

1.2 Technical Progress and Main Results

WP 5 + 7 – Geophysics led by TNO-NITG and supported by Statoil, BGS, SINTEF, BRGM and IFP

Summary

In the reporting period work has continued on the following tasks:

- Task 5.4 Interpretation time-lapse data
- Task 5.5 and 5.7 Seismic inversion (AVO) and forward modelling
- Task 5.8 Feasibility micro-seismic monitoring
- Task 7 Thermodynamic and petro-acoustic lab experiments

Task 5.4 Interpretation time-lapse data

Work carried out during the reporting period

Interpretation of the CO₂ captured under the thin intra-Utsira shale layers has been refined. By assuming a relation between the seismic amplitudes at the different depth levels and the thickness of the different CO₂ accumulations a more detailed image of the distribution has been acquired. From this more detailed interpretation again volume calculations of the CO₂ in situ have been carried out and compared to the actual injected volume. The results are sensitive to a number of parameters such as the rock- and CO₂-properties, but in fairly good agreement. The volume of CO₂ estimated from the seismic data tends to be too large (factor 1 to 2) with respect to the actual injected volume, however not in contradiction with respect to the uncertainty margins. A lot of effort has been put (and is still ongoing) on the sensitivity analysis and the reduction of the uncertainty margins.

Problems and difficulties encountered

The discussion on the density of the CO₂ under reservoir conditions has continued amongst partners for a while. Discrepancies were mainly due to uncertainties on and about the reservoir temperature measurements. Finally the uncertainty margin has been narrowed down to values on which reasonable consensus exists now.

Task 5.5 and 5.7 Seismic inversion (AVO) and forward modelling

Work carried out during the reporting period

Post-stack inversion has been carried out over the 3D seismic data. Pre-stack inversion has been tested on a selected 2D line and is still ongoing for the remainder of the seismic survey. The results look promising leading to a higher resolution, though they suffer from the sea-bottom multiples present in the data.

Problems and difficulties encountered

Obtaining the seismic pre-stack data from the seismic contractor (Geco) in a proper format has been tedious and too long. This has delayed the start of the pre-stack inversion process considerably.

Task 5.8 Feasibility micro-seismic monitoring**Work carried out during the reporting period**

The finalisation of the report is still ongoing.

Problems and difficulties encountered

None.

Task 7 Thermodynamic and petro-acoustic lab experiments**Work carried out during the reporting period**

The methodology of measuring Gassmann's parameters in the lab by di-phasic fluid substitution has been completed. The report will be distributed soon.

Furthermore an Excel Dynamic Library enabling an easy computation of the density and the compressibility of CO₂ containing CH₄ traces for a wide range of P-T conditions has been constructed and distributed among the partners.

Finally the impact of freezing on acoustic properties of saturated loose sands has been tested: a first experiment tends to show that after a freezing/defreezing cycle the acoustic properties are not too much disturbed (surprising and encouraging for future work on frozen cores).

Problems and difficulties encountered

Transport of the frozen core from Norway to France was not straightforward.

Brief forecast of next six months activities

A 2-days meeting of the seismic Work Package partners was held in Trondheim at June 26th and 27th, where final deliverables and responsibilities were agreed.

Task 5.4

Interpretation of the 2001 survey

Volume estimate based on amplitudes only

Volume calculation including saturation function

Study push-down effect (near-offset interpretation)

Task 5.5 and 5.7

3-D pre-stack inversion (incl. Required velocity model) on different time-lapse surveys
Volume calculation from pre-stack inversion

Task 5.8

Finalisation of the report

Task 7

Test of geophysical impact of CO₂ phase change under reservoir conditions (P-T)

Commence Final Work Area 5 Report.