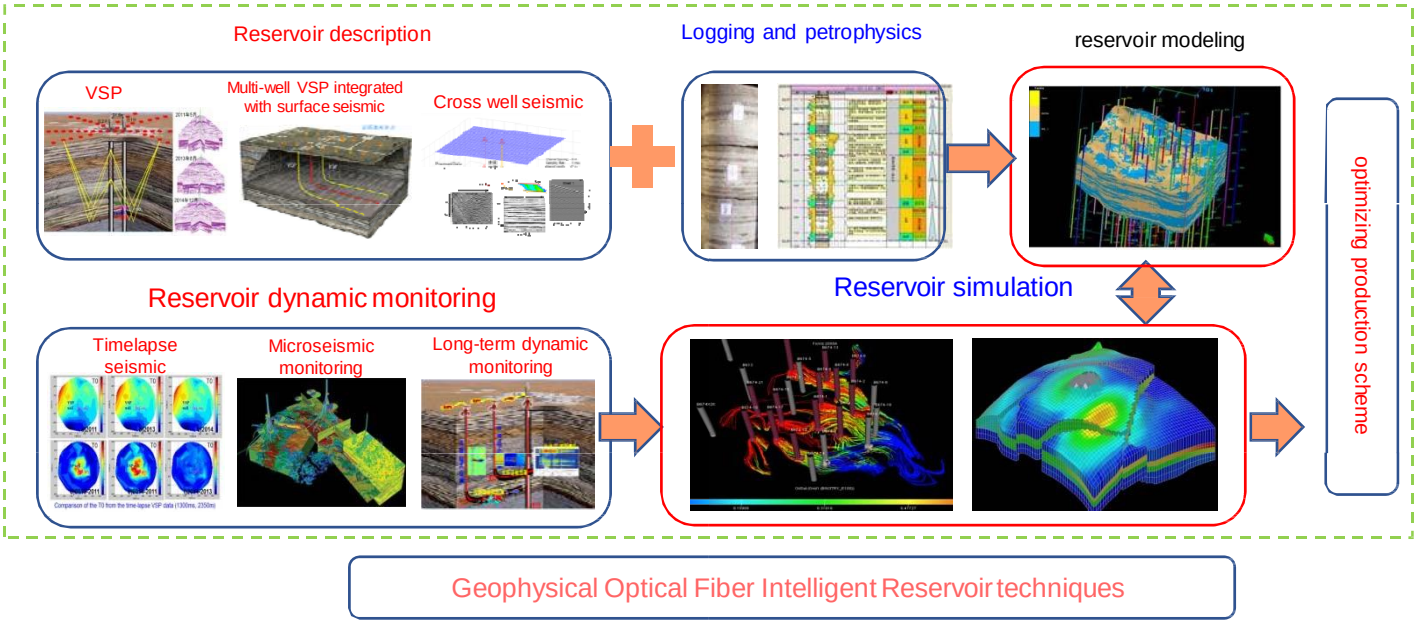
Pressure, temperature and injection & production parameters sketch map

Introduction to BGP's integrated borehole seismic services

1 Research & development

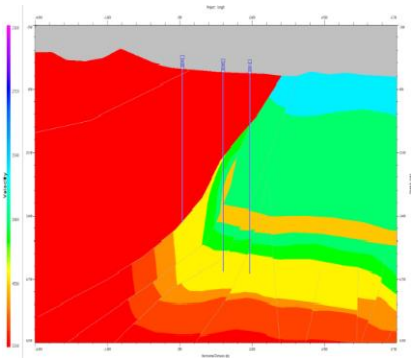
1. Techniques

BGP's borehole seismic integration service utilizes static descriptions and dynamic monitoring, integrates logging, petrophysics and reservoir modeling to achieve reservoir simulation and it provides a basis for finding remaining oil, enhancing oil recovery and optimizing production schemes.



1.2 Modeling demostration

Optimizing geometry of the VSP (DAS & conventional geophone), micro-seismic monitoring and DAS dynamic monitoring based on parameters demonstration through modeling, ray-tracing and inverting.



