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20

Improving efficiency, robustness and flexibility of 3D integrated drilling site surveys: A North Sea case study

P.E. Dhelie[1], C. Roalkvam[1], M. Halvorsen[1], T. Kluever[2], A. McKay[2], V. Hlebnikov[2]

[1] Aker BP; [2] TGS

Summary

Traditionally, site investigations have relied on high-density 2D grids of seismic lines or low-efficiency 3D high-resolution (3DHR) or ultra-high-resolution (3DUHR) volumes (typically 2 sources and 4 streamers). However, multiple potential well locations, and the need for rapid de risking of jack up foundations motivated a different approach for the prospects in the southern North Sea.

A fully integrated high-efficiency 3DHR/3DUHR seismic survey, acquired concurrently with multi-beam echo sounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP), and magnetometer (MAG) data, was selected and acquired in March 2026. The novel 3DHR/3DUHR concept was chosen to provide consistent spatial coverage, improved subsurface imaging continuity, and increased flexibility for well placements within the surveyed area.

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Introduction

Shallow hazard identification and well planning in mature, but operationally complex areas increasingly require acquisition solutions that balance data quality, operational efficiency, and flexibility over well placements.
Traditionally, site investigations have relied on high-density 2D grids of seismic lines or low-efficiency 3D high-resolution (3DHR) or ultra-high-resolution (3DUHR) volumes (typically 2 sources and 4 streamers). However, multiple potential well locations, and the need for rapid de-risking of jack-up foundations motivated a different approach for the prospects in the southern North Sea.
A fully integrated high-efficiency 3DHR/3DUHR seismic survey, acquired concurrently with multi-beam echo sounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP), and magnetometer (MAG) data, was selected and acquired in March 2026. The novel 3DHR/3DUHR concept was chosen to provide consistent spatial coverage, improved subsurface imaging continuity, and increased flexibility for well placements within the surveyed area.

The chosen acquisition solution was designed to improve operational efficiency with a sail-line spacing of 125 m (4 times larger than traditional site-survey solutions), reduce sensitivity to weather-related downtime using a modern, high-capacity acquisition fleet, and enable fast-track delivery of geohazard and geological interpretations. The resulting dataset supports both near-surface hazard assessment and broader geotechnical understanding, with consistent spatial coverage around the potential well location and future work in the area, offering advantages in planning certainty compared to conventional 2D-based site surveys.
This paper presents the rationale behind adopting a 3DHR/3DUHR site survey solution, describes the acquisition design and integrated sensor strategy, and discusses key operational experiences and early subsurface insights relevant to future high-res site survey projects.

Method

A fully integrated suite of sensors was deployed comprising high and ultra-high resolution 3D seismic, MBES, SSS, SBP and MAG. All measurements were acquired simultaneously. Figure 1 provides schematics of the acquisition configuration. The novel seismic layout was designed to simultaneously acquire 3DHR and 3DUHR data, both datasets largely compliant with International Association of Oil & Gas Producers™ (IOGP™) guidelines (IOGP, 2025). Data was recorded with 0.5 ms sampling interval. The setup consists of 15 streamers spaced 12.5 m, 13 with a length of 168.75 m and two extended to a length of 1050 m. Channel spacing for the first 36 channels was 1.5625 m and 3.125 m for the rest. Four air-gun sources were deployed with a crossline separation of 31.25 m. Each source had a volume of 180 cu.in. (2x90 cu.in. in a cluster). Source pop interval was 3.125 m, i.e., 12.5 m shot point interval per source. The source separation was chosen such that a sub-set of the CMP lines are nominally illuminated by two different source-streamer combinations, generating a natural crossline bin size of 3.125 m. This differs from the 1.5625 m bin size expected from 4 sources and 12.5 m streamer separation and is the main efficiency enabler. The layout generates 40 unique CMP lines covering 125 m. Coverage of the setup is nearly twice the water depth in the survey area. The long streamers were placed such that they, together with the four sources, generate eight unique CMP lines per sailline spaced 15.625m. These will be processed as 3DHR data volume down to a depth of about 1000 m below the seabed. The MBES and SSS data acquisition parameters were chosen to provide full coverage of the seabed. The MBES unit was mounted amidships, whilst the SSS was towed deep with the magnetometer towed behind the SSS in “piggy-back” fashion to provide total field magnetic data along profiles. The SBP unit was mounted on the vessel stern at a suitable distance from the vessel thrusters to avoid interference.

