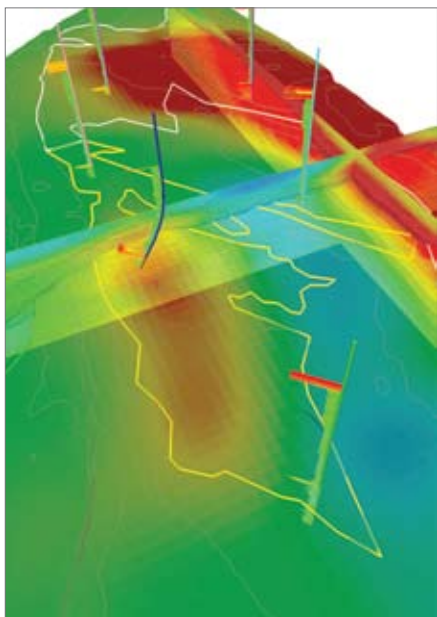


## EVIDENCE 03: NORTH SEA, NORWAY – A POWERFUL ENDORSEMENT OF CLEARPLAY EVALUATE

A 3D EM SURVEY OF THE TROLL WEST OIL PROVINCE, FOLLOWED BY 3D INVERSION, CONFIRMS CLEARPLAY'S ABILITY TO DELINEATE RESERVOIRS AND PREDICT HYDROCARBON DISTRIBUTION.



01



02

### StatoilHydro survey validates Clearplay

At EMGS, we wanted a comprehensive example we could use to demonstrate the value of Clearplay and showcase our state-of-the-art integrated EM services. So, in 2008, we revisited the StatoilHydro operated Troll field in the Norwegian North Sea, where we first proved the seabed-logging concept in 2003 and 2004.

All three Clearplay service offerings were used: Clearplay Find, Clearplay Test and Clearplay Evaluate. Here we focus on Clearplay Evaluate, a dense wide azimuth 3D EM acquisition service designed to delineate prospects and/or reservoirs - to improve certainty and efficiency in appraisal and development phase decision making.

### The Troll western oil province:

A dense, wide azimuth, 3D grid acquisition was undertaken on the Troll West oil province in the North Sea. Troll West is a producing field, characterised by shallow marine sediments trapped in a north-south aligned fault complex. Water depths in the area are 300m and burial depth to target around 1500m.

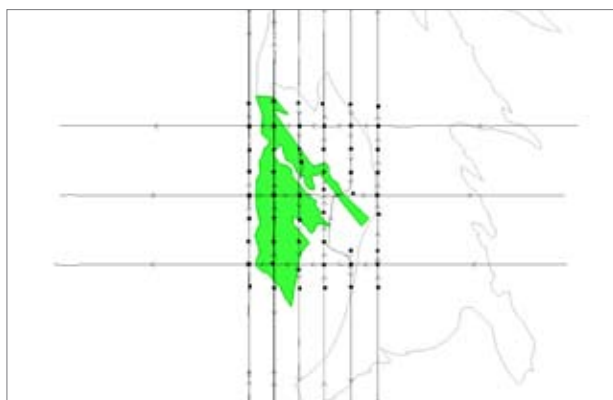
The size of the oil field is approximately 10x2.5km. The reservoir comprises a 20m meter thick gas column with an equally thick oil- leg below. However, the final processed results show that thickness and hydrocarbon saturation vary throughout the field.

From previous EM results and modelling studies a response of only 20 percent was expected from the EM data. These minor responses are a challenge where standard methods are close to the limit of detection. However, by acquiring 3D EM data, the uncertainty is reduced by the increased data coverage, because even weak responses are reliable when they are consistent over an area.

