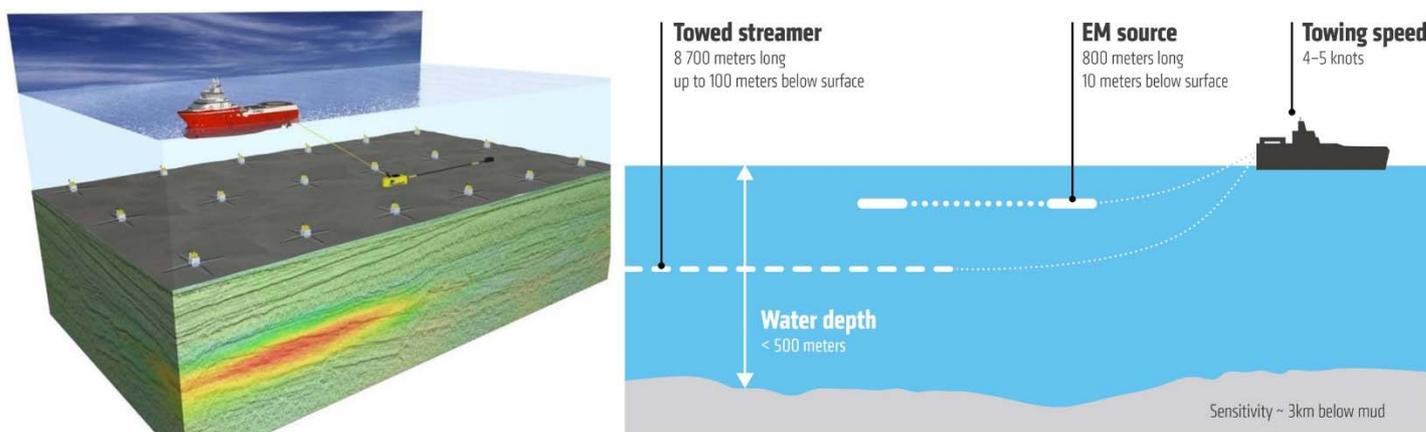


CSEM – Reducing the Risk

Why consider using more information in your exploration decisions?

If your company is exploring for hydrocarbons, the chances are you have a portfolio of prospects under consideration for further investment. Your ability to make money for the shareholder through exploration depends on the quality of your prospect portfolio. The challenge all exploration companies have is that most of the prospects in their portfolio are either brine-filled or contain non-economic amounts of hydrocarbon, and hence are not worth further investment.

The above observations are clearly demonstrated by the recent failure of several high-profile frontier basin prospects, supported by apparently good AVO (Druid/Drombeg in the Porcupine basin, Araku in Suriname, Hippocampe and Lamantin in Mauritania). These contributed to the industry's very poor reserve replacement ratio of only 11% achieved in 2017, so despite the considerable advances of seismic technology, we appear to be getting worse at finding material reserves. The four cases cited were either wet or had residual h/c in non-reservoir, circumstances which could have been identified using CSEM, at a fraction of the drilling cost



EMGS' (left) nodal and PGS' (right) towed streamer CSEM acquisition systems

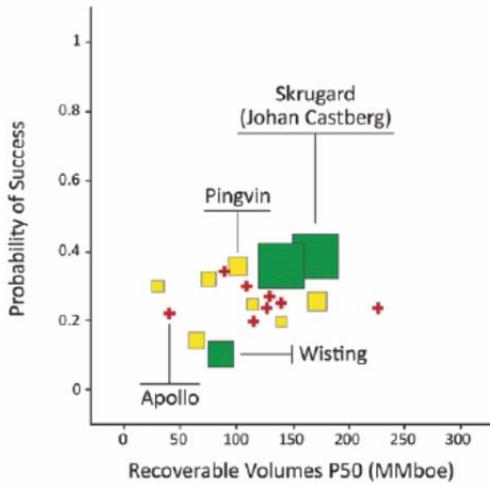
Why CSEM is a great tool for your portfolio management

Identifying these likely dry or sub-commercial wells is a key step in improving the economic performance of your exploration ventures. Think about all that brine currently sitting in your portfolio: which is the most outstanding of all its measurable properties? Resistivity. CSEM is a remote-sensing technology much like refraction seismic, but with electromagnetic waves. With the appropriate acquisition, processing, and imaging, CSEM provides a resistivity image of the subsurface. Brine's resistivity is low, orders of magnitude lower than the rest of the materials in a sedimentary basin. Resistivity logs have, of course, been used for almost a century to identify pay zones in oil and gas wells. CSEM is basically a massive well-logging tool turned on its side, which can help identify some of those brine filled prospects in your portfolio.

