The convergence of monitoring and modelling to demonstrate conformance and understanding at European CO_2 storage sites

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A key regulatory requirement in the European Directive on CO_2 storage is to demonstrate "….. conformity of the actual behaviour of the injected CO_2 with the modelled behaviour". Here, we will present monitoring and modelling data from the Sleipner and Snøhvit CO_2 storage operations, offshore Norway, to demonstrate convergence of monitoring and modelling data. This convergence will be used to demonstrate how increased understanding of subsurface properties and processes are developed over a project lifetime.

Conformance assessment is challenging due to geophysical data resolution, geological heterogeneity and the limitations of modelling software, yet, monitoring data acquired throughout the life of the storage site is utilised to update the reservoir model. Detailed analysis of time-lapse seismic data, incorporating amplitude, spectral and temporal techniques, are used, alongside downhole measurements, to determine the spatial and vertical extent of CO_2 and pressure anomalies and build an understanding of reservoir and caprock heterogeneity. These results can then be used to constrain predictive tools that model future growth of the subsurface anomaly with an accuracy that increases as more data is available.

The Norwegian examples presented here will show: the vital role new high fidelity seismic played in developing revised geological interpretations at Sleipner, enabling modelling-monitoring convergence of the spreading geometry of the topmost CO_2 layer; and how different approaches were required to understand two distinct injection phases at Snøhvit, where observations of increased downhole pressure provided a key challenge to our developing understanding of the reservoir.

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