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Detection and Monitoring of Hydrocarbons Using Transient Electromagnetics

When oil replaces water in a rock all the physical properties of the rock change. Resistivity is affected most, while properties sensitive to seismic wave propagation such as density and velocity are changed only slightly. Electromagnetic (EM) methods are sensitive to changes in resistivity and therefore have the potential to detect the presence or otherwise of hydrocarbons and their movement in targets located using seismic methods.

Two EM experiments were carried out over a known gas storage reservoir in France in 1994 and 1996, to try and demonstrate this potential. I present the results of these surveys. A novel approach to handling the data, involving processing rather than inversion has been applied. This involves recovering an approximation to the impulse response of the earth. The results clearly show an event at a time of 3ms across the extent of the reservoir for both surveys which agrees with the time predicted from modelling. Also, the response is not seen at short offsets which do not penetrate deep enough to see the reservoir. Finally when differences are taken between the two surveys there is again a difference seen only across the reservoir and of the correct polarity; that is, the response is bigger when there is more gas in the reservoir. The results demonstrate the huge potential of EM methods for hydrocarbon detection and monitoring.