

CSEM technology performance in oil exploration - Limitations or opportunities?

Stefatos A.¹, Hesthammer J.^{1,2} & Boulaenko M.^{1,2}

1. Research & Development, Rocksource ASA, Olav Kyressgate 22, 5041, Bergen, Norway.

2. Department of Earth Sciences, University of Bergen, Allègaten 41, 5007 Bergen, Norway.

Over the past years, Rocksource has studied and tested the application of Controlled Source Electromagnetic (CSEM) surveys for hydrocarbon detection in numerous shallow and deep water settings, mainly in the Norwegian continental shelf, the UK continental shelf, offshore West Africa, and offshore East India.

Offshore West Africa, 43 geological models have been studied for their suitability to be mapped through a CSEM survey. The vast majority (70%) of the tested prospects were very suitable for the application of the technology, while only 16% were considered to be “not suitable” to the CSEM mapping. As expected, the reservoir burial depth is the most important factor that affects feasibility. Water depth, transverse resistivity and resistivity contrast of reservoir to the background do not exhibit a direct, systematic control on the feasibility and therefore should not be considered as apriory limiting factors to the applicability of the CSEM surveys. Furthermore, the absence of such a direct and dominant control indicates that the feasibility is controlled by additional factors mainly the background resistivity distribution for both the overburden and the underburden close to the reservoir depth.

Today, Rocksource has information about 11 exploration wells that were drilled over CSEM datasets that have been processed and analyzed in-house. Out of the 11 CSEM datasets, six (6) were evaluated before drilling, four (4) were evaluated after drilling and one (1) was a post drilling blind test. Five (5) wells were dry and six (6) were discoveries. In all cases the Rocksource interpretation of the CSEM data was in full agreement with the well results suggesting excellent reliability of these data. Drilled EM anomalies provide invaluable ground truth evidence for the estimated performance of the technology and insights into what could be regarded as interpretational limitations today.

Case studies from current ongoing CSEM exploration in the Norwegian continental shelf indicate that a lot of potential prospects could fall into the grey zone of what is considered CSEM feasible and what is not. However, extensive data analyses suggest that the interpretation limitations could actually be reduced further, thus providing new opportunities for the oil and gas industry and new technological challenges for the CSEM service providers.