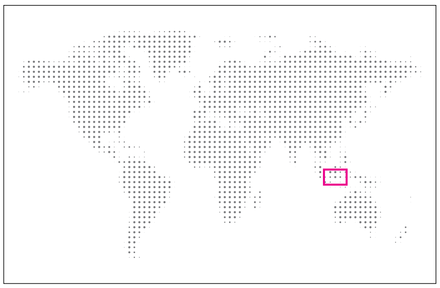
Clearplay

INTEGRATED EM SYSTEM
FIND/TEST/EVALUATE

EVIDENCE 02: BORNEO, MALAYSIA – CLEARPLAY TEST DERISKS PROSPECT, UPGRADES LEAD

A CLEARPLAY TEST SURVEY WAS DESIGNED FOR MURPHY SABAH TO DERISK A HYDROCARBON PROSPECT ASSOCIATED WITH FIZZ GAS AND INVESTIGATE LOW QUALITY LEADS.



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Knowing where to drill

Murphy Sabah Oil Co. Ltd needed to evaluate a prospect identified from a flat spot in the seismic data and also investigate some poorly defined leads.

The main aim was to lower the risk involved in drilling a prospect in a reservoir containing non-commercial gas. Clearplay Test provided the ideal combination of a powerful source and sensitive receivers, world-leading data processing and 3D modelling, expert interpretation - and effective integration with other data.

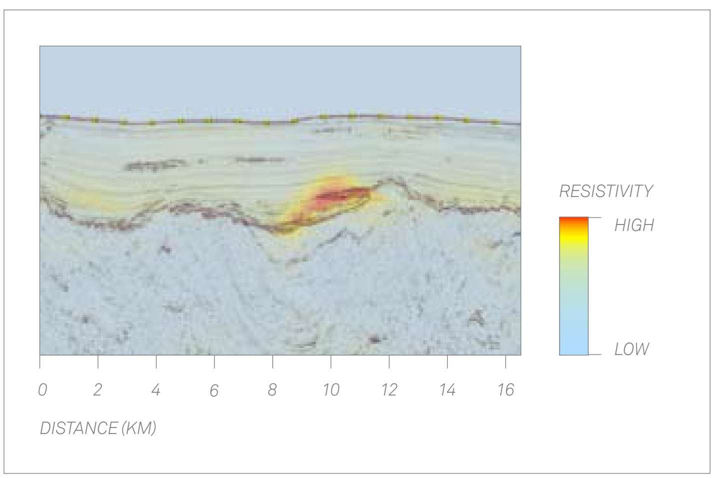
Subsequently a successful well was drilled in the prospect.

A comprehensive workflow

Both prospect and targets were in a late Miocene, deepwater turbidite sequence overlain by a thick sequence of late Miocene to Plio-Pleistocene deepwater shales. This is a successful play in nearby wells, which penetrate 50–100m of good reservoir-quality sand.

Three EM survey lines were acquired in October/November 2006 and a processing, interpretation and integration methodology determined that Murphy would achieve their goal.

Attribute analysis was the first-pass interpretation process and a quick way of examining the EM data. Common midpoint (CMP) offset plots for different frequencies quickly indicated the presence of two anomalies along one of the lines at different depths.



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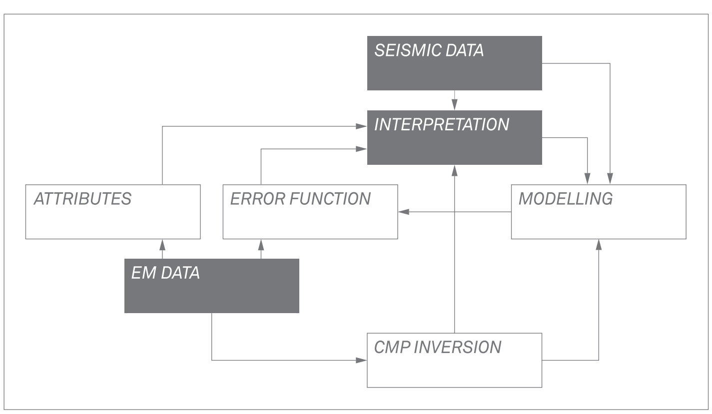

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The survey took place off the coast of Borneo, Malaysia

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A resitive anomaly (red) that closely aligned with the seismic prospect was seen in CMP inversion of the EM data.

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Integrating EM - the processing, modeling and interpretation workflow. It is important to use all types of information and data available to obtain a successful interpretation.