Geological model with weathered layer

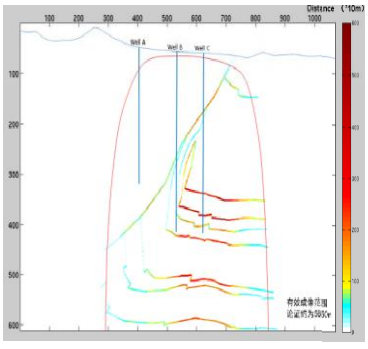
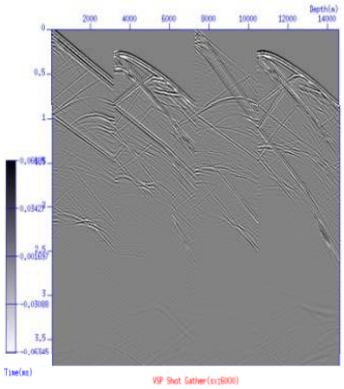
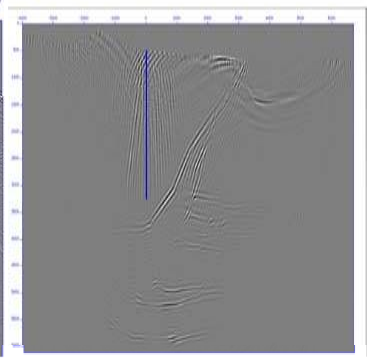


Image range and fold times



Modeling



Inversion RTM image

Introduction to BGP's integrated borehole seismic services

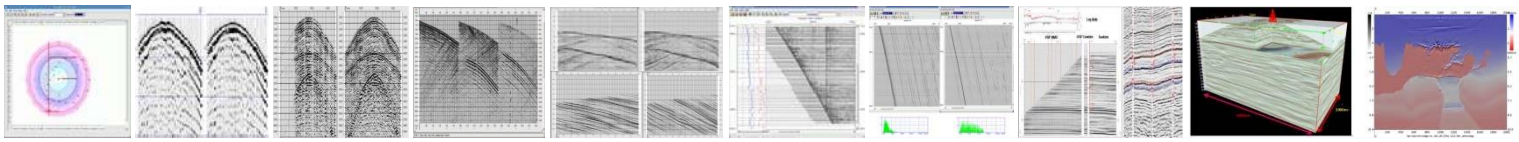
1 Research & development

1.3 Software development

BGP developed GeoEast VSP and GeoEast ESP software with independent intellectual property rights which is professionally qualified for VSP and micro-seismic monitoring data processing and interpretation.

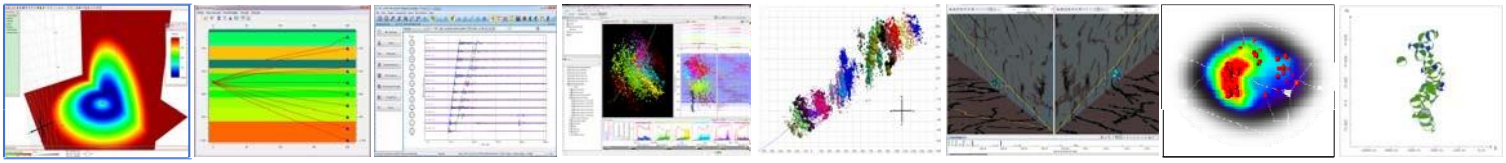
Integrated VSP data processing & interpretation system

Geo East-VSP



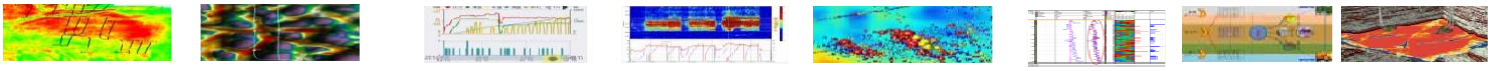
Integrated micro-seismic data processing & interpretation system

Geo East-ESP



Optical fiber-based integration of seismic geology & engineering

Geo East-SGE



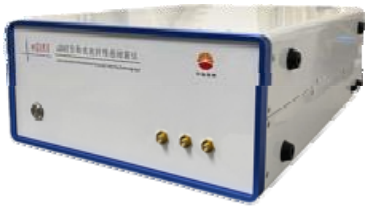
Introduction to BGP's integrated borehole seismic services

2 Equipment capability

BGP has successfully developed the 3rd generation advanced distributed optical fiber series instruments, named uDAS.

uDAS ® Conventional

uDAS®-FT



uDAS®-HD

BGP possess 3C conventional downhole tools which can adapt to different downhole pressures and temperatures.

