Dual-azimuth depth imaging of marine surveys over Fenja Field

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Introduction

The Fenja Field is located on the southern Halten Terrace, close to the Vingleia Fault Complex and the Frøya High. It lies within a subcrop/structural trap. The reservoirs are Upper Jurassic sandstones in the Vingleia Fault hangingwall and on the Klakk Fault footwall.

Two datasets with different marine acquisition parameters are available for this project – a conventional PGS survey from 2007 and a Geo-streamer PGS survey from 2015. They both have different shooting directions. Both surveys have been previously pre-processed using a conventional processing sequence. Although the quality of the surveys is good, improvement would be expected from the combination of the two surveys.

The main objective of this project was to improve the seismic definition of the Jurassic sandstone section and achieve a better understanding of the reservoir and the trap for planning production wells. In addition, the new image aimed to improve definition of near-field exploration targets against the Vingleia Fault.

The new workflow included advanced multi-azimuth depth processing as well as multi-azimuth velocity model building, reflection and diffraction imaging.

Seismic data challenges

In 2012, a standard PSDM processing project was undertaken over the PL586 exploration license. Input data came from conventional streamer data acquired in 2007. This dataset was used in the first exploration drilling campaign, which resulted in the discovery of the Fenja field.

For a better understanding of the discovery and the upside potential, in 2015 it was decided to use a new dataset that could increase the bandwidth. The velocity model was redefined using geo-statistical extrapolation of the sonic logs based on the existing structural model. It was then updated using a number of iterations of grid based tomography and followed by a Kirchhoff TTI migration. Non-hyperbolic picking was used for RMO analysis and tomography (Jones, 2010). The next step was velocity scanning around the fault to check for possible improvement of the image in this area. It was found that bulk changes in anisotropy helped enhance the image in the target area next to the fault. This processing workflow significantly improved the imaging of the Vingleia fault itself, but not areas surrounding it. The dataset was used in targeting wells during the second exploration drilling campaign, where three wells were drilled. The PSDM dataset predicted the BCU with less than 10 meters depth error. New wells discovered more complex geology south west of field. They also showed a large shale body above Fenja reservoir, which was previously interpreted as sand.

In 2018 the Fenja development project was sanctioned. Reprocessing from 2015 has not resolved all the challenges, specifically in the areas near Vingela fault. To integrate new available well information and improve these areas it was decided to reprocess both seismic datasets from demultiple shots. The processing sequence included deghosting of conventional data, noise removal via enhanced LIFT technology, velocity scans to define the shape of the shale body discovered during the previous drilling campaign, velocity update with multi-azimuth tomography and Common Reflection Angle domain Migration/CRAM and ES360 (Koren Zvi, 2008, 2011). This generated reflection (figure 1) and diffraction images (figure 2) over the Fenja field.

