# Troll Area, Norwegian North Sea: Case Study of CO2 Storage Sites in an Aquifer Under Depletion

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## ABSTRACT

Pressure management of aquifers is important both for CO2 storage and petroleum production in mature petroleum provinces. In a closed or half-open aquifer pressure build-up will often be a limiting factor for the storage capacity of injected CO2. Aquifers surrounding producing gas fields have good storage capacity potential without need for production of formation water because of pressure depletion. A structure east of the giant Troll oil and gas field is presently being evaluated for CO2 storage as part of a full cycle CCS pilot initiated by the Norwegian government. The plan is to capture CO2 from Norwegian industry plants in East Norway, ship it to the west coast and pipe it to a structural closure located at 1200-1400 m depth in the upper Jurassic Sognefjord and Fensfjord formations east of Troll. Gas production from Troll East started up in 1996. The pressure in the Sognefjord Formation is depleted with approximately 50 bar in the field. Exploration wells recently drilled in the area outside the field were depleted with 15 to 25 bar in this formation. Pressure depletion exceeding 50 bar in the storage site will bring CO2 into gas phase. If this happens, the storage capacity will be significantly decreased due to the density difference between gas phase and dense phase. The risk of leakage may increase. The NPD has conducted an aquifer study in order to investigate the pressure depletion in the storage site and look into alternative strategies for storage. The pressure development of the aquifer was modelled in an Eclipse reservoir simulator, based on a regional geological model covering 7500 km2 and a pore volume of 220 Gm3. The pressure depletion in the aquifer within the area of the Troll field model was history matched, as well as the pressure depletion in 3 exploration wells drilled in the aquifer outside the field. Most of the area is covered by high quality 3D seismic data, which allowed a reliable mapping of the top and base of the 400 m thick reservoir formations as well as the internal seismic facies. In the southern part of the aquifer, a deltaic lobe and associated channel structures could be defined by seismic data in the uppermost part of the Fensfjord Formation. The channels can be correlated with ancient valley systems in the Norwegian mainland. The integrated mapping and modelling effort has met the objectives of clarifying the risk of depletion and suggested alternative ways of reducing uncertainty and deal with this risk.