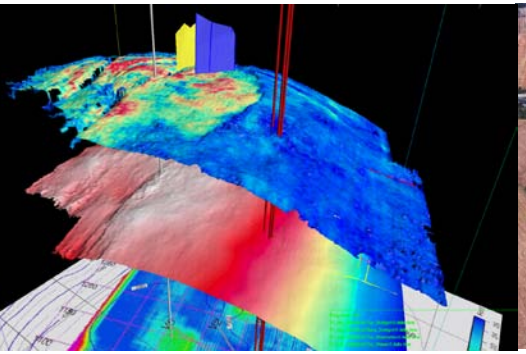
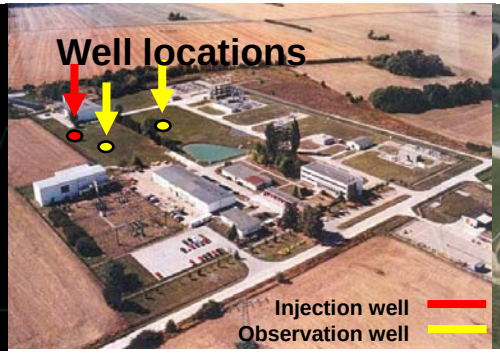
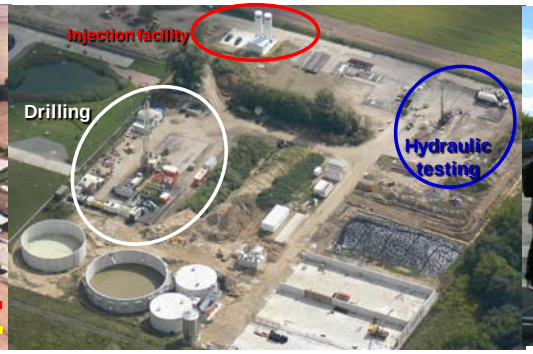
Status Report CO_2SINK

Hilke.Wuerdemann@GFZ-Potsdam.de
and the CO_2SINK Team







SIXTH FRAMEWORK PROGRAMME