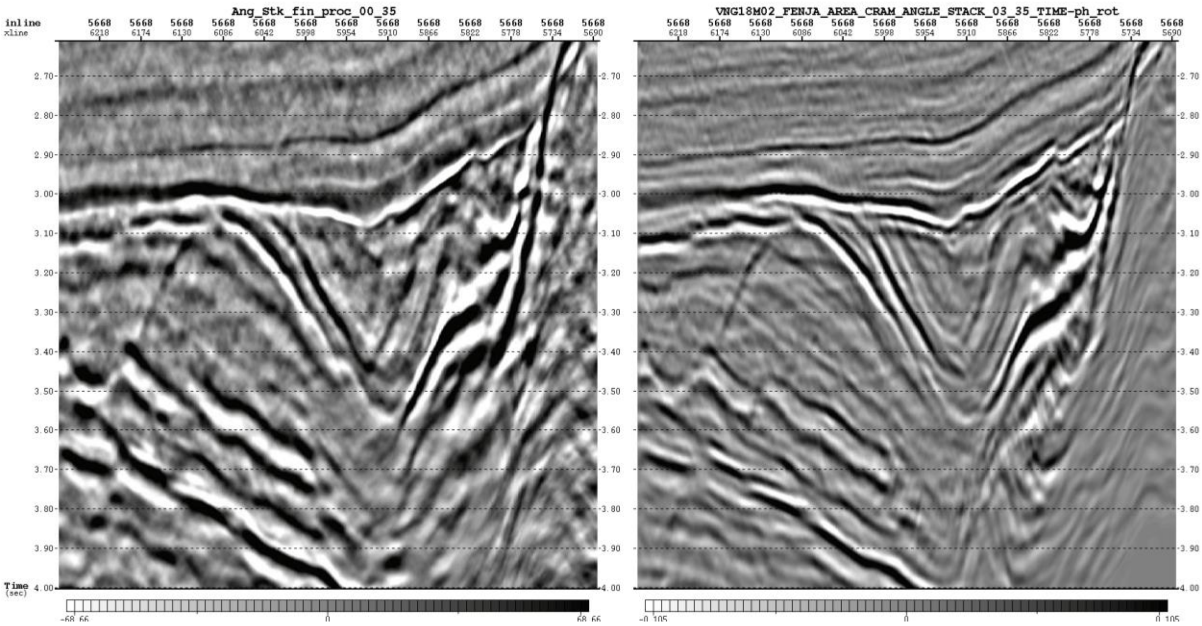

Figure 1. KPSDM reprocessing from 2015 vs multi-azimuth Q-CRAM from 2018 in Time

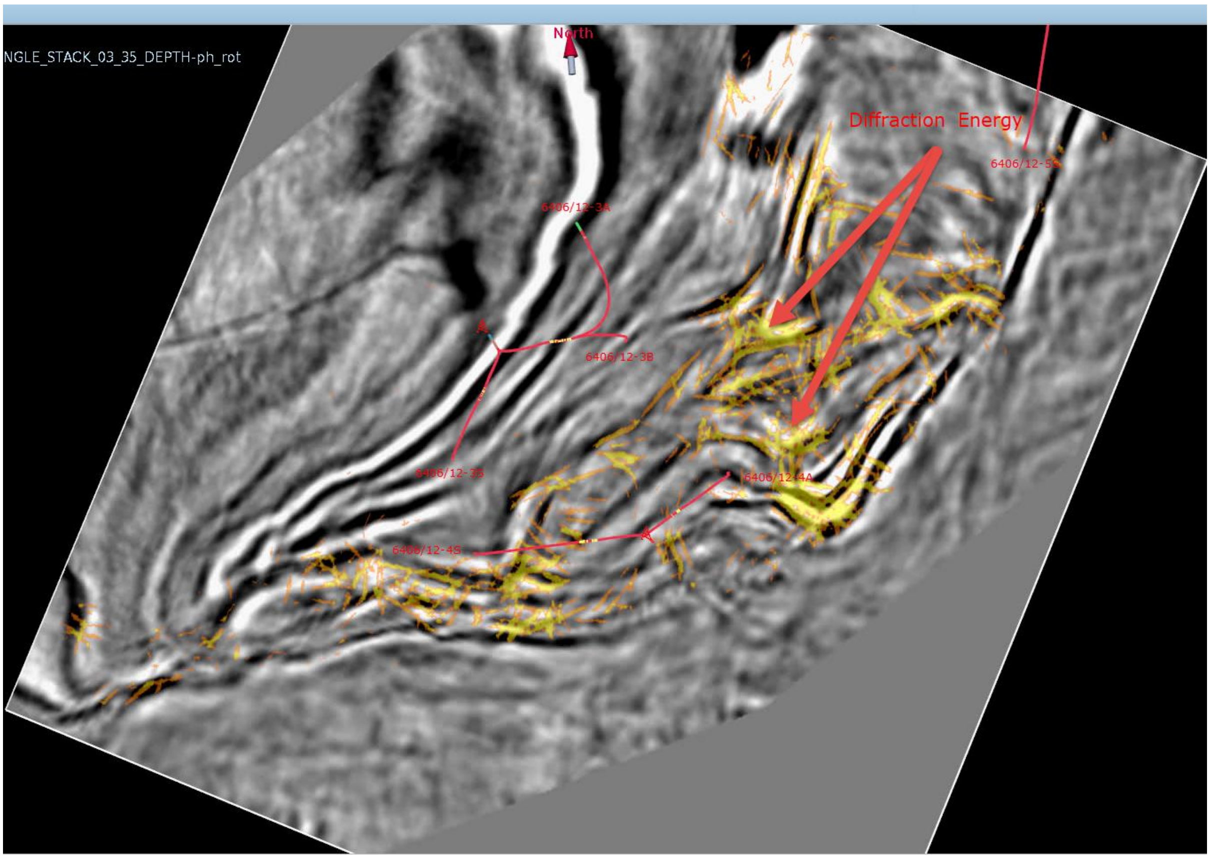

Figure 2. Diffraction energy overlaid on seismic cube, depth slice over Fenja field.

Conclusions

Advanced multi-azimuth depth processing improved the resolution of the data. Subtle structural information was easier to map in the new data. This approach helped to understand complex geology around the Vingleia fault and improve reservoir definition in a sin-rift deposit. Diffraction imaging highlighted the areas of possible drilling hazards.

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