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From LOTEM to Marine tCSEM™ for hydrocarbon exploration:concepts and realization

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energy propagating through the air (the "air wave") often obscures subsurface signals. This has triggered a variety of hands-on industry approaches for handling airwave effects in CSEM data. These include the selection of frequency and distance windows that contain little airwave signal, up-down separation of EM fields, and related approaches similar to seismic predictive deconvolution. In contrast, Peter Weidelt(1) provides a comprehensive mathematical analysis of the nature and properties of air-related CSEM signals, which may lead to a deeper understanding and development of new approaches for dealing with the airwave problem. In this presentation, I attempt to provide an overview and illustration of Weidelt's treatment of airwaves in 1D media, relate this to some of my own CSEM modeling test cases, and discuss potential consequences and future applications of this work in hydrocarbon exploration.

(1) Weidelt, P., 2007, Guided waves in marine CSEM, Geophysical Journal International 171, 153-176

V07

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The depth of interest for hydrocarbon exploration is from one to several kilometres. Transient electromagnetic techniques with controlled source as LOTEM and tCSEM™ for land and marine surveys are designed to reach this depth of penetration. The long offset and the conductive environment is convenient for acquiring the transient response as time series, which are processed by robust stacking and optimized filter techniques.

Although in time domain the decay of the electromagnetic fields after a switch off the transmitter current is diffusive, assumptions and ideas of the seismic world is influencing the explanations for the response. Especially the concept of waves is used to describe the signal response of the ocean, the target and the air-sea interface with reflection and the refraction at the boundaries. Some aspects of the wave propagation explain the transient behaviour well but there are other aspects which are not consistent with the wave concept.

The hydrocarbon target is often described as a thin resistive layer with finite horizontal dimensions. A thin and horizontal elongated rectangular resistor embedded in depth of 2 km below the seafloor has been applied for numerical experiment. Two tow lines have been modelled across the long side and the short side of the rectangular prism. The 3-D numerical modelling has been done with Comsol Mulitphysics and SLDMEM3T. The comparison of the results shows that both numerical method – finite element and finite difference with the Lanczos decomposition – are in good agreement.

V08

Smoothness-constrained model error and resolution estimates from the inversion of direct-current resistivity and radiomagnetotelluric data

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