Model: MaxiWave (3-Component)
Pressure rating: 1200 bars (17400psi)
Temperature rating:
135℃(275℉)operating

Model: Geochain SlimTM (3-Component)
Max outside diameter: 43mm (1" 11/16)

GeoWave 3C down-hole receivers 32 levels
20,000psi, 180 ℃

BGP possess different seismic sources, such as vibrator, air gun, and weight drop which can satisfy different surface conditions. BGP also has logging unit which are designed for VSP services.

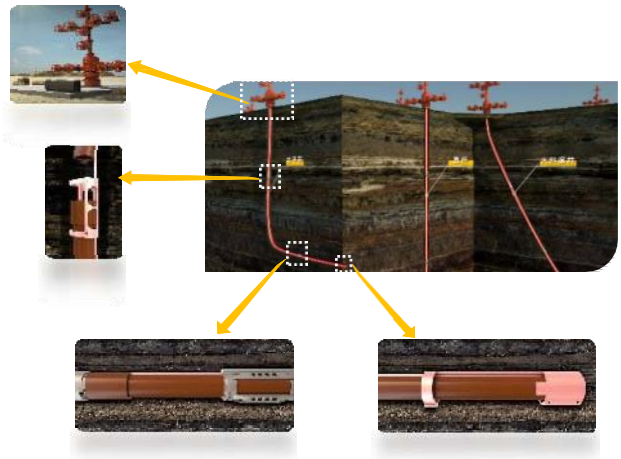
Vibrator

Air gun

Weight drop

Logging unit

BGP provides cable deployment and cable mapping services. BGP has recorded the deepest vertical well (5800 meters) and horizontal well (3630 meters) cable deployment in China, and 21 wells have been successfully installed.



Optical cable deployment (wellhead protection, device passing through the tubing collar, customized centralizer, cable tail end)

Introduction to BGP's integrated borehole seismic services

3 Operation experiences

BGP has provided integrated borehole seismic services for about 30 oil companies in China, and some overseas oil companies, such as PERTAMINA EP (Indonesia national oil corporation), CNPC INTERNATIONAL (Turkmenistan) LTD, CNPC INTERNATIONAL (CHAD) CO. LTD, CNPC NIGER PETROLEUM S.A. BGP has performed about 4000 well projects for VSP & micro-seismic monitoring and accumulated abundant operational experience. BGP has sufficient personnel and equipment to perform multiple projects at the same time.

