

HYDROCARBON EXPLORATION VECTORIAL ANALYSIS



OVERVIEW

The technology is an advanced method for hydrocarbon exploration that utilizes the detection and vector analysis of low-frequency microseismic emissions. Specifically, it focuses on analyzing the full three-dimensional (3D) microseismic fields generated naturally by the Earth's subsurface activities. This method leverages the phenomenon that hydrocarbon reservoirs emit distinctive low-frequency seismic waves, typically in the range of 2 to 5 Hz. By capturing and analyzing these emissions, geoscientists can identify and characterize potential oil and gas deposits without the need for traditional active seismic sources.



PURPOSE AND OBJECTIVES

Hydrocarbon Detection: the primary purpose of this technology is to directly detect the presence of hydrocarbons (oil and gas) under the surface. It provides a means to locate reservoirs by identifying anomalies in the natural microseismic background noise.

Reservoir Characterization: beyond mere detection, the technology aims to characterize the identified reservoirs. This includes determining the type of hydrocarbons present (oil vs. gas), estimating reserves, and understanding the structure and extent of the reservoirs.

Risk Reduction in Exploration: by providing direct indicators of hydrocarbon presence, the technology reduces the risk associated with drilling dry wells. It enhances the decision-making process in exploration by supplying more accurate subsurface information.

Cost Efficiency: the method is designed to be more cost-effective than traditional seismic exploration techniques. It requires fewer resources, less equipment, and can be conducted more rapidly, leading to significant cost savings.

EXPLORATION IN CHALLENGING ENVIRONMENTS

Complex Geology: The technology is particularly useful in areas with complex geological settings, such as regions with salt domes, faulted strata, or heavy tectonic activity, where traditional seismic methods may be less effective.

ONSHORE AND OFFSHORE SURVEYS

Versatility: It can be applied both on land and at sea, making it suitable for a wide range of exploration scenarios.

