

CO₂ Storage and Testing Enhanced Gas Recovery in the K12-B Reservoir

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TNO | Knowledge for business



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Overview

- Introduction
- Geological Model
- Test results
 - Test 1
 - Test 2
 - Vertical Flow Performance
 - Reservoir Simulation Model
 - History Match
 - Test 2 simulation results
- Conclusions

Introduction - setting

- Kyoto Protocol => IPCC – Subsurface storage possible reduction option
- Dutch government already active for many years => CRUST
(CO₂ Re-use through Underground Storage)
- Gaz de France Production Nederland B.V. (GPN) operator of the K12-B field
- The Offshore RE-injection of CO₂ (ORC) by GPN is supported by the CRUST project.

Introduction – larger context

- World wide several ongoing storage projects:
 - Sleipner offshore/Norway Statoil
 - K12-B offshore/Netherlands Gaz de France
 - In Salah onshore/Algeria BP
 - Weyburn onshore/EOR/Canada EnCana
 - Japan onshore/test/Japan RITE
 - Frio onshore/test/USA DOE/Nat. Lab.
 - Allison onshore/ECBM/USA Burlington Res.
 - Snøhvit offshore/Norway Statoil
 - Ketzin onshore/German GFZ/EU-CO2SINK
 - Tarnov onshore/EOR/Poland CMI

*Incomplete list

Introduction – Key factors

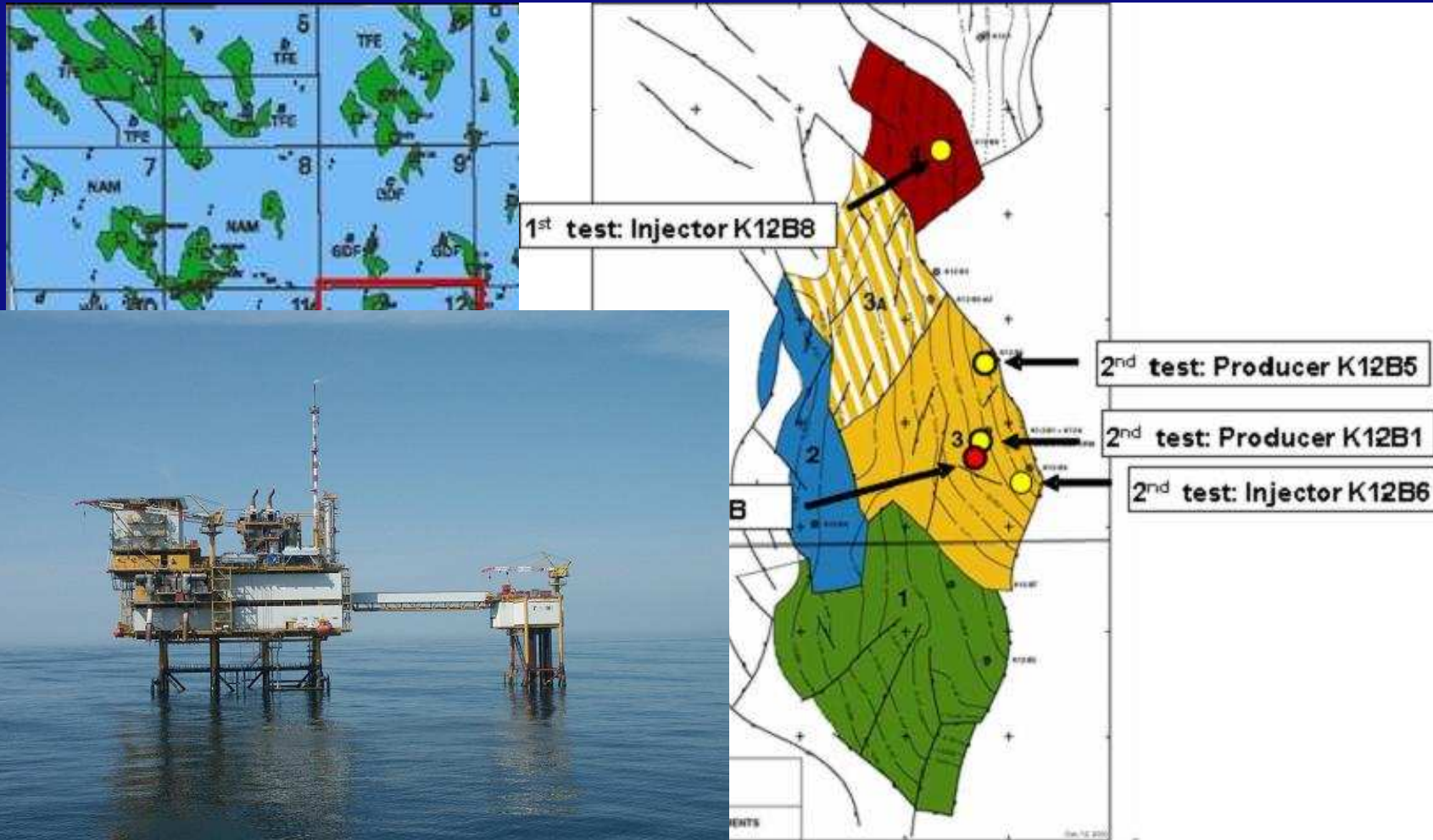
K12-B

- Gas field (nearly empty)
- Deep (3900m SS)
- High temperature (128 °C)
- Low pressure (40 bar)
- Low permeable (mD)
- Confined space
- Full test site
- ~30,000 Nm³/d