Results

At the time of writing, acquisition was just finished and processing of the various data had just started. The early and preliminary results shown in Figure 2 and Figure 3 illustrate that high quality data for shallow hazard analysis and site characterization has been acquired. Figure 2 shows a time slice just above the first order water-bottom multiple from an early iteration of the ultra-fast track processing after post-stack Kirchhoff time migration. Figure 3 shows structures at the seabed imaged with MBES, SSS, and MAG.

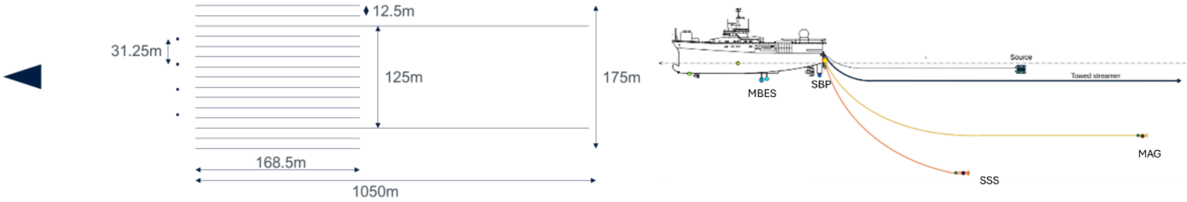

***Figure 1** Survey configuration: seismic layout (left) and placement of integrated sensors (right).*

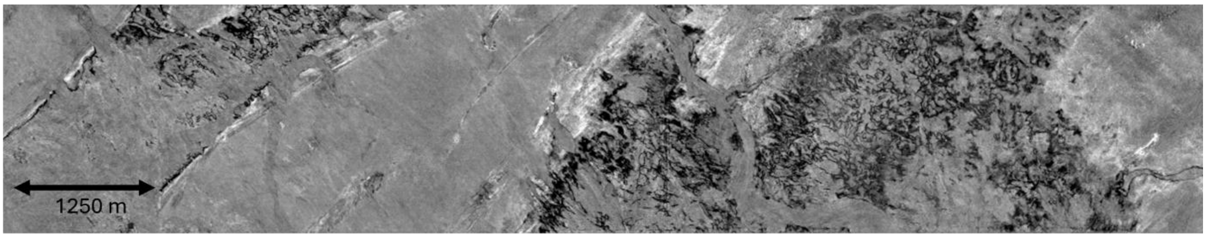

***Figure 2** Time slice at 170 ms through early iteration of ultra-fast track post-stack time migrated 3DUHR volume sampled 3.125 m x 3.125 m.*

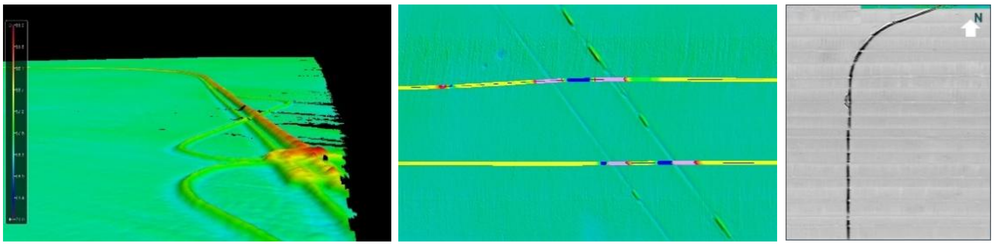

***Figure 3** MBES (left), MAG (middle), and SSS final mosaic (right) images of seafloor infrastructure.*

Conclusions

The integrated 3DHR/3DUHR and multi-sensor acquisition concept demonstrates a practical step-change in site-survey efficiency for mature, operationally complex North Sea settings. By increasing sail-line separation while preserving consistent spatial coverage, the approach accelerates delivery of geohazard and geological interpretations. Early results indicate high-quality subsurface imaging and complementary seafloor characterization from the concurrent sensor suite. Overall, the method provides greater flexibility for well placement and stronger planning certainty than conventional 2D-based site surveys, and is well suited for future integrated site investigation campaigns.

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References

IOGP [2025] Guidelines for the conduct of offshore drilling hazard site surveys. Report **373-18-1**.