RESOURCE ESTIMATION

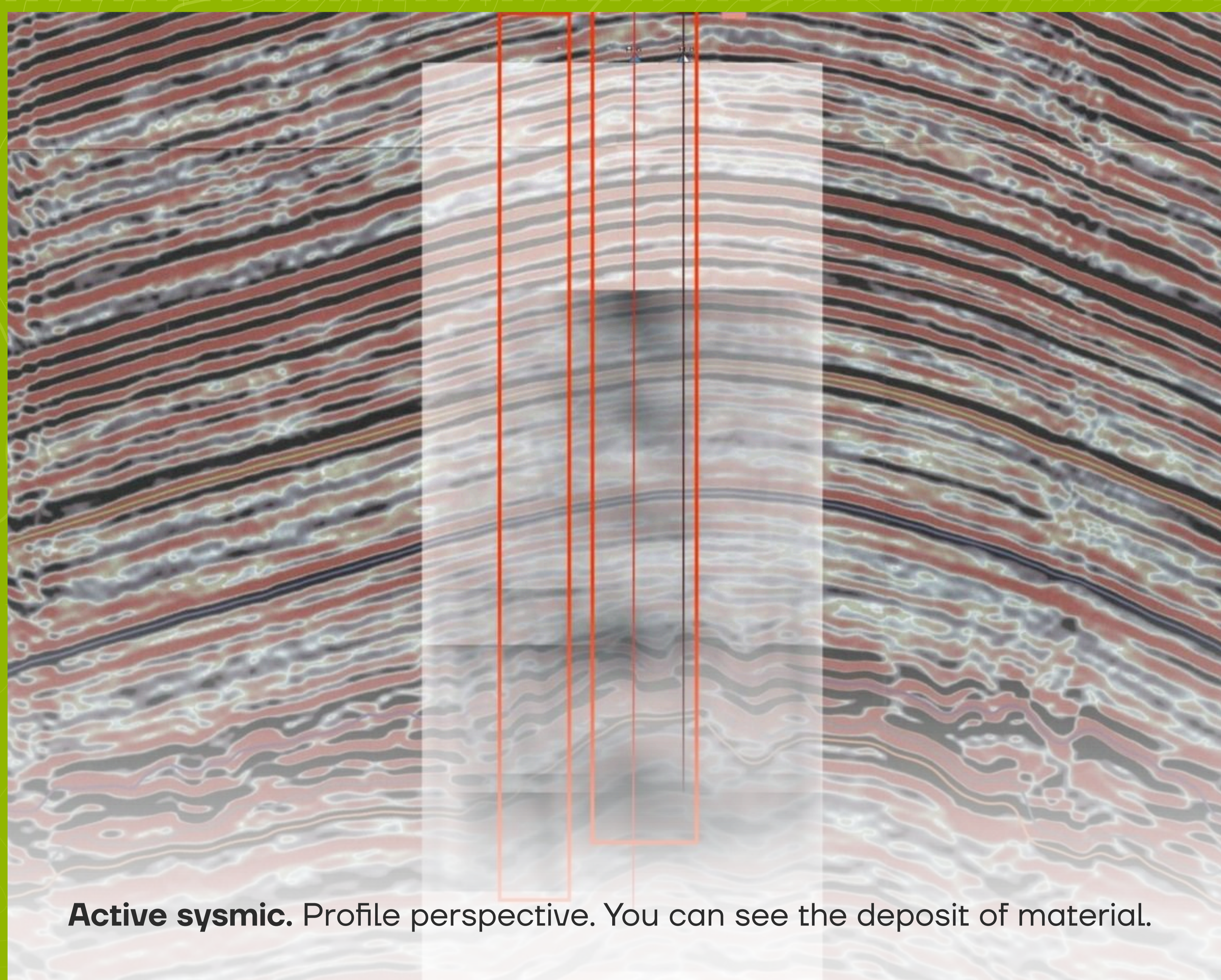
By analyzing the intensity and extent of the seismic anomalies, estimations of hydrocarbon reserves can be made, aiding in the assessment of a field's economic potential.

