Chadwick, R.A.; Arts, R.; Eiken, O.. 2005 4D seismic quantification of a growing CO2 plume at Sleipner North Sea. In: Dore, A.G.; Vining, B.A., (eds.) *Petroleum Geology: North-West Europe and Global Perspectives - Proceedings of the 6th Petroleum Geology Conference.* Geological Society, London, 1385-1399.

CO2 produced at the Sleipner natural gas field is being injected into the Utsira Sand, a major saline aquifer. Time-lapse seismic data were acquired in 1999 and 2001, with 2.35 and 4.26 million tonnes of CO2 in the reservoir respectively. The CO2 plume is imaged as a number of bright sub-horizontal reflections within the reservoir unit, growing with time, and underlain by a prominent velocity pushdown. No leakage has been detected from the repository reservoir. The reflections are interpreted as tuned responses from thin (< 8 m thick) layers of CO2 trapped beneath thin intra-reservoir mudstones and the reservoir caprock. However, these alone are unable to account for the amount of observed pushdown. A two-component 3D saturation model is therefore developed for the 1999 dataset, with high saturation CO2 forming the layers and a lesser component of low saturation CO2 in between the layers. Saturations are calculated from the observed reflectivity and velocity pushdown and the resulting model contains 85 % of the known injected mass of CO2. A 2D synthetic seismic section through the saturation model matches the observed seismic response well and the model is considered to provide an acceptable description of the CO2 distribution. Signal attenuation is more pronounced within the 2001 plume and its effects are likely to become more significant with time, perhaps reducing the efficacy of seismic verification techniques as the plume grows further. Other geophysical methods, such as microgravimetry, may become increasingly useful at this stage.