

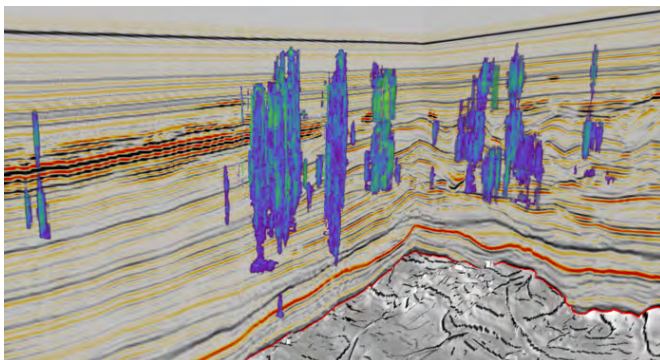
Shallow geohazard assessments: firm foundations for future operations

Shallow hazard assessments are a critical, but often overlooked stage in the well-planning process. While this activity comes with its own set of challenges, the advantages of getting this right for safe, successful oil and gas operations cannot be overstated.

What are shallow hazard assessments?

Shallow hazard assessments identify and map all types of top-hole geohazards. The top hole is the first section of a well, nominally from seabed to a depth of 1,000m. Shallow hazards include aspects of the seabed and sub-surface that are challenging or dangerous. These need to be fully considered when planning any well, covering activities from rig emplacement to drilling operations, generally before installing a blow-out preventer (BOP).

Assessments are primarily completed by analysing high resolution geophysical and geotechnical datasets from offshore site surveys or by using 3D seismic data. Advanced analysis is possible by bringing such data together, delivering a more comprehensive assessment.



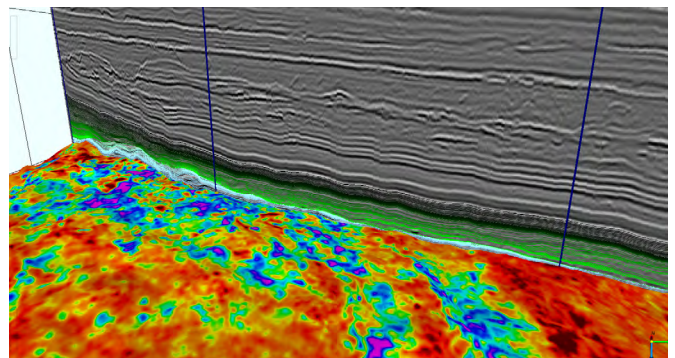
A 3D view for the bigger picture: Neural-network calculated gas chimneys and fault patterns, helping to understand the connection between faulting and migration of gas-to-shallow reservoirs.

How they help

Shallow hazard assessments support oil and gas activities in numerous ways, including:

- Applying for permits
- Optimising well locations
- Placing rigs and other seabed infrastructure
- Installing conductors
- Streamlining the top-hole drilling and casing process
- Protecting personnel and the environment from petroleum accidents.

The consequences of relying on a poor shallow hazard assessment can be serious. Risk to operations, life and business reputations are all heightened if major issues are encountered while drilling. We have also seen operators experience a jump in non-productive time, with associated costs. The economic viability of a well plan can even be thrown into doubt when shallow hazards are not interpreted or communicated effectively. In short, shallow hazard assessment is something to get right, first time around.



3D image showing seismic acoustic impedance inversion result.

Assessment challenges

There are three main challenges oil and gas operators face when commissioning shallow hazard assessments.

1. Time pressure and communications

Time is critical for reporting and, without sound management, operational and safety critical milestones can be missed. Consequently, deliverables could be rushed, with limited time resources to fully analyse data. Geohazards sometimes go unnoticed or are simply identified too late on in the project to efficiently reduce risks.

Clear communication is equally important. Well planning includes different disciplines, encompassing operations geologists, drillers and geophysicists. Reports are often written in a technical language that is unclear and ambiguous to those not familiar to this specialism. There are many instances where deliverables are misunderstood, introducing unnecessary drilling risks.