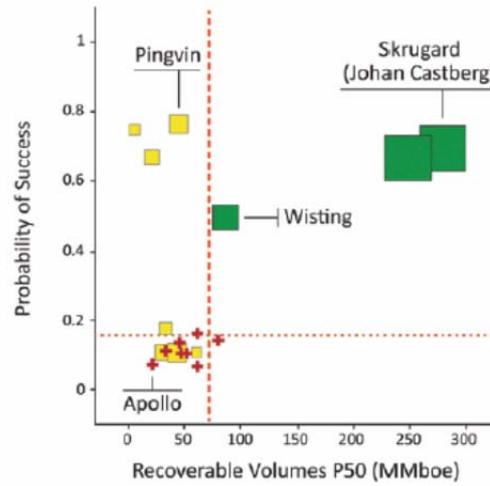
Example of Barents Sea Case Study (Zweidler et al, AAPG Explorer, 2015):

This is the most extensive public analysis of pre-drill CSEM performance, based on the results of 18 exploration wells, primarily drilled between 2007-2014 in the Barents Sea, Norway. It successfully contrasts the results of a campaign based largely on seismic with that which a combined seismic and CSEM approach would have predicted:

Opportunity Evaluation Based on Seismic



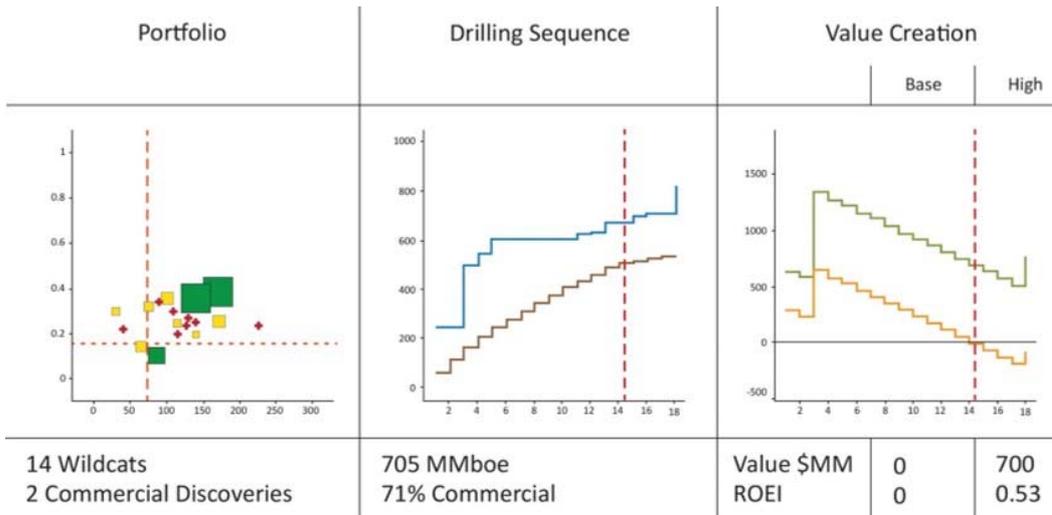
Opportunity Evaluation Based on Seismic and CSEM



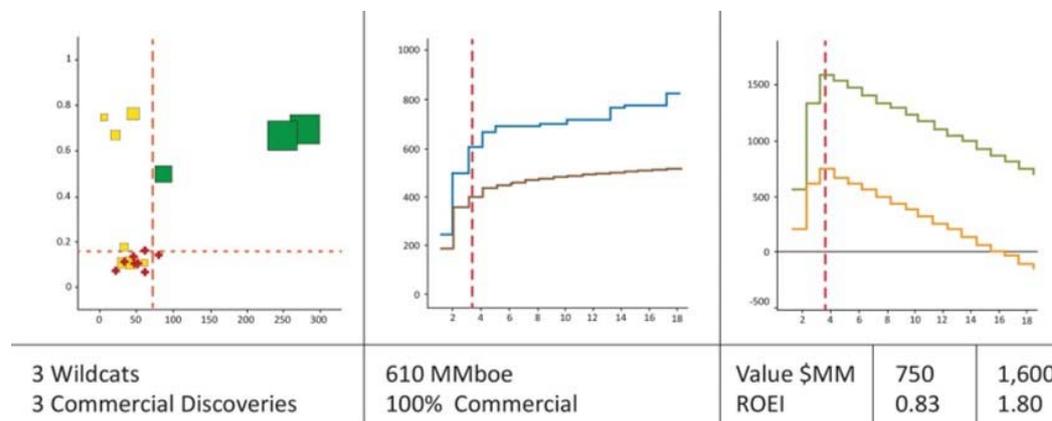
Discovered Contingent Resources P50 (MMboe) + 0 5 - 100 > 100 Minimum Risk Tolerance Minimum Economic Field Size

The left-hand figure shows the prospect distribution of size and risk based only on seismic (mostly 3D). Prospect size is spread between 50-200 mmbo and risk between 20-40%.