MONITORING AND APPRAISAL

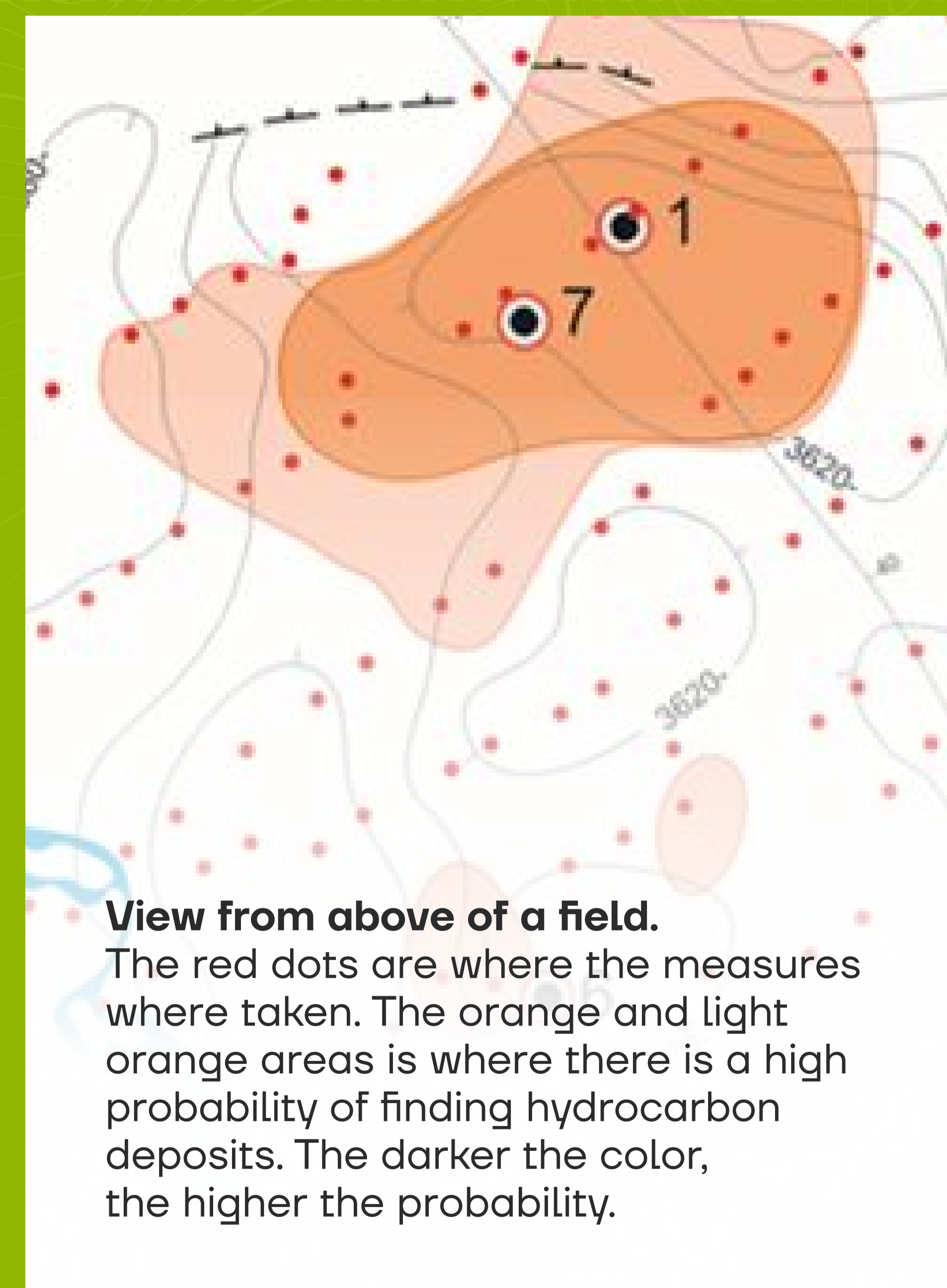
Field Development: The method can be used during the appraisal and development phases to monitor reservoir changes over time, optimizing production strategies.



EXAMPLE



Active seismic. Profile perspective. You can see the deposit of material.



View from above of a field. The red dots are where the measures were taken. The orange and light orange areas are where there is a high probability of finding hydrocarbon deposits. The darker the color, the higher the probability.

ADVANTAGES OVER TRADITIONAL METHODS

1. HIGH COST-EFFECTIVENESS

Direct Detection: Because it provides direct indications of hydrocarbons, increases the confidence in drilling decisions. Our accuracy in detection of Hydrocarbon reserves is around 85%.

Reduced Dry Wells: By improving the accuracy of reservoir identification, the likelihood of drilling non-productive wells is decreased.

Reduced Survey Time: The limited equipment needed to make the survey allows a fast deployment in the field. This combined with a tried data acquisition procedure, leads to shorter project timelines.

2. MINIMAL ENVIRONMENTAL IMPACT

Minimal Disturbance: The passive nature of the technology utilized means there is less environmental impact, as it avoids the need for explosives or heavy machinery.

Regulatory Compliance: Easier to obtain permits in environmentally sensitive areas due to the non-invasive approach.

TECHNICAL DETAIL

EQUIPMENT USED:

- Three-Component Geophones (e.g., LE-3DLITE, A0531): Sensitive instruments capable of detecting low-frequency seismic waves.
- Data Acquisition Systems (DAQ): High-resolution systems that digitize and record the seismic data from the geophones.

DATA ACQUISITION STRATEGY:

- Sensor Deployment: Geophones are strategically placed across the survey area, typically with spacing of 1000 meters between stations.
- Recording Sessions: Each recording session lasts between 45 to 60 minutes, capturing the natural microseismic background.