2. Lack of data integration and complementary skillsets

Survey contractor reporting can be limited and generalised, with little context in terms of geological background. This results in an assessment that not only lacks valuable regional context, but is inaccurate when seen alongside all relevant data insights.

This needn't be the case as operators typically have extensive datasets. Useful information to hand includes offset well logs and reports, 3D seismic data, other legacy site survey findings, and geotechnical or environmental data. All of these elements are crucial for understanding geology and geohazard characterisation.

Additionally, shallow hazard assessments require a multi-disciplinary team, capable of working together to make links between geoscience, geophysics and engineering. Without this combined expertise, assessments will always be limited.

3. Lack of advanced 3D analysis

Most assessments are performed using 2-dimensional techniques, forgetting the advantages of more complex seismic analysis in the 3D environment. This means that geohazards are often not fully characterised or missed entirely, and there is insufficient sub-surface understanding to mitigate well-planning risks.

Checklist for shallow hazard assessments

For any well, in any water depth, in any country and situation, we recommend the following process.

- Start with a risk-based strategy.
- Insist on industry standards as a minimum, such as those of the International Association of Oil & gas Producers (IOGP).
- Focus on early engagement in the well-planning life-cycle.
- Use multi-disciplinary teams.
- Make the most of leading technology to characterise geohazards, mitigate top-hole drilling and foundation risks and guide engineering design.

Main assessment components

The exact approach will depend on the planned rig type and water depth. These factors will determine if a site survey or data re-processing is the best solution. From our 40-year experience of supporting operators with shallow hazard assessments, the following steps should typically be incorporated into a project.

Integration and regional/preliminary assessment

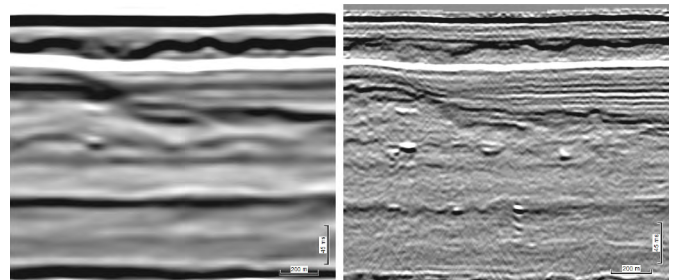
Client supplied and relevant public data are integrated to gain an understanding of the geological and geohazard complexities within a licence block. Combining 3D seismic data is key to fully understanding any site; these regional insights will shape more detailed analysis required at drilling locations.

Survey and assessment strategy

A data gap analysis is carried out, guiding site-survey design. This ensures all necessary data are acquired to allow clearance of the well and optimise the approach – delivering the most cost-effective solution. This process can be extended to cover the project's full exploration, development and production lifecycle.

Data re-processing

Advanced re-processing of seismic data using the latest 3D technologies to enhance the resolution within top-hole depths can save money on further site surveys, while delivering enhanced results. Re-processing often leads to improved data quality and fidelity, optimising seismic interpretations.



