

Marine EM methods for sub-basalt imaging: Case study from the Norwegian Sea

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The present case study from the Norwegian Sea demonstrates how the use of electromagnetic data can add value in areas difficult to be imaged seismically.

The geological environment in this case is complex, covering the margin between oceanic and continental crust (the Møre Margin), and the western part of the Møre Basin, in which Eocene basalts are present within the section. One of the objectives is to determine the thickness of pre-basalt sediments, and if possible to identify the presence of a crystalline basement.

2D seismic data were collected along line GMNR-102, by Geco Prakla (now WesternGeco) in 1994. Marine magnetotelluric (MMT) and controlled source electromagnetic (CSEM) data were collected along the same line in the late summer of 2008.

EM data were acquired with variable receiver spacing along a 160 km line, in order to address the different survey needs, according to the geological information available before the acquisition.

CSEM amplitude and phase responses were obtained using CSEM-xpress, WesternGeco proprietary technology. The MMT time series were processed using a robust remote reference algorithm to derive smooth impedance tensor estimates.

Single-domain inversions were performed on the two datasets and one- and three-dimensional simultaneous joint inversions were also run to derive an accurate resistivity model of the sub-surface. The resistivity distribution was used at a later stage in combination with the seismic data to provide a clearer interpretation of the geology of the area.