Sleipner West CO_2 Sequestration Monitoring Study

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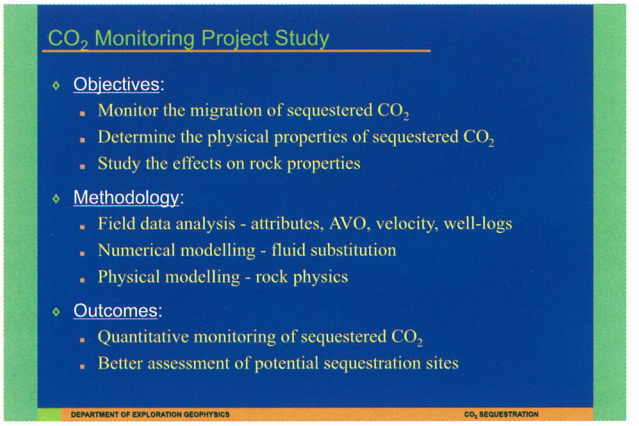
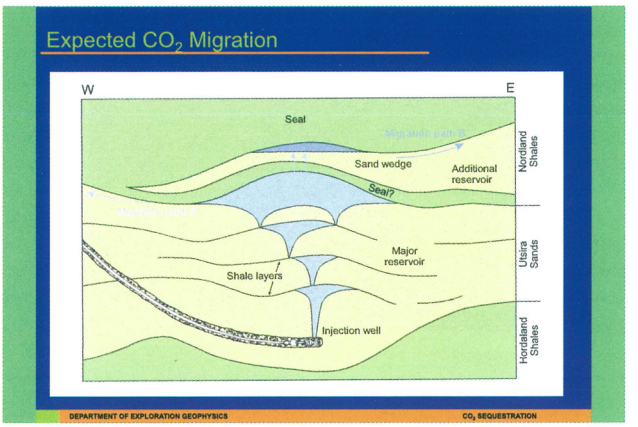
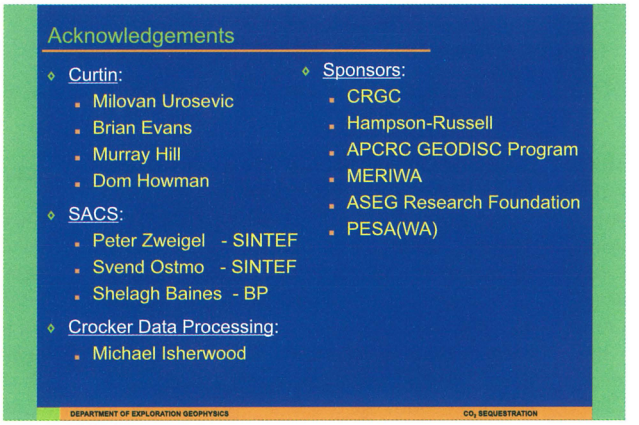
In an attempt to meet the 1997 Kyoto agreement, the Norwegian government has introduced a direct tax on CO_2 emissions from producing petroleum reservoirs at US$53/tonne. The Sleipner Field is currently producing natural gas, within the Norwegian sector of the North Sea, containing 9% CO_2, which must be reduced to 2.5% before sale. Consequently, the field operator (StatOil) has disposed of approximately 3MM tonnes of waste CO_2 into a saline aquifer (Utsira Formation) at approximately 800 m depth below the seabed, at the site for their first pilot CO_2 sequestration project. Time-lapse 3-D seismic techniques are being utilised to monitor the flow of the sequestered CO_2 within the Utsira Formation. The migration of the CO_2 appears to be unpredictable due to problems such as the complex geology of the Sleipner Field, and uncertainty surrounding whether the Utsira Formation provides conditions for supercritical or subcritical CO_2.

This research project is a collaborative project between GEODISC and SACS to monitor the flow of CO_2 sequestered at Sleipner West. The aims of this monitoring study are (1) to monitor the migration of the injected CO_2, (2) determine the physical properties of the injected CO_2 and thereby deduce state-of-phase, and (3) to study the effects of CO_2 injection on the surrounding rocks. These objectives will be achieved through a combination of physical modelling, field data analysis and numerical modelling. A scaled model of the sediments overlying the Utsira is to be constructed.







Scaled seismic data will be acquired over the model and matched to the 1996 field seismic data. A synthetic sandstone reservoir will later be incorporated into the model and CO_2 (or equivalent fluid) injection performed. The controlled laboratory conditions will allow a study of the seismic response to known fluid properties. To correctly simulate CO_2 injection, appropriate fluid flow scaling must be applied in conjunction with seismic scaling. In conjunction with the physical modelling study, lithology and fluid properties extracted from well log analysis will be used for numerical fluid (CO_2) substitution within the Utsira Formation. Numerical modelling of the seismic response will be calculated from the substitution and will be compared with the seismic response of the 1999 survey. The fluid properties will be altered and the acoustic response recalculated until a match is achieved in an attempt to determine the properties of the sequestered CO_2. Once the CO_2 properties and changes to the local stress regime have been derived, quantitative analysis of CO_2 migration can be conducted.

Biography

Jason McKenna received a first class B.Sc.(Hons) degree from Curtin University of Technology in 1999. He is currently completing a PhD in petroleum geophysics at Curtin. To date he has received awards for merit from the ASEG, SPE, PESA, APPEA, APCRC, Melbourne University and Curtin University. He is a member of the ASEG, SEG, SPE and AAPG.

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