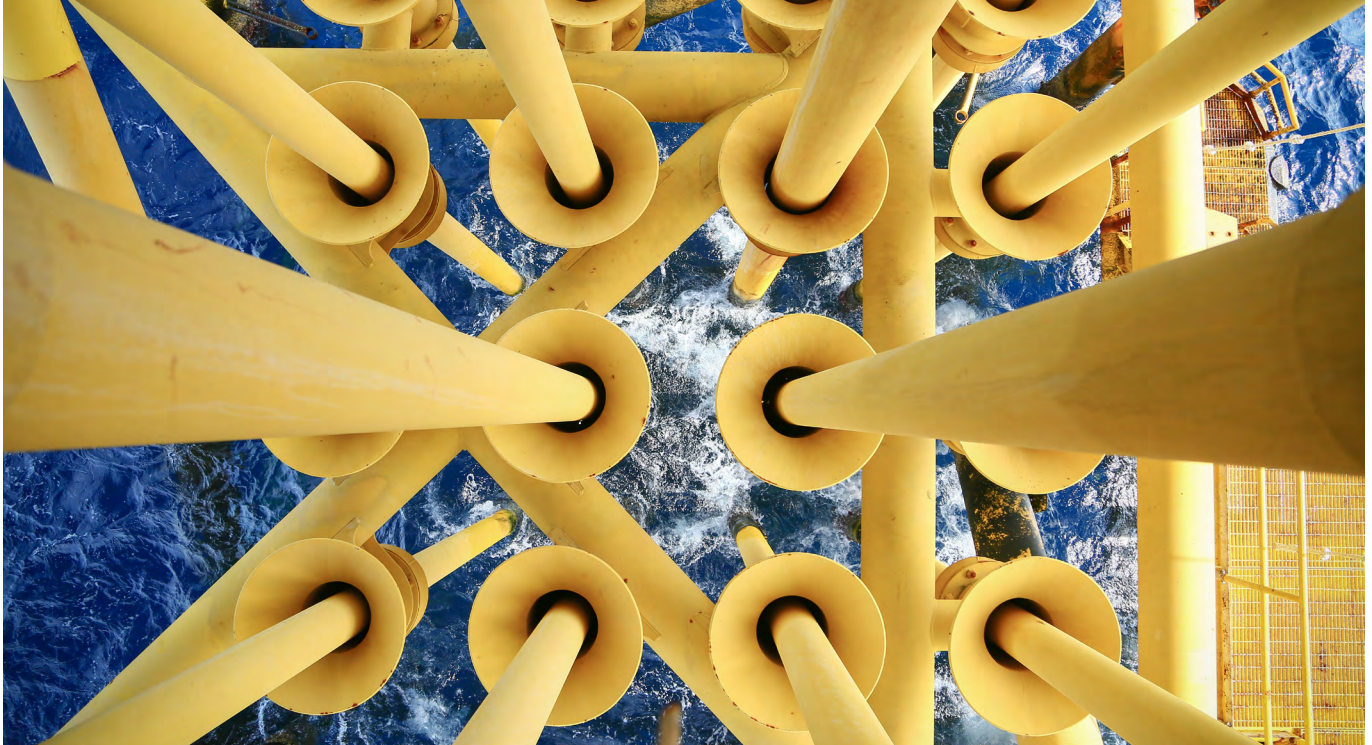
Enhanced resolution; enhanced results: Original 3D exploration seismic image (left) compared with the re-processed, high-resolution version (right).

Detailed shallow hazard assessment

The assessment can then be completed at the proposed well location. All information from the latest survey/re-processing results and geotechnical investigations should be integrated, along with details on the proposed well plan and rig. It is important that results are communicated clearly for all end-users. Regular client meetings and technical workshops should be included.

Today's challenges: How advanced capabilities are helping

No operator wants to face serious issues once drilling begins. Innovative, technical workflows are instrumental in helping to prevent such unwanted circumstances, being designed to identify and characterise complex geology and geohazards. Adopted from the exploration and reservoir geophysics community, we find that such workflows help minimise uncertainty and support our clients' engineering decisions to reduce risks.



At a glance:

Leading assessment technologies and techniques

Amplitude variation with Offset (AVO)

A range of advanced AVO techniques help identify gas accumulations which represent a risk to drilling.

Seismic attribute analysis

Used to enhance seismic interpretation of geological features and geohazards, including spectral decomposition and structural attributes.

Seismic inversion techniques

Seismic inversion converts seismic reflections to layered earth models of rock-properties – critical for basic interpretation through to quantitative analysis.

Gas volumetric calculations and hydrocarbon overpressure estimations

Useful for assessing the risk of gas-influx to a well and its severity.

3D visualisation and geobody extraction

Helping clients better understand the sub-surface and the relationship between complex geological features and geohazards.

Why Vysus Group

Vysus Group Survey & Geoengineering provides comprehensive shallow hazard drilling assessments using the latest technologies and thinking. These are incorporated into a detailed risk assessment framework to inform well-planning decisions.
