Marine CSEM data interpretation: Pitfalls and possible solutions

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Even though many experimental results collected over the past decade support marine CSEM methodology for hydrocarbon exploration, we cannot ignore that many artefacts can affect data quality and, as a consequence, the final interpretation results.
These artefacts can be generated at each step of the workflow, during acquisition, processing and inversion.

In fact significant bathymetric irregularities, variations of source elevation above sea floor, incorrect analytic rotations of dipole orientations and so on, can affect strongly the measured electric and magnetic fields.

These problems are generally magnified in relatively shallow water conditions.
In order to reduce the possibility of "false anomalies" and misleading models, each potential source of artefact introduced during acquisition and processing must be taken in account in the modelling and inversion work.

Moreover in marine CSEM the inversion process aimed at extracting electrical properties from the measured electromagnetic fields is ill-posed and ill-conditioned.
In other words small error bars in the data strongly affect the final solution of inversion; moreover data sensitivity to model parameters is extremely offset dependent.
As a consequence all the interpretation pitfalls linked with acquisition problems are strongly magnified during the process of CSEM data inversion.

All the above considerations should guide the interpretation work flow.

Simplistic approaches should be avoided, but also sophisticated inversion techniques should be applied only when proper understanding of the data has been obtained.
Accurate exploration of data/model space before running optimized multidimensional inversion can be performed with many different techniques, such as by data normalization, pseudo-sections, various types of electromagnetic attributes, forward modelling and so on.

In order to introduce our idea of a proper interpretation work flow, in this paper we first discuss shortly some of the most frequent pitfalls in marine CSEM. We show how common artefacts introduced during the acquisition can be easily detected and eliminated. Then we discuss some real examples where Eni applied an interpretation approach that combines inversion techniques with electromagnetic attributes.