2011 Europe Honorary Lecturer

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Presented by

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OHM Ltd., Aberdeen, United Kingdom

2011 Europe Honorary Lecturer

Integrating Well Log, Seismic, and CSEM Data for Reservoir Characterization

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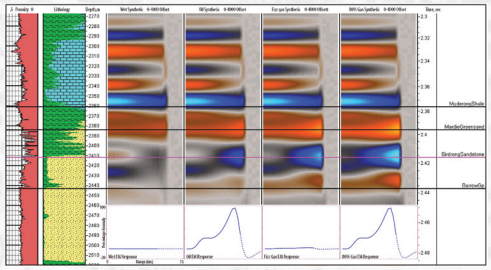
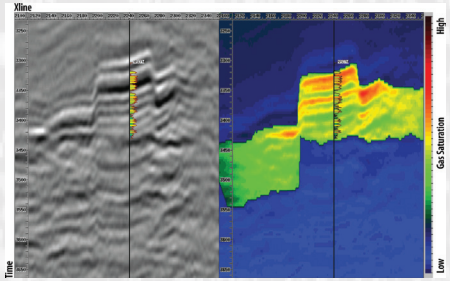
Integrating Well Log, Seismic, and CSEM Data for Reservoir Characterization

Abstract

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 measurements of reservoir properties across the extent of a field are desirable for reservoir management or production optimization. Remote geophysical measurements are therefore required. Seismic data are most commonly used for this purpose; however, in recent years CSEM methods, which measure the resistivity structure of the seafloor, have also been widely applied.

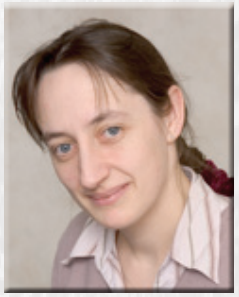


CSEM use a high-powered source to transmit low-frequency signals through the Earth to an array of receivers. By interpreting the received signals using forward modeling and inversion approaches, the resistivity structure of the seafloor can be determined. Resistivity well logs often show that commercial hydrocarbon deposits may be many times more resistive than surrounding lithologies. In principle, such variations should be readily detected using CSEM tools. In contrast, seismic data are sensitive to boundaries between lithologic units but are often less sensitive to fluid changes within these units. Given high-quality seismic and well data and sophisticated seismic inversion and rock physics tools, we can sometimes relate seismic changes to saturation effects. Nevertheless, the change in resistivity caused by variations in saturation should be much easier to detect.



However, despite the sensitivity of resistivity data for determination of saturation, there are two inherent challenges to interpreting CSEM data. First, the structural resolution of CSEM data is poor. Second, the cause of resistivity anomalies (particularly high-resistivity features) cannot be uniquely linked to the presence of hydrocarbons in the subsurface when taken in isolation. In many situations, these are equally likely to be caused by other high-resistivity material (for example, tight carbonates, salt, or volcanics). These limitations can be mitigated using an integrated approach to geophysical interpretation. Seismic information can outline the reservoir structure (but potentially not its content or extent), and we have independent constraints on the surrounding strata within which it is embedded. This is therefore a constrained interpretation problem and one that the CSEM data are in a much better position to answer.

Biography



Lucy MacGregor

Lucy MacGregor is currently the chief technical officer of Offshore Hydrocarbon Mapping, and has been a leading researcher in CSEM and its application to the detection and characterization of fluids in the Earth for more than 16 years. Lucy has extensive experience in the development and application of data processing, modeling, and inversion techniques, and has been responsible for survey design and data interpretation on commercial surveys in a wide variety of geological environments.

Lucy has a PhD from the University of Cambridge for research in CSEM. Following her PhD, she was a Green Scholar at the Scripps Institution of Oceanography working on marine electromagnetic methods, before returning to Cambridge as a Leverhulme Trust/Downing College research fellow. In 2000, she moved to the National Oceanography Centre, Southampton as an NERC research fellow to continue her work on marine CSEM sounding in both academic and industrial settings. She was a co-founder of OHM in June 2002.

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