THE MARINE CSEM RESPONSE OF A RESISTIVE SHEET: STRAIGHTFORWARD BUT NOT TRIVIAL

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Thin conductive sheets are often used to model base metal deposits for mineral exploration. In a similar manner, thin resistive sheets can be used as simple models for oil, gas, or gas hydrate reservoirs. One would expect that the calculation of the electromagnetic response of a resistive sheet using an integral equation method should follow trivially from the well-studied solution methods for a conductive sheet. The only physical difference between the two situations is the fact that the conductive solution relies on the continuity of the electric field tangential to the sheet surface whereas the resistive solution requires continuity of the normal current density. We started to develop a practical tool which would be useful in our marine controlled-source electromagnetic projects. Progress proved slow. We eventually realized that the approximations used in the conductive calculation resulted in solutions in the resistive case that failed to converge! It turns out that the resistive problem is far more subtle than one might expect, for both the full three-dimensional case and the simplified two-dimensional version. We outline the fundamental theory required to correctly calculate the marine CSEM response of 2D and 3D resistive sheets in a double halfspace; we further validate the software against results obtained independently through 3D finite difference modelling and through layered earth solutions. Results show that a thin resistive sheet behaves in a similar way as a “thick” plate with corresponding finite thickness and resistivity, suggesting that a sheet is a good representation of an idealized buried resistive zone.

Marine CSEM, Offshore hydrocarbon exploration, Resistive sheet modelling

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