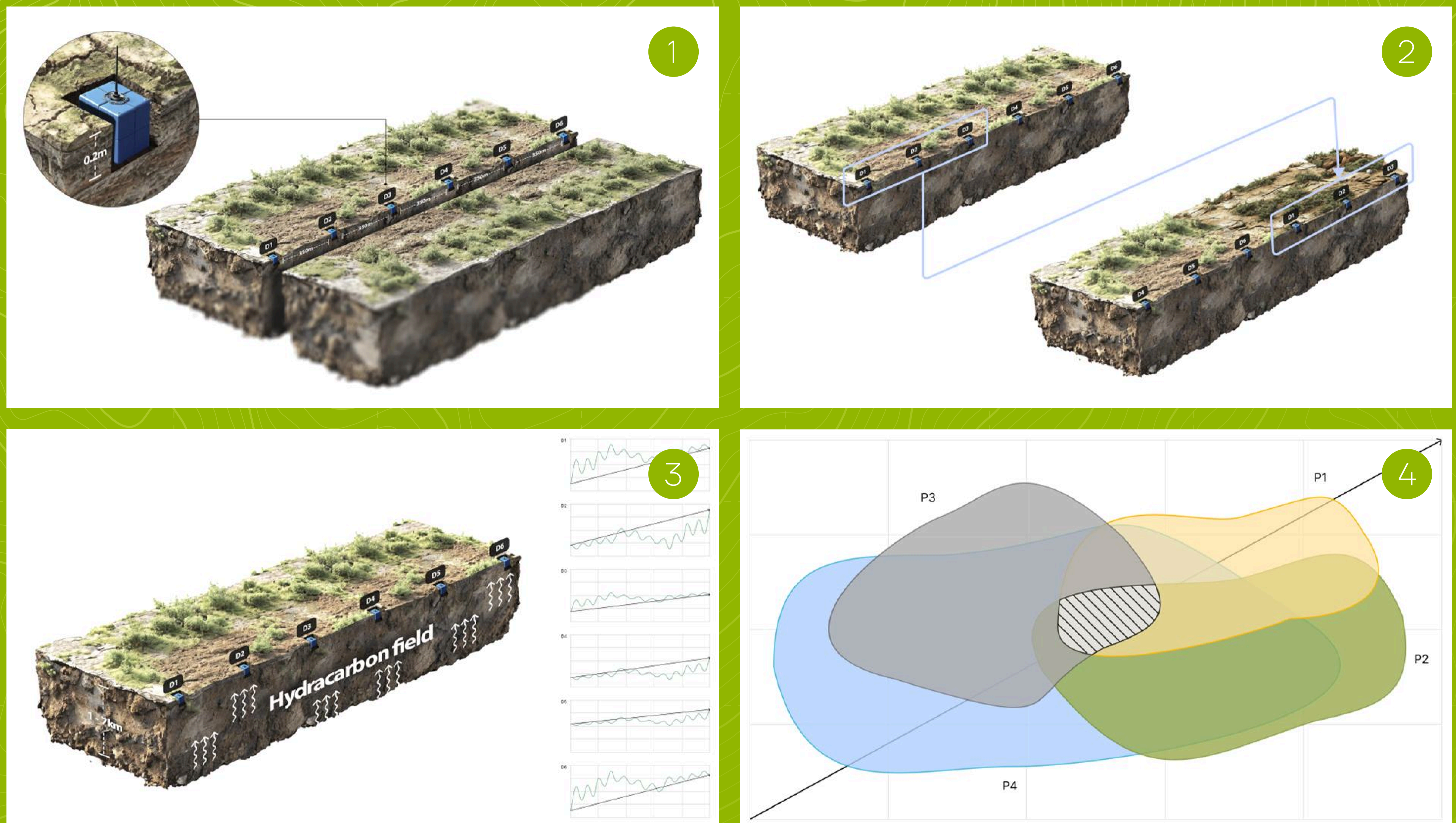
DATA PROCESSING TECHNIQUES:

- Noise Reduction: Environmental noise (e.g., wind, traffic, wildlife) is filtered out to enhance the quality of the seismic signals.
- Vector Analysis: The 3D nature of the data allows for the determination of wave propagation directions, aiding in the localization of anomalies.
- Anomaly Identification: Statistical and spectral analyses are performed to detect anomalies associated with hydrocarbon presence.