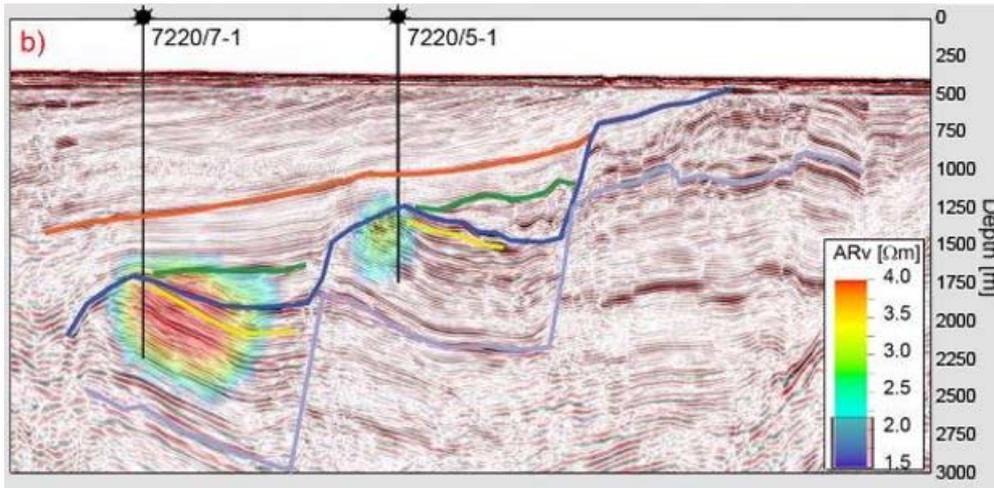
The right-hand figure shows the distribution after CSEM results were included in the evaluation. Not only has CSEM distinguished between high COS prospects (>50%) compared to <20%, but has also upgraded the size of Skrugard to 300 mmbo and better constrained Pingvin (from 100 to 50 mmbo).



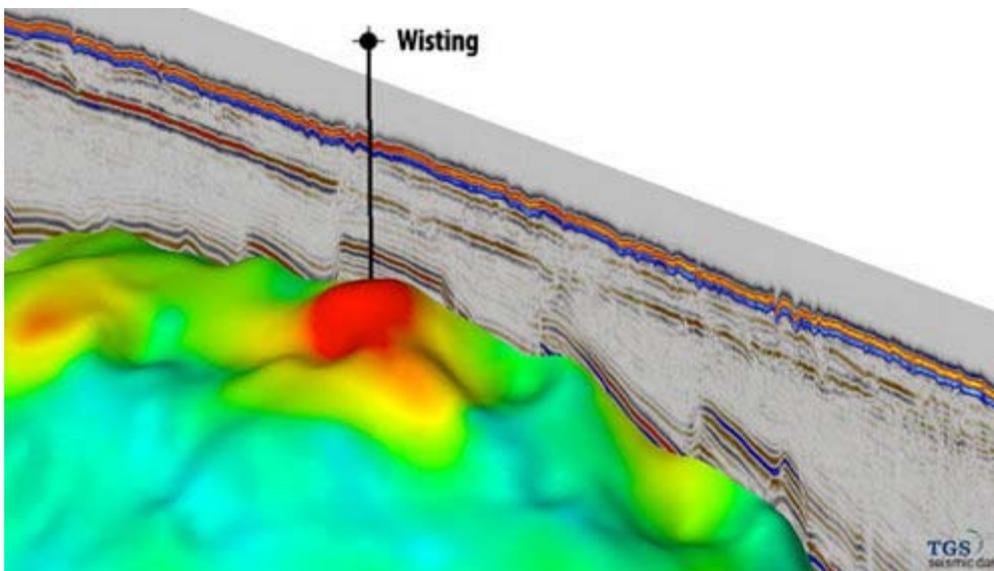
This series of figures shows the actual result of the exploration programme, based on the prospect evaluation from the seismic. Most of the wells were dry and several of the discoveries were too small to be economic. Consequently, when taken as a whole the cost of the drilling campaign was greater than the value of oil discovered.



In this series of figures, the drilling decisions are based on the combined seismic and CSEM response and only those with acceptable risk and size are selected. This correctly drills the only three commercial discoveries and does not destroy the resulting value by dry or sub-commercial wildcatting.



Seismic line through the Johann Castberg/Skrugard fault blocks, showing the positive CSEM response at the crest, behind the erosional u/c (figure c/o EMGS)



Seismic line through Wisting discovery, showing the positive CSEM response filling the structural crest (figure c/o TGS & EMGS)

How can I use CSEM?

Like any new technology there is a learning curve to using CSEM in exploration. The good news is that the process of incorporating CSEM into your exploration technologies no longer needs to be a science experiment:

- We have ample experience in producing reliable integrated prospect evaluations, and understand the tools, workflows and training that it takes to consistently achieve this.
- We know the conditions where CSEM adds the most value and what it takes to deliver that value in a timely manner. Equally we know the environments in which you will struggle to extract value from CSEM – it is not a silver bullet or necessarily applicable for every prospect.
- We know the available acquisition and processing service providers, their strengths and weaknesses, and can advise which technology and company to use in each exploration case.
- Finally, and arguably most importantly, we understand that exploration is a team effort, requiring close collaboration between team members with a range of specializations. The processes we develop and follow are designed to leverage the skills of your entire team, providing a safe and less-disruptive way to reach the additional value available in the CSEM information.

To arrange an in-depth discussion on the technology, your exploration case, and how CSEM could improve your business model, get in touch with Daniel Baltar: daniel.baltar@foxgeoexploration.com or Peter Mikkelsen: PeterMikkelsen@simco-pet.com