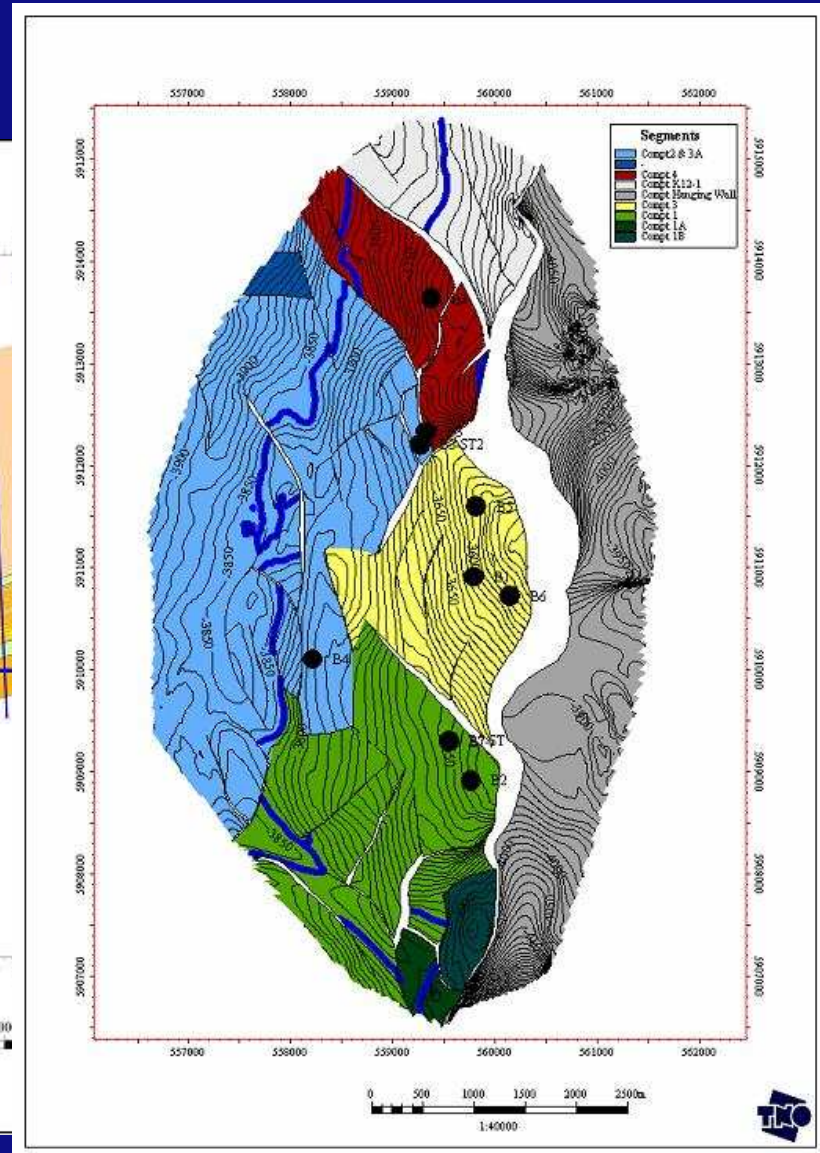
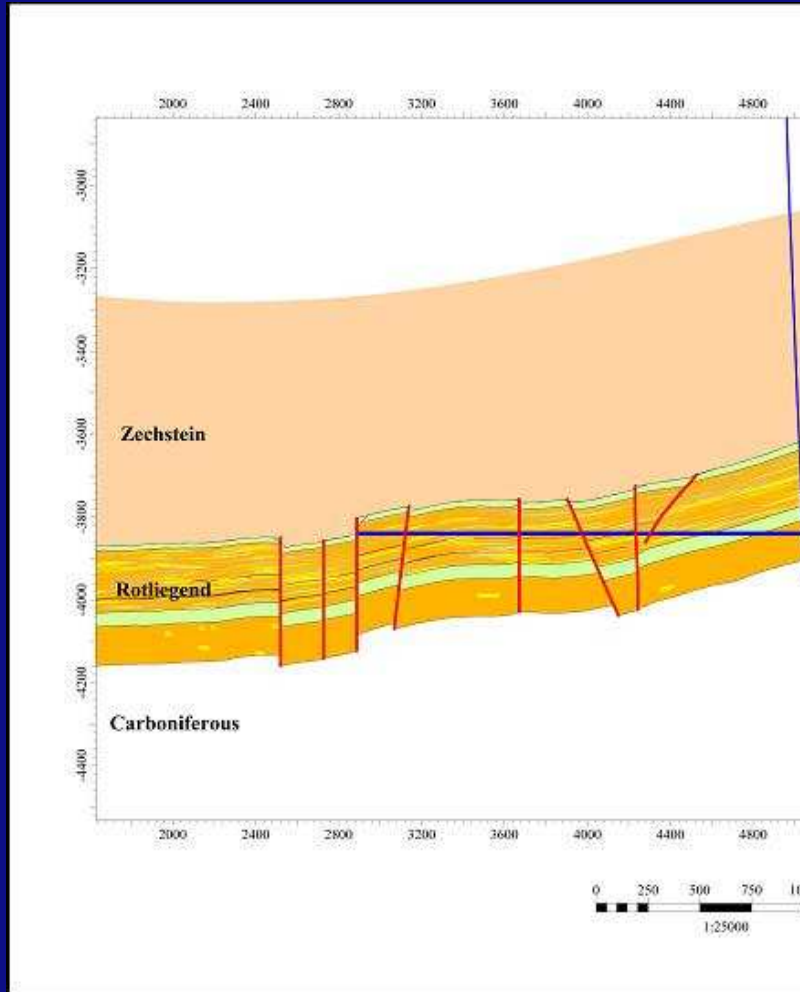
Sleipner

