Exploration in the Northern North Sea has been extremely successful, with important discoveries such as Statfjord in 1974, and Oseberg, Snorre, Gullfaks and Troll, discovered in 1979. More recently, several smaller but still very valuable discoveries have been made, demonstrating the remaining potential of the area. This has been achieved through further maturation of established plays, as well as the addition of new plays being identified and explored within different stratigraphic levels. Between 2014 and 2018 CGG undertook acquisition of a north–south 44,000 km² 3D broadband survey over the Northern Viking Graben, known as ‘NVG’. Recently, CGG has completed the first phase of a multi-year east–west acquisition project over the existing survey to generate a dual-azimuth (DAZ) volume. This initiative comes in response to industry demand for improved data quality and regional coverage, which will be particularly important going forward with the increased focus on near-field exploration and the hunt for less obvious targets.

This seismic line, from the PSDM processing of the original north–south NVG data, passes through a number of new discoveries in the Northern Viking Graben, such as Dugong, Echino South (Lower–Upper Jurassic), Gnomoria, Kallåsen, Syrah, Swisher, Grosbeak (Upper Jurassic) and Duva (Lower Cretaceous). Close-up examples of the Dugong and Duva discoveries are taken from other sections extracted from the NVG PSDM north–south data.

Norway: The North Sea Super Basin Story Continues

This map shows the location of the foldout line and the original north–south NVG survey (blue). The green polygon shows the location of the new east–west survey acquired in 2020.
After the 2013 Exploration Revived Conference in Bergen highlighted the need for improved data quality and regional seismic coverage in the Northern North Sea, CGG acquired the Northern Viking Graben (NVG) Brentfield 

‘minorseismic’ dataset in a north-south direction in seven phases (NVG and NVGS), from 2014–2018. This contiguous dataset enables numbers interpretation of the petroleum provinces and structural elements, from the West Voss area across the western Utsira High to the Northern Viking Graben. An example of the latest PSTM data can be seen in the west–east foldout. Several discoveries made in the Northern North Sea since the survey was acquired attest to the complexity of structure and acknowledge from the Norwegian Petroleum Directorate, attention to the impact of the dataset. With several of the producing fields having their lifecycle extended by 10–20 years there is a drive to develop additional resources. This, in combination with the recent success rate, suggests a continued high level of exploration and development in the area for many years to come. To assist this, CGG recently completed the first phase of acquisition of east–west new data over the existing NVG that, together with a complete reprocessing of the existing data, will create a dual-azimuth PSDM data. Several of the producing fields having their lifetime extended through detailed mapping of the trap elements. The Middle Jurassic Brent Group in the northern North Sea is a mappable with seismic multi-channel 3D deconvolution imaging and multiple images such as 3D source and receiver deghosting, and multi-channel 1D deconvolution imaging and multiple azimuths. Reprocessing of underlying data is also important to unlock the potential of the data. Beneath injectites and along complex structures such as remobilised chalk or the BCU, the triple-source (Cara) and Presto wells have tested the play more recently while others, such as Harben, are planned and other prospects are yet to be defined. The Petroleumsfondet Luton Formation Gullfaks field data shows how has been encountered at this level in the Zoels and Ring fields. Dual-azimuth data may help with regional mapping of this complex play. These sands, which have been identified within the Tampen area and on the eastern margin of the basin, require further investigation to mature the play further.

How a high quality seismic dataset can impact regional exploration in a mature basin.

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NVG: Igniting Exploration

 Developing Plays

Exploration in the Northern North Sea has a long history with several carboniferous and lower hydrocarbon plays present, yet many areas are still untested and exploration potential remains.

The Middle Jurassic Brent Group is an example of an established producing play building important reservoir rocks. Figure 1 highlights the fault complexity at the top Brent Group which hosts multi- directional fault systems. A fields such as leases, the entire Jurassic section is eroded and net present. The Upper Jurassic flood basins (Brent Group) on the southern flank of the Statfjord structure.

This is seen in Figure 2 comparing the NVG (north–south PSTM, double-azimuth) and the NVGS (north–south triple-source) data. Beneath the fields and along complex structures such as remobilised chalk at the BCU, the triple-source data shows fewer illumination issues and less operator noise. Beneath sheltering basins and under injectites, signal-to-noise ratio and resolution will benefit from more comprehensive imaging. This is seen in Figure 3 where combined with targeted dual-azimuth processing techniques, imaging beneath the basement and along complex faults can be achieved. The new dual-azimuth data volume should significantly improve seismic imaging of the Caro sands.

The Next Phase

CGG’s initiative to add a regional state-of-the-art dataset in the northern North Sea will together with a complete reprocessing of the existing data, will create a dual-azimuth PSDM data. Several of the producing fields having their lifetime extended through detailed mapping of the trap elements. The Middle Jurassic Brent Group in the northern North Sea is an important reservoir rocks. Figure 1 highlights the fault complexity at the top Brent Group which hosts multi-directional fault systems. A fields such as leases, the entire Jurassic section is eroded and net present. The Upper Jurassic flood basins (Brent Group) on the southern flank of the Statfjord structure.

Figure 2: Arbitrary seismic section from the north–south NVG PSDM through Liatårnet, showing clear brightening at top reservoir and the approximate extent of the discovery.

Figure 3: Arbitrary seismic section from the north–south NVG PSDM through Liatårnet, showing the approximate extent of the discovery. This is seen in Figure 2 comparing the NVG (north–south PSTM, double-azimuth) and the NVGS (north–south triple-source) data. Beneath the fields and along complex structures such as remobilised chalk at the BCU, the triple-source data shows fewer illumination issues and less operator noise. Beneath sheltering basins and under injectites, signal-to-noise ratio and resolution will benefit from more comprehensive imaging. This is seen in Figure 3 where combined with targeted dual-azimuth processing techniques, imaging beneath the basement and along complex faults can be achieved. The new dual-azimuth data volume should significantly improve seismic imaging of the Caro sands.

The Paleocene Lista Formation is a significant play and regional trend. Recent discoveries, such as Oljevar, have tested the importance for unlocking the potential of this play.

One of the most recent exciting oil discoveries in the Northern North Sea is Liatårnet (2018), which partial pool in the Statfjorden Structure with an approximate well plan for 2021. The new CO2Ferring sands commonly being the main producing interval within the Caro, the structures remain an area of intense interest in the northern North Sea with the hope for new discoveries and further development of the area.