

Marine CSEM for the future

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Looking back from the very first test of using CSEM to detect hydrocarbon reservoirs in 2001, we have seen a tremendous improvement in technology and processing. We have moved from 2D lines to true 3D acquisition and from attribute analysis to 3D inversion. We have seen significant improvements in data quality and acquisition efficiency, and we have seen an increased effort in integrating EM data with seismic data. All these improvements have contributed to better resolution, deeper penetration, less ambiguity, and, as a consequence, better interpretation and understanding of the subsurface.

This rapid development should not come as a surprise for such a young technology. However, as for most new technology introduced in a market, there are certain adoption stages that the market will go through. This typically spans from an R&D stage, via technological and commercial adoption, to large scale adoption. Needless to say, the technology development and the market adoption will interact. Thus, future developments are difficult to predict. From a technical viewpoint we can at least make some predictions.

Compared to seismic measurements, Marine EM measurements suffer from severe damping, a serious drawback for a remote sensing technology. This is compensated by using relatively low frequencies with correspondingly long wavelengths. Thus, there will be a compromise between resolution and depth penetration. In order to understand how to improve, we need compare the signal caused by a particular feature in the subsurface (for instance a given resistive body) with what we can reliably detect. First of all the difference in the EM signal caused by the presence of the resistive body must be larger than the noise present in the data. Otherwise, the signal is lost. Thus, as a first requirement we must have a sufficient signal to noise ratio. Second, the relative change in the signal must be sufficiently large to overcome acquisition uncertainty. This typically relates to positioning and orientation accuracy. Some of this can be mitigated by improved acquisition accuracy, and some by processing techniques which enhances the subsurface response. Unfortunately, many of these processing techniques depend on the acquisition accuracy, and hence they may not significantly improve the final subsurface understanding. Thus, in order to reliably enhance the subsurface information robust processing techniques are introduced. These show great potential in under conditions which are usually considered difficult; shallow water and deep burial depth.