TYPICAL PROCEDURE FOR CONDUCTING A POC

The trial aims to demonstrate the effectiveness of using low-frequency seismic sensors for hydrocarbon exploration over a 9 square kilometer (km²) area. The procedure involves deploying two active sensors as a pair and having a third sensor as a backup. The core principles focus on efficient data acquisition, processing, and interpretation to identify potential hydrocarbon anomalies.



1. PREPARATION PHASE

■ SURVEY DESIGN:

Objective Identification: Use existing geological data to pinpoint areas within the 9 km² that are most likely to contain hydrocarbons.

■ SENSOR PLACEMENT STRATEGY:

Initial Placement: Deploy the two active sensors as a pair, positioning them approximately 1 kilometer apart. This spacing optimizes the detection of low-frequency microseismic emissions across the entire survey area by ensuring broad coverage and minimizing blind spots.

■ GRID COVERAGE THROUGH SENSOR RELOCATION:

Systematic Movement: After each recording session, relocate the pair of active sensors by 250–300 meters in a predetermined pattern (e.g., grid or zigzag) to systematically cover the entire 9 km² area. This step-wise movement allows the limited number of sensors to effectively map the full grid by overlapping coverage zones and ensuring comprehensive data acquisition.

EQUIPMENT CALIBRATION:

Calibration Tests: Ensure all three sensors are calibrated and functioning correctly by conducting express tests where sensors are placed together to verify consistent readings.

TEAM ASSEMBLY:

Personnel Involved: Geophysicist (1): Oversees the trial, data interpretation, and reporting. Technicians (1–2): Handle equipment setup, data acquisition, and field logistics.

Training and Safety Briefing: Team members receive instruction on equipment operation and safety protocols.

2. FIELD DEPLOYMENT PHASE

SENSOR INSTALLATION:

Deployment: Install the two active sensors at the first set of predetermined locations, ensuring secure ground contact for optimal data quality.

Backup Sensor Readiness: Keep the third sensor prepared to replace any malfunctioning sensor immediately.

DATA ACQUISITION:

Recording Sessions: Collect seismic data at each location for 45–60 minutes to capture sufficient microseismic activity.

Relocation: Move the sensors systematically to new locations to cover the survey area effectively.

Environmental Logging: Record environmental conditions (e.g., wind, nearby machinery) that might affect data quality.

REAL-TIME MONITORING:

Data Quality Checks: Use a laptop to monitor incoming data and ensure recordings are free from significant noise or errors.

Issue Resolution: Address any equipment malfunctions or environmental interferences promptly.

4. FIELD DEPLOYMENT PHASE

RESULTS COMPILATION:

Report Preparation: Summarize methodologies, findings, and interpretations in a comprehensive report.

Maps and Data: Include visual representations of anomalies and sensor locations.

STAKEHOLDER PRESENTATION:

Findings Presentation: Share results, explaining the implications for hydrocarbon exploration.

Recommendations: Provide suggestions for further exploration or investigation based on the findings.

3. DATA PROCESSING PHASE

DATA MANAGEMENT:

Secure Storage: Transfer collected data to secure storage devices and maintain backups.

DATA ANALYSIS:

Noise Filtering: Apply filters to isolate the 2–5 Hz frequency range associated with hydrocarbon emissions.

Vector Analysis: Perform three-dimensional analysis of the seismic data to detect directional patterns indicative of hydrocarbons.

ANOMALY MAPPING:

Visualization: Create maps highlighting areas with significant low-frequency anomalies.

Interpretation: Analyze these anomalies in the context of geological information to assess their potential as hydrocarbon indicators.