3C geophone routine maintenance

VSP tool deployment

DAS VSP Worksite

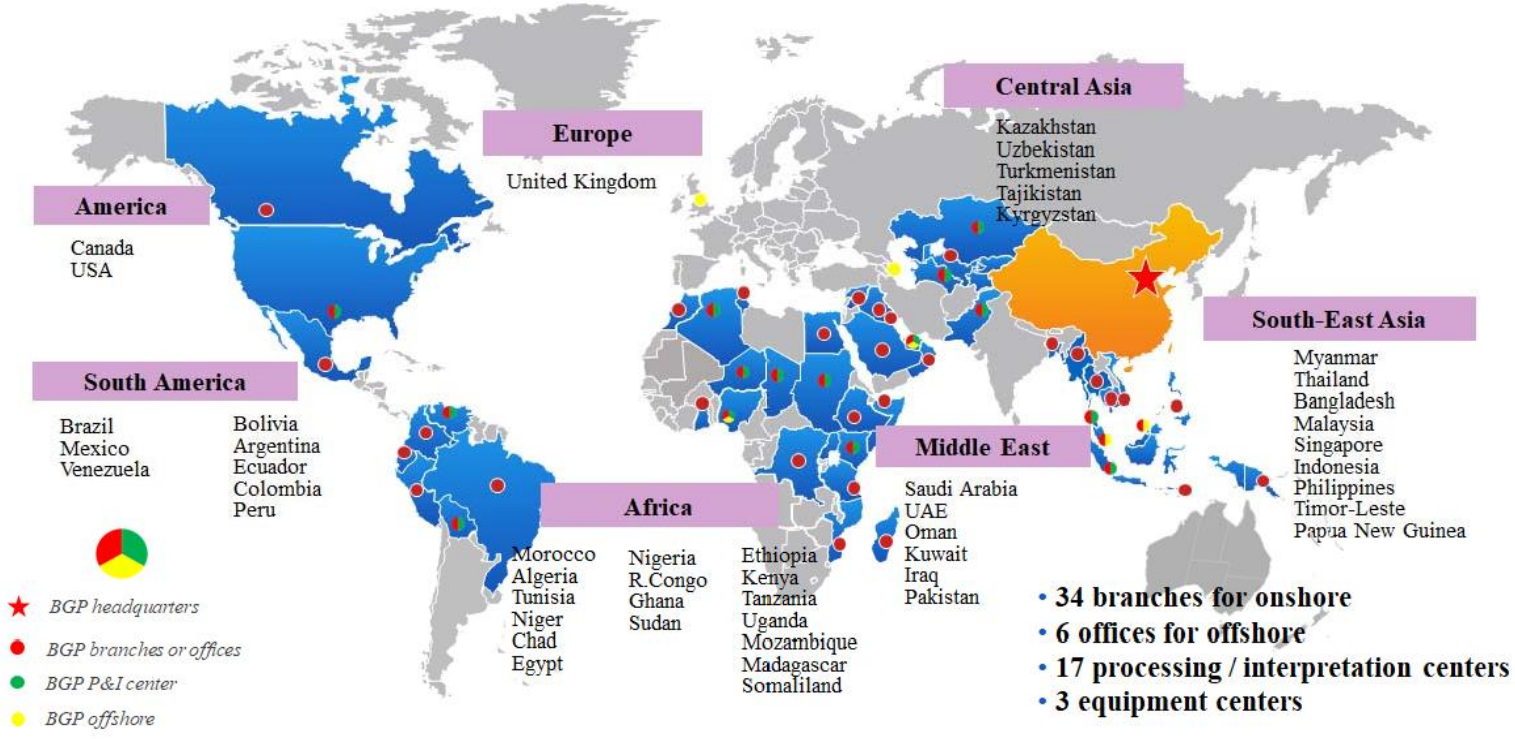
Fracturing microseismic monitoring

Wirch truck operation

Walkaway VSP source drilling

BGP overseas operations

BGP has forty (40) overseas branches which provides over 300 clients with onshore and offshore integration geophysical services, such as seismic acquisition, processing & interpretation and GME services. BGP's overseas branches can provide personnel, equipment and other local resources in support of VSP operations, to make its VSP operations successful with high efficiency and low cost.



Introduction to BGP's integrated borehole seismic services

4 QHSE management

BGP has always adhered to "Safety is our core value". BGP's HSE Management System has been established since the early 1990 based on relevant OGP standards and IAGC guidelines. The HSE Management System (HSE-MS) is updated annually to include best practices in the geophysical industry.

According to the ISO9001 standard, BGP has established a quality management system which consists of operational standards and work procedures for borehole seismic services.


CONFORMITY CERTIFICATE OF
CNPC HSE MANAGEMENT SYSTEMS
Registration No. HSE190010R5L
This is to certify that the HSE system of
BGP Inc. China National Petroleum Corporation
Unified social credit code:91130000710926983Y
Has been assessed and found to be in conformity with the requirements of
Q/SY1002.1-2013 and SY/T6276-2014
The scope covered by the system is
The sites covered by the system refer to annex
Beijing CNPC Audit Company Limited
Room A-708, Building No. 1, Yard No. 1, Huanghe North Street,
Shahe Town, Changping District, Beijing
Initial certification Date: Dec 31,2003
Modifying Date: Feb 01,2019
Expiry Date: Feb 01,2022
General Manager:


OCCUPATIONAL HEALTH & SAFETY MANAGEMENT
SYSTEM (OHSMS) CERTIFICATE
Registration No. 06819S20005R5L
This is to certify that the Occupational Health & Safety Management System of
BGP Inc. China National Petroleum Corporation
Unified social credit code:91130000710926983Y
Has been assessed and found to be in conformity with the requirements of
GB/T28001-2011(OHSAS18001:2007,IDT)
The scope covered by the system is
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Expiry Date: Feb 01,2022
Beijing CNPC Audit Company Limited
Room A-708, Building No. 1, Yard No. 1,
Huanghe North Street, Shahe Town,
Changping District, Beijing
General Manager:
CNAS
MANAGEMENT SYSTEM
CNAS C068-M