- Aquifer
- Shallow (800 m SS)
- Temperature ~37 °C
- Hydrostatic (100 bar)
- High permeable (D)
- Extremely large
- Restricted
- ~1,380,000 Nm³/d
- 10 years in operation

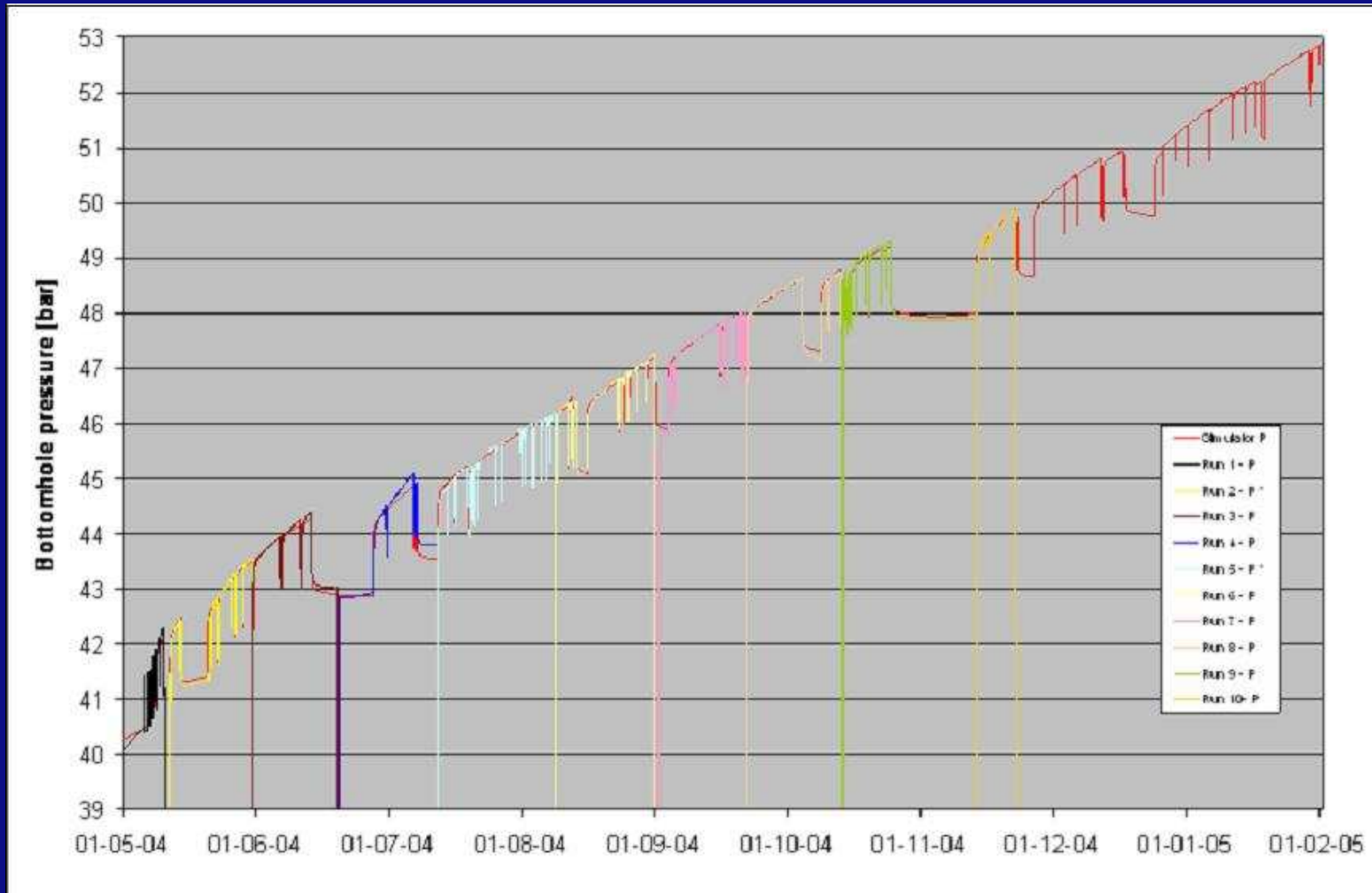
