PARADIGM CUSTOMER STORY

Paradigm®

Subsalt Imaging using 3D Pre-Stack Depth Migration Aided by Gravity Modeling in Onshore Germany

The Challenge

In a subsalt reservoir, improve the focus of the seismic data underneath the salt dome, in order to reduce drilling risk.

The Assessment

In recent years, advances in velocity model building and depth imaging have provided a better understanding of complex subsalt plays. The tomographic approach to subsurface velocity modeling, using interpretive processes, has led to significant progress in solving subsalt imaging problems, which were once considered to be impenetrable barriers.

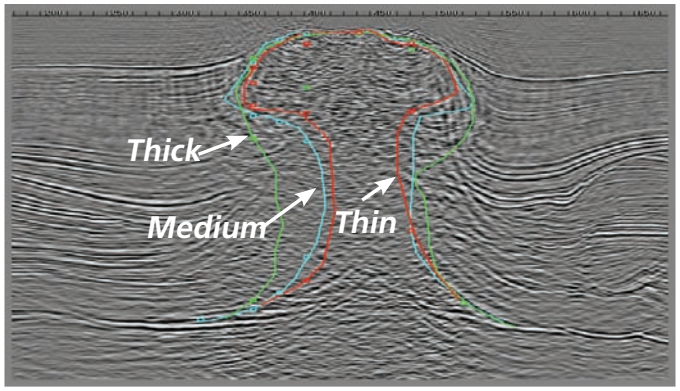
The field in question contained a number of exploration wells which had been drilled upon the discovery of gas in a subsalt reservoir, based on 2D seismic data. A 3D seismic survey was then conducted, but time processing of the data gave very limited insight into the subsalt. A post-stack depth migration improved the imaging, but the structural risk in the area beneath the salt dome was still considered too high to drill. The client chose advanced seismic processing and imaging solutions from Paradigm™ as the best tools to perform pre-stack depth migration in order to reduce the risk by improving the focus of the seismic data underneath the salt dome, and by migrating the faults and structures to their correct position.

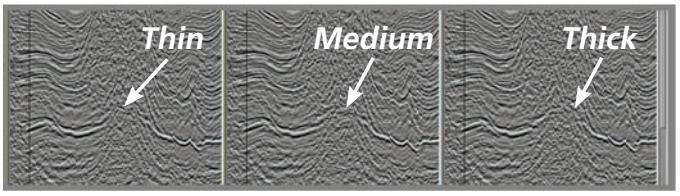
The Solution

The Echos® pre-stack time processing system was used to pre-condition the input data, and a stack volume was generated for quality control.

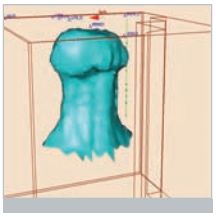
An interval velocity model obtained from the earlier post-stack depth migration project was used as the initial velocity model for pre-stack depth migration. Paradigm's industry-leading GeoDepth® software was then used for velocity modeling and pre-stack depth migration. The overburden layers were updated using Paradigm's combined 3D horizon-based (for the shallow layers, including Tertiary and Upper Cretaceous) and grid-based (beneath the Upper Cretaceous layer) tomographic procedure.

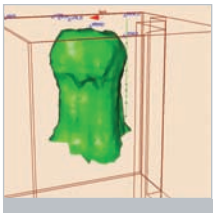
Once the overburden velocity model was established, pre-stack depth migration on a regular grid of lines was used to interpret the complex salt shape. Three different salt body shapes were interpreted within the limits of seismic data uncertainty. The complex salt shapes were modeled using Paradigm's SolidGeo® technology. Subsalt imaging was performed on the three salt bodies, and the results of the imaging were used to construct the To further confirm the shape of the salt body, gravity forward



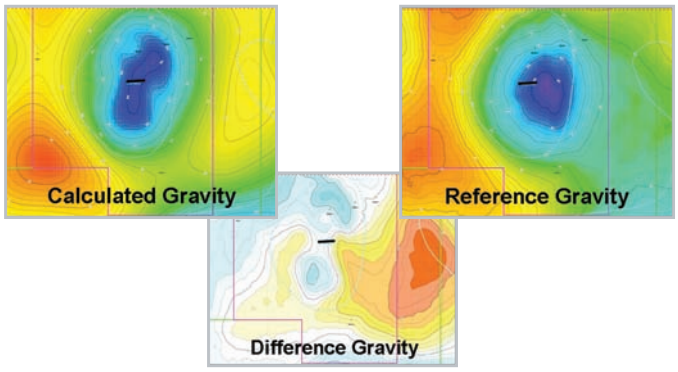



▲ Thin Salt

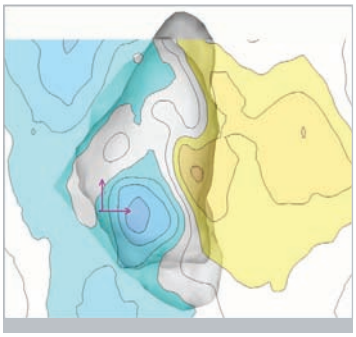

▲ Medium Salt


▲ Thick Salt

modeling was performed on the interpreted salt shapes. The 3D gravity response of each salt shape was modeled and compared to the measured gravity.



The difference gravity field was then used to find the most suitable salt geometry. The gravity and seismic results were combined, leading to the production of a final salt model with optimal gravity and seismic response. The final salt model interpretation was embedded in the overburden velocity model, to attain the final velocity depth model.



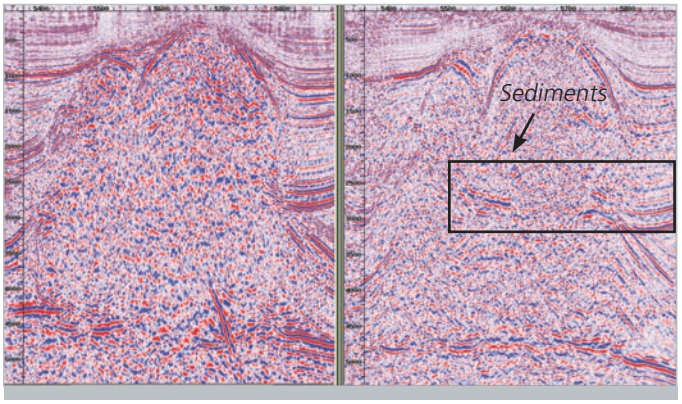
▲ Difference Gravity (Medium Salt)

Once the final model was established, final production imaging was conducted. Post-migration processing, including residual moveout correction, further improved the image.

The Benefit

Paradigm's pre-stack depth migration provided a marked improvement in image quality, compared to the client's vintage processing results. The combined use of horizon and grid-based tomography produced an accurate velocity depth model of the overburden. 3D gravity modeling helped in identifying the optimized salt structure. The integration of seismic and gravity data in the depth domain significantly improved the complex image of the salt body, and the subsalt target structure of the Rotliegendes layers.

Paradigm's velocity model building and model update methodology proved to be very effective, and became the precedent for a number of subsequent projects. The clients were extremely pleased with the result, as it provided them with accurate targets for their future drilling activities.



▲ Post-stack time migration ▲ Pre-stack depth migration

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