01  
Troll West Field, North Sea, offshore Norway.

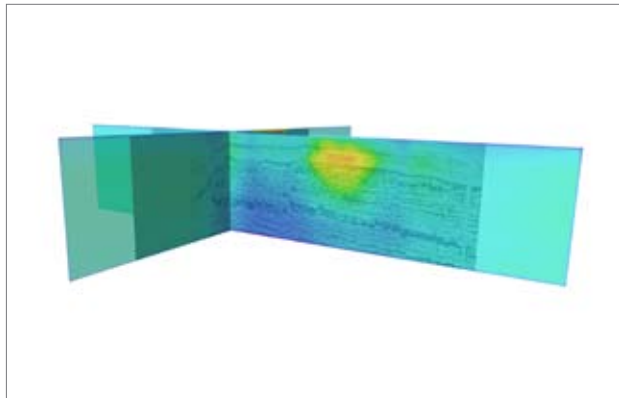
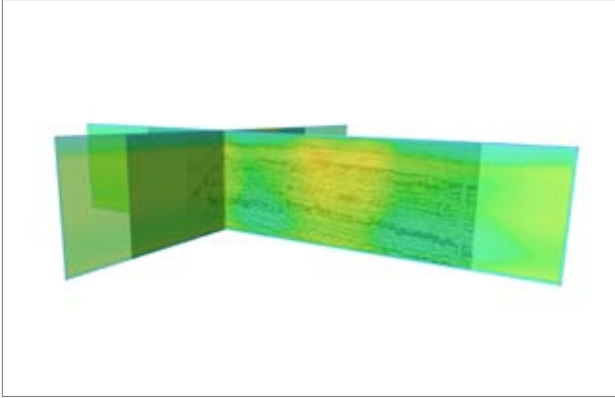
02  
Clearplay Evaluate's dense acquisition grid with 1.25km spacing enables the generation of resistivity-depth volumes by performing 3D inversion of the complete receiver grid. The inversion resistivity model is shown with seismic sections, a seismic-derived surface and well- log data. The volumes provide assessments of the resistivity distribution which matches the seismic data and resistivity logs. Resistivity variations within the reservoir obtained from the 3D inversion of the EM data matches the resistivity logs.

03  
Survey layout for the Troll Clearplay Evaluate survey of the dense 3D EM grid. All receivers are actively recording at all times enabling the use of 3D inversion producing a 3D resistivity- depth volume of the subsurface.



03

04



05

04  
3D inversion result by using inline data only. This would be equivalent to acquiring a grid of individual 2D lines. To be compared with figure 05.

05  
3D inversion result by using inline and azimuthal data. By acquiring true 3D data the inversion output is significantly improved with respect to the spatial resolution of the final resistivity model.

06  
Data coverage map for a constant offset with inline data only. This would be equivalent to acquiring a grid of individual 2D lines. To be compared with figure 07.

07  
Data coverage map for a constant offset with acquisition of 3D data. Data coverage is significantly increased due to azimuthal receivers.

Data courtesy of StatoilHydro.

### Acquisition

One of the key points with Clearplay Evaluate acquisition is that multiple receiver lines are laid out at the same time during acquisition. Compared to traditional 2D acquisition this enables data coverage not only along each individual line, but also between the receiver lines. In addition, all receivers in the grid are live while the source is being towed, which allows data to be recorded for a multiple of narrow to wide azimuth angles. The wide coverage and resulting high-density of azimuthal information improves the processing and inversion results significantly and provides an increased resolution image of the target.

### Results

A full 3D inversion is performed on the EM data to obtain a resistivity-depth volume model of the subsurface. This model is delivered in seg-y format and can be imported to any geophysical interpretation platform. It is now ready to be integrated with depth converted seismic and any available well logs. This case example shows that the 3D resistivity model obtained from inversion doesn't just detect the reservoir, it also delineates its area and reveals resistivity distribution. It is especially convincing when integrated, visualised and interpreted with seismic and resistivity logs as shown.

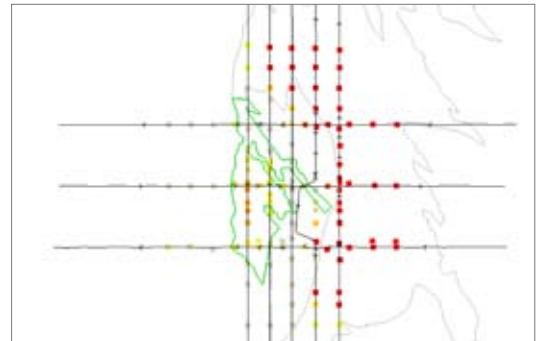
The integration of seismic, wells and resistivity data from EM strengthens the understanding of the subsurface. The resistivity information from the 3D inversion gives input valuable to the process of evaluating the outline of a prospect. Resistivity distribution at target depth can be scaled to hydrocarbon saturation providing input about reservoir quality. The additional information provided by Clearplay Evaluate will help the explorationist estimate size, quality and hydrocarbon saturation variations within the prospect.

These results show that Clearplay Evaluate can be used to delineate a proven prospect and reduce the uncertainty of hydrocarbon volume estimates. It can guide the decision making in the placement of the next appraisal well and avoid dry holes. Also the increased data coverage obtained by using dense 3D EM grids, gives confidence in weak responses. This means that by using a 3D EM grid, the challenges phased with 2D EM acquisition, such as burial depth, thickness and size of the prospect, is reduced.

### Contact

To discover more about Clearplay, email [clearplay@emgs.com](mailto:clearplay@emgs.com), visit our website [EMGS.COM](http://EMGS.COM) or call your nearest office.

06



07