Created by emgs

Inversion and post-survey 3D modelling

To convert the EM data to depth-resisitivity profiles, application of inversion is necessary. In this example an EMGS-developed CMP inversion method is used. CMP inversion is a 1D inversion algorithm applied simultaneously on common midpoint (CMP) bins, allowing for 2D lateral variations along the surveyed line. It is a quick and robust method and results confirmed a seismic flatspot with a high resistive anomaly at the same depth.

Any inversion image still needs to be interpreted. Therefore, hypotheses were built based on the inversion image and seismic horizons to create a 3D resistivity and structural model. In this way, we integrate the seismic and the EM data. Simulation is performed on the model and compared to the acquired data. Initially, a background model is built to take into account regional trends and other background geological phenomena. Then, a number of simulations are performed where the 3D model includes a resistive anomaly similar to the one obtained from the inversion result. The resistor is placed at several depth intervals and with a range of resistive values for each depth interval. Misfit values are calculated for each iteration and a resistivity-depth uncertainty matrix can be obtained. In this case, a model with a box-shaped resistor at about 2000m depth and with an average resistivity of 50 Ohm-m produced a synthetic EM response that closely matched the measured data. This model also made geological sense. Once one resistor had been placed in the model, a second resistor was added to account for the remaining error. A depth of 1700m and a resistivity of 30 Ohm-m were calculated as offering the smallest error for the second resistor. This resistor coincided with another shallow high seismic amplitude.

Reducing prospect uncertainties

By combining CMP inversion with seismic horizons, a 3D resistivity and structural model is obtained. An extensive post-survey 3D modelling study introducing resisitive anomalies at different depth steps with different resisitivity values gives an uncertainty matrix. This matrix provides most-likely scenarios for the resisitive anomalies and gives valuable input to the risking of the prospect. This case example shows that the depth of the resisitive anomaly has high probability of matching the depth of the seismic flat spot as well as the resistivity values are high, increasing the confidence in a commercial hydrocarbon saturation. A well was drilled which confirmed the joint interpretation of seismic and EM data.

Contact

To discover more about Clearplay, email clearplay@emgs.com, visit our website *EMGS.COM* or call your nearest office.

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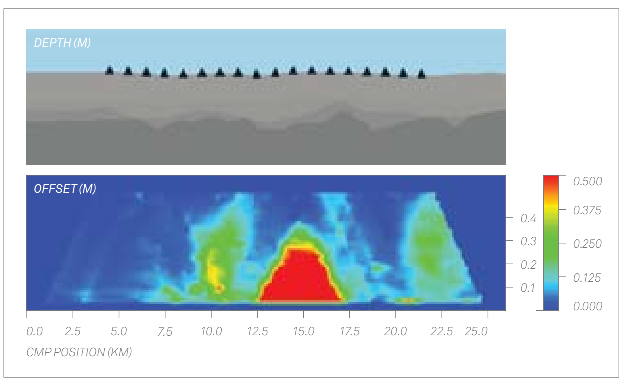

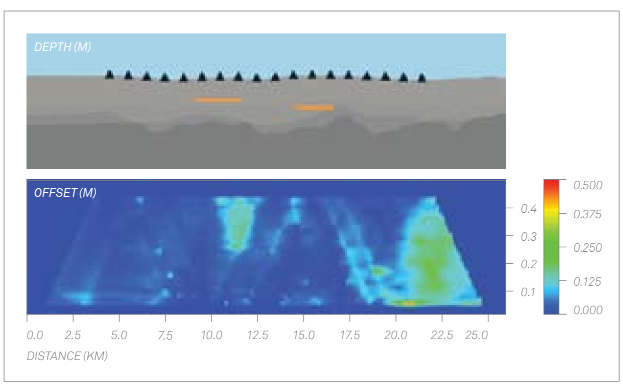

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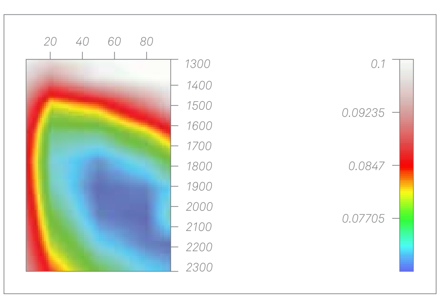

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A resistivity model is created based on CMP inversion results and seismic horizons. The difference between the synthetic data generated using this model and the measured EM response is calculated. Red indicates a large error. The addition of two resistors reduced the error (bottom). An automated iterative process was used to create an uncertainty resistivity-depth matrix of the resistor (06). The matrix shows that the resistivity anomaly most likely matches the seismic flat spot and has resistive values which give confidence in a commercial hydrocarbon saturation - as resistivities lower than 30 Ohm-m are less likely.

Data courtesy of Murphy.