H_2S leakage drill

Medvac drill

Security training

Operation at wellsite

Teachnology- uDAS®

Introduction:

The uDAS® realizes continuous and accurate measurement of the acoustic wave/vibration signal at each position in the laying direction of the sensing fiber by demodulating the phase change of the Rayleigh scattering interference light signal in the fiber. Through independent and original research, uDAS has solved a series of key technical problems in the new generation seismic/acoustic sensing. It realizes a new generation of fiber-optic distributed sensing geophone technology with ultra-high acquisition density, ultra-high resolution, ultra-high dynamic range, and ultra-low frequency response characteristics. The uDAS® has become the replacement product of the core seismic equipment in CNPC, reaching the international leading level.

The uDAS® was successfully selected as one of the "Top 10 Scientific and Technological Advances of CNPC in 2019", which is the landmark product of CNPC released internationally in 2019. In 2021, the uDAS® appeared in the national 13th Five-Year Science and Technology Innovation Achievement Exhibition. In 2022, the uDAS® won the First Prize of Technological Invention of the Chinese Society of Optical Engineering. The uDAS® has been widely applied in all oilfields of CNPC, and has large-scale promotion and application in Sinopec and CNOOC. It has opened a new era of high-precision borehole-surface joint three-dimensional exploration and reservoir development seismic, providing a key transformative technological means for "searching for oil and gas, increasing storage and producing", which runs through the whole life cycle of oil and gas exploration and development.

Technical superiority (highlights):

- High spatial resolution, high sampling density, high sensitivity, long working distance;
- High-fidelity restoration of acoustic wave/vibration signal;
- It can be operated in special well conditions such as high temperature and high pressure wells and ultra-deep wells;
- The measurement interval is continuously adjustable;
- Support continuous acquisition, interval acquisition, trigger acquisition and other data acquisition modes;
- The sensor is resistant to electromagnetic interference, electrical insulation, corrosion resistance, and can be used in harsh environments such as flammable and explosive.

Application Scope:

- Full life cycle services in the field of oil and gas exploration and development;
- Distributed optical fiber hydrophone field;
- Distribution monitoring of structural defects in large infrastructure buildings such as dams, river embankments, bridges, etc.;
- Partial discharge monitoring of power cable lines;
- Security applications are applied to the perimeter intrusion warning of sensitive places such as airports, border lines, prisons, military bases, etc.

uDAS-2.3

Teachnology- uDTS®

Introduction:

The uDTS® (distributed optical fiber temperature measurement system) is a system that uses optical fiber as a sensing element and signal transmission medium to realize real-time temperature measurement in space. The uDTS® uses the principle of backward Raman scattering to obtain temperature information, and realizes precise positioning based on optical time domain reflectometry. Combined with optical loss compensation algorithm and temperature automatic calibration design, it can continuously measure the temperature of each position in the laying direction of the sensing fiber, with good performance indicators and system stability.

The uDTS® is equipped with a special user-friendly software interface, providing real-time data acquisition, visualization, and zone temperature alarms. Compared with traditional temperature sensors, uDTS® has the advantages of essentially passive, explosion-proof, anti-corrosion, anti-electromagnetic interference, and long-distance measurement. The uDTS® is widely used in large infrastructure temperature distribution monitoring, tunnel fire warning, oil tank pipeline temperature measurement, oil and gas well exploration, power grid cable monitoring and other fields.

Technical superiority (highlights):

- The system comes with automatic calibration function;
- High spatial resolution, high temperature resolution and high temperature accuracy;
- The measurement interval is continuously adjustable;
- Accurately locate abnormal temperature points and fiber fault points;
- The optical fiber sensor is anti-electromagnetic interference, electrical insulation, corrosion resistance, intrinsically safe, and can be used for flammable and explosive.

Application Scope:

- Temperature distribution monitoring of large infrastructure buildings such as dams, river embankments, bridges, etc.;
- Leak monitoring and positioning of oil tanks and oil and gas pipelines;
- Oil and gas downhole temperature profile measurement;
- Power cable equipment safety monitoring, long-distance transmission line temperature monitoring;
- Temperature monitoring and fire warning of traffic routes such as highways, tunnels, and subways.

uDTS