Introduction – location map



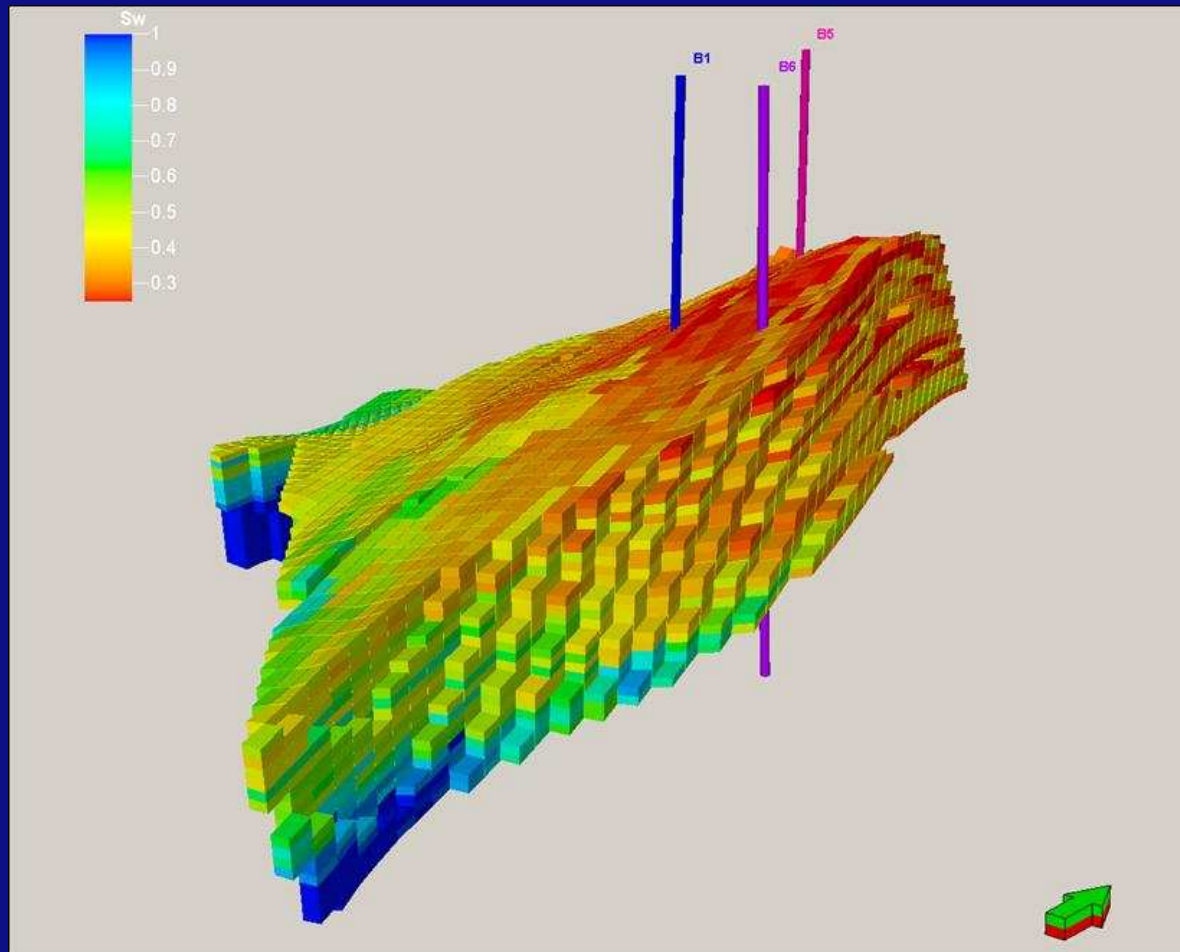
Geological Model



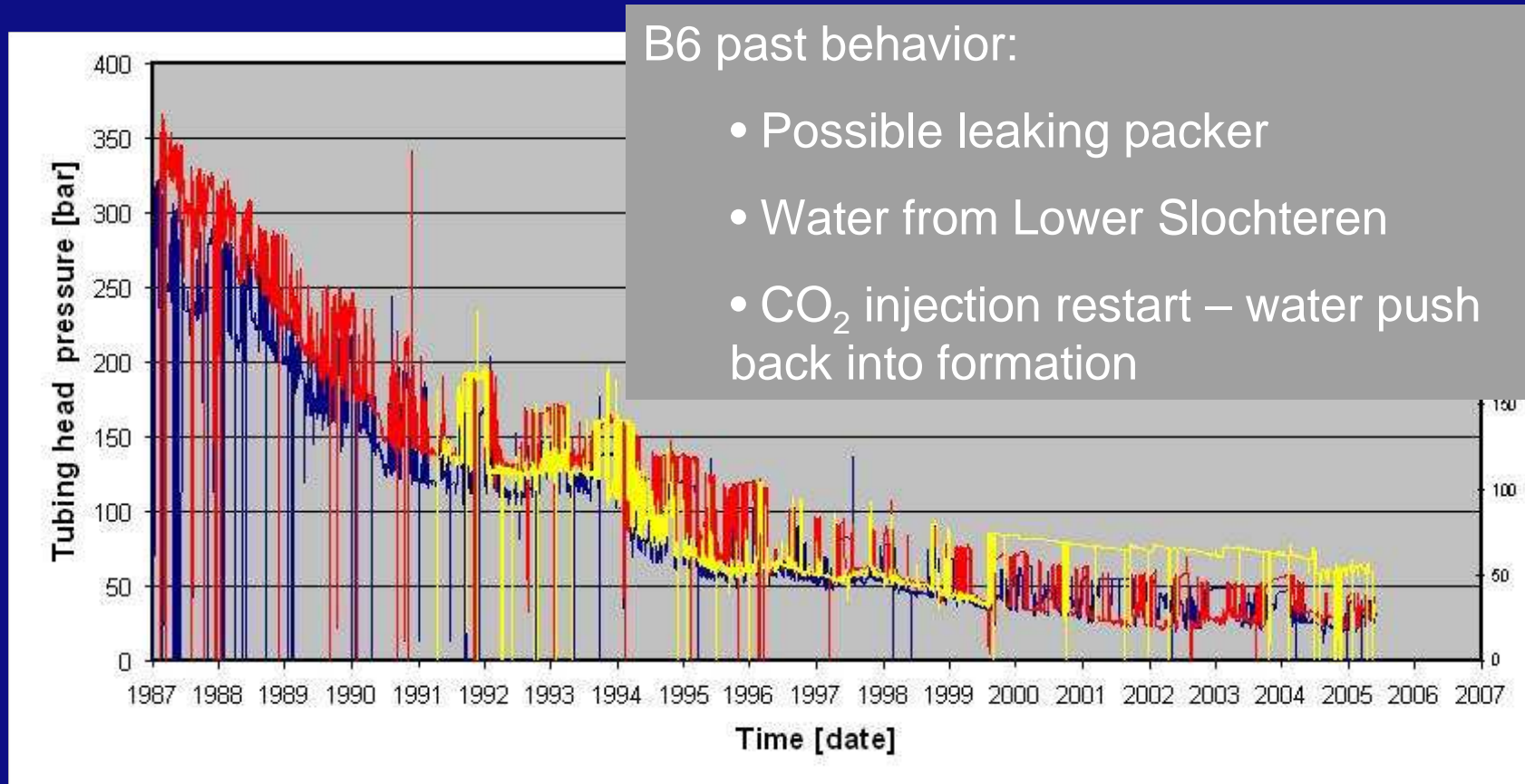
Test Results – Test 1



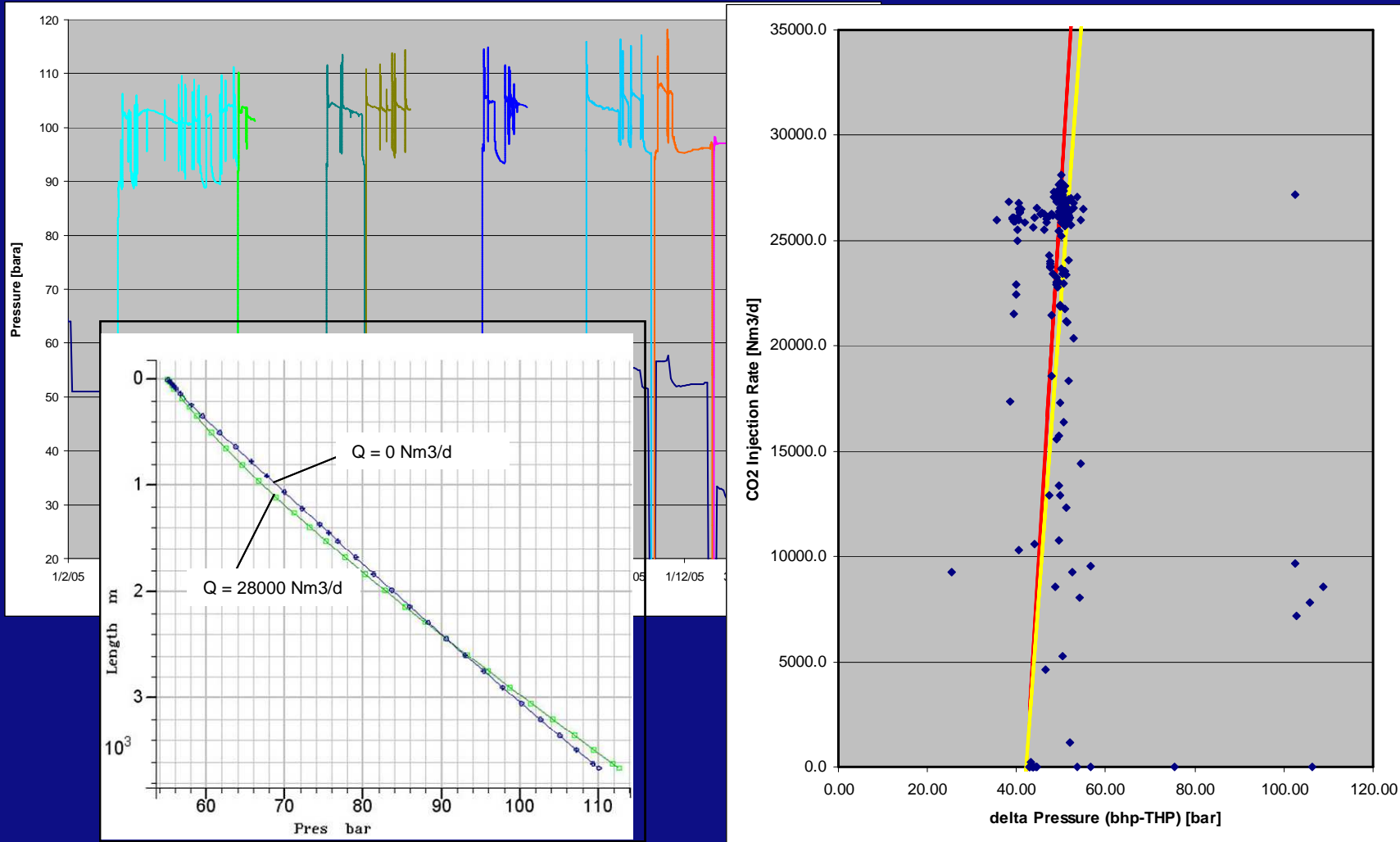
Test Results – Test 2



