Extracting the Full Value of CSEM Data: Interpretation of Anisotropic Resistivity

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ABSTRACT

It is now commonplace to interpret Controlled Source EM (CSEM) data using anisotropic inversion methods, where two components of sub-surface resistivity are determined: horizontal and vertical. In the context of petroleum exploration the vertical resistivity is usually considered the component of resistivity of prime interest to a geoscientist. This focus on the vertical resistivity is because thin, horizontal, resistive strata - a geophysicist's model of a petroleum reservoir - are usually recovered best in the vertical resistivity. However, CSEM data acquired using Towed Streamer EM is well-suited to determining the horizontal resistivity, and that is relevant for petroleum exploration at numerous stages in the exploration life-cycle. First, the horizontal resistivity component should match the overall background geology: to appraise the result of inversion of CSEM data we should consider how well, or otherwise, the horizontal resistivity matches/conforms with geological structure. Second, the horizontal resistivity can reveal deep seated geological features such as salt-diapirs, the geometry of which may not be readily interpreted, or even imaged using seismic data alone. Finally, the horizontal resistivity should not be ignored in the context of exploration de-risking. Using a combination of data examples and synthetic modelling we show that it is feasible to detect a thick, but low Net to Gross reservoir in the horizontal resistivity component, even when sensitivity to vertical resistivity is reduced due to a complex overburden.