Integrated interpretation of controlled source electromagnetic, seismic and well log data for reservoir characterisation.

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Improved reservoir management and production optimisation demands require accurate characterisation of reservoir properties and their changes through time. Advances in geophysical data acquisition and interpretation have led to significant improvements in the remote imaging of earth structure and properties. However, when only a single data type is considered, ambiguities in the interpretation can remain. Integration of disparate geophysical data types allows the strengths of each to be exploited. Here we will concentrate on three contrasting methods: surface seismic, marine controlled source electromagnetic (CSEM) and well-log data.

Seismic data are commonly used to provide images of the sub-surface, and develop high resolution geological models of structure and stratigraphy. Amplitude variation with offset (AVO) and inversion for acoustic and elastic impedance may also be used to constrain properties such as elastic moduli and density. However seismic data alone in many situations cannot give a complete picture of the reservoir. For example, AVO anomalies may be caused either by fluid or lithological variations, which cannot be separated on the basis of the seismic data alone.

The CSEM method has gained acceptance in recent years as a technology for hydrocarbon exploration and reservoir characterization. The method uses a high powered electric dipole source to transmit an electromagnetic signal through the seafloor to an array of receivers. Analysis of the resulting data allows remote mapping of the resistivity structure beneath the seafloor. The CSEM technique lacks the fine structural resolution of seismic data, however the method is particularly sensitive to the properties and distribution of fluids within the earth.

Well logs provide a high resolution measurement of the properties of a reservoir and the surrounding strata, however properties can only be determined in a small area local to the well. Often a measurement of reservoir properties across the extent of a field are desirable for reservoir management or production optimization.

It is clear that a careful combination of all three data types can supply information that is not available, or is unreliable from any one data type alone. By integrating complementary sources of information and exploiting the strengths of each, estimates of rock and fluid properties such as gas saturation and porosity can be obtained with greater confidence than from any one data type alone.