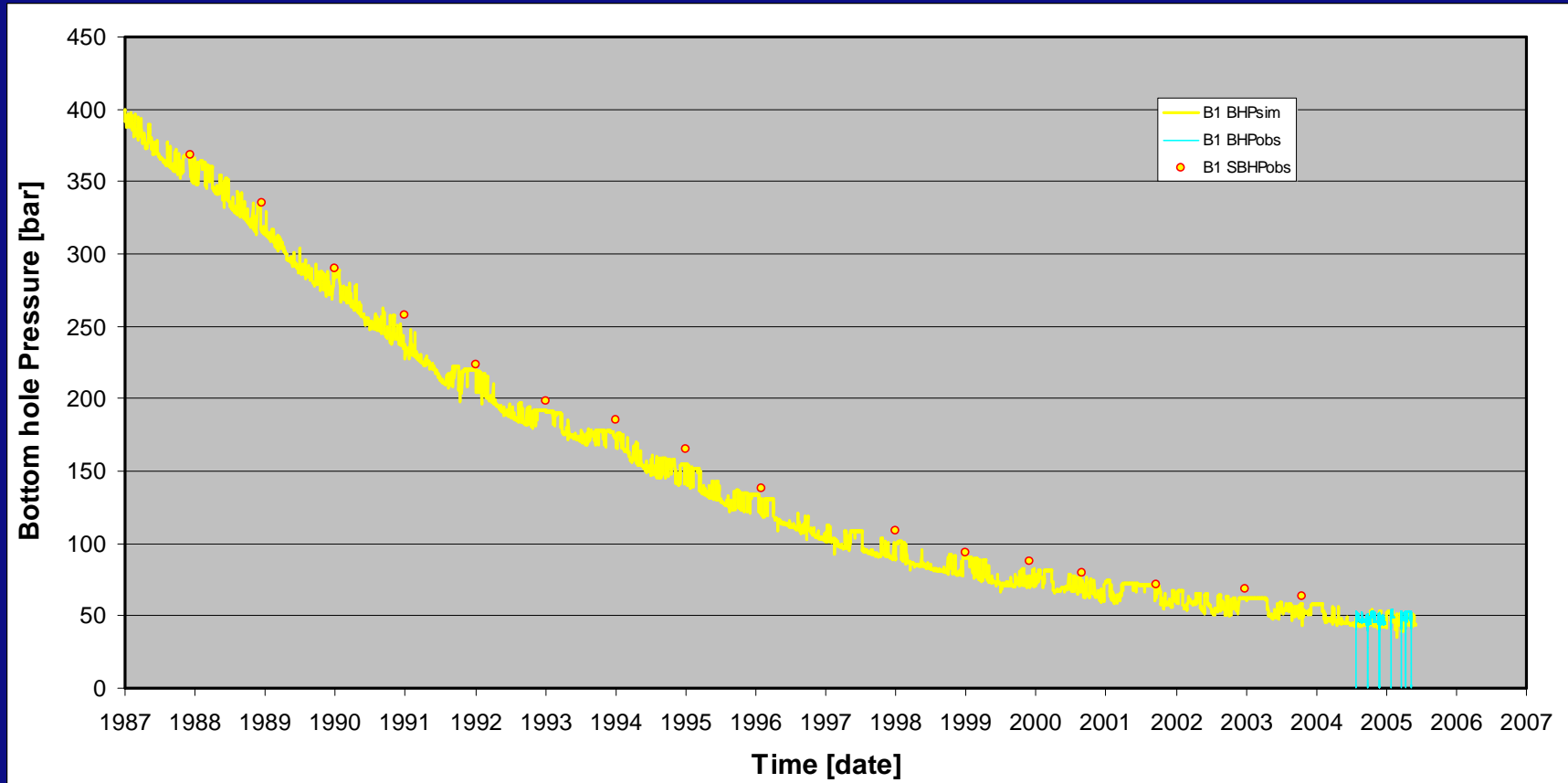
Past Performance



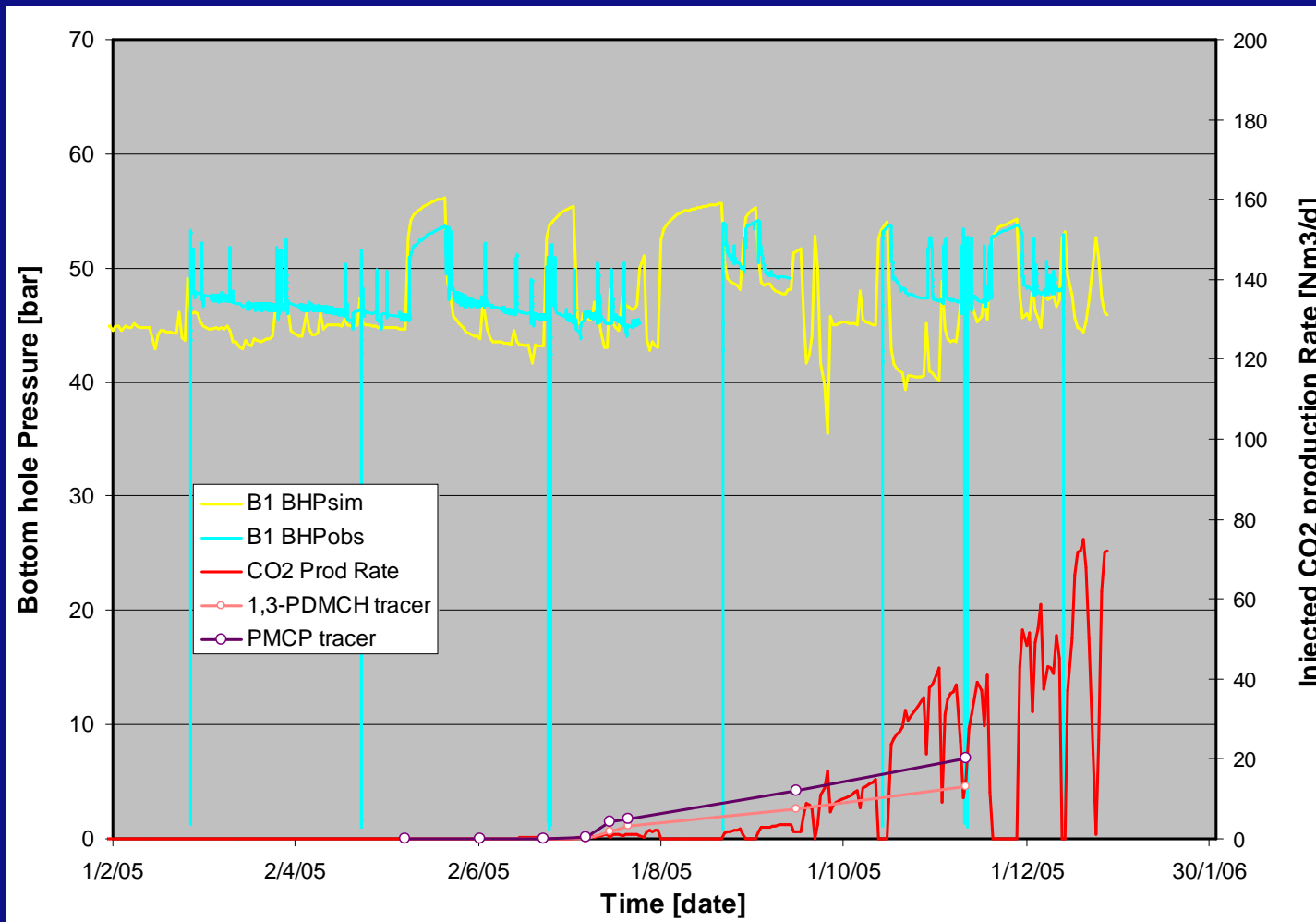
Vertical Flow Performance



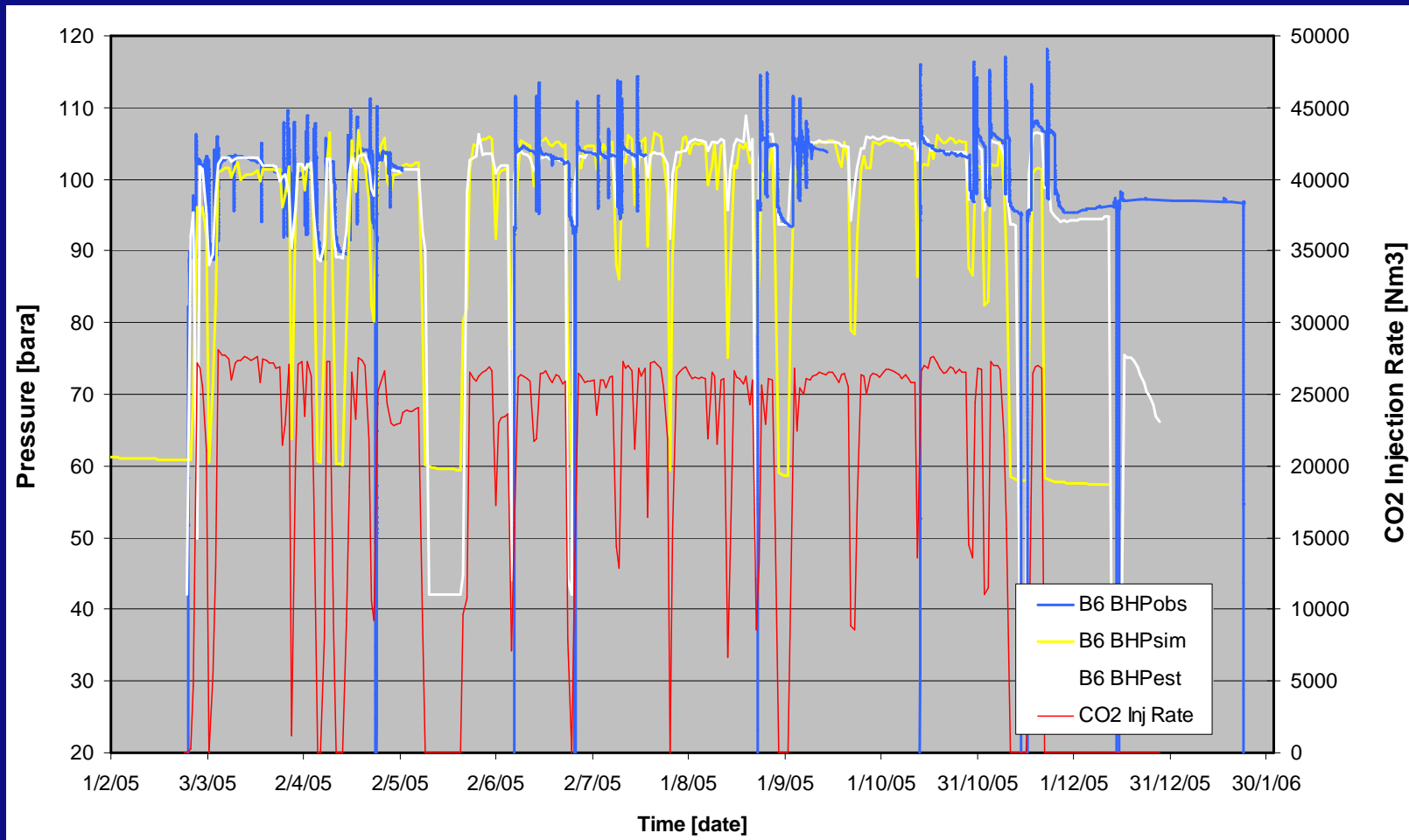
History Match



Test 2 - Simulation Results



Test 2 - Simulation Results



Conclusions

- CO₂ injection first time in Netherlands and unique in respect to active gas field, depth, pressure and temperature range.
- Past performance modeled and explained
- Detailed modeling can be used for data QC
- CO₂ injection as predicted
- CO₂ breakthrough B1 modeled is slow and gradual
- Volumetric consequences of CO₂ injection undetected in 2005 test period i.e. no EGR potential yet
- Further study needed and GPN committed to continue CO₂ injection

Acknowledgments

- GDF Production Nederland B.V. and partners
 - EXPRO North Sea
 - DRC
- Dutch Government (CRUST, CATO)
- European Commission (FP6, CASTOR)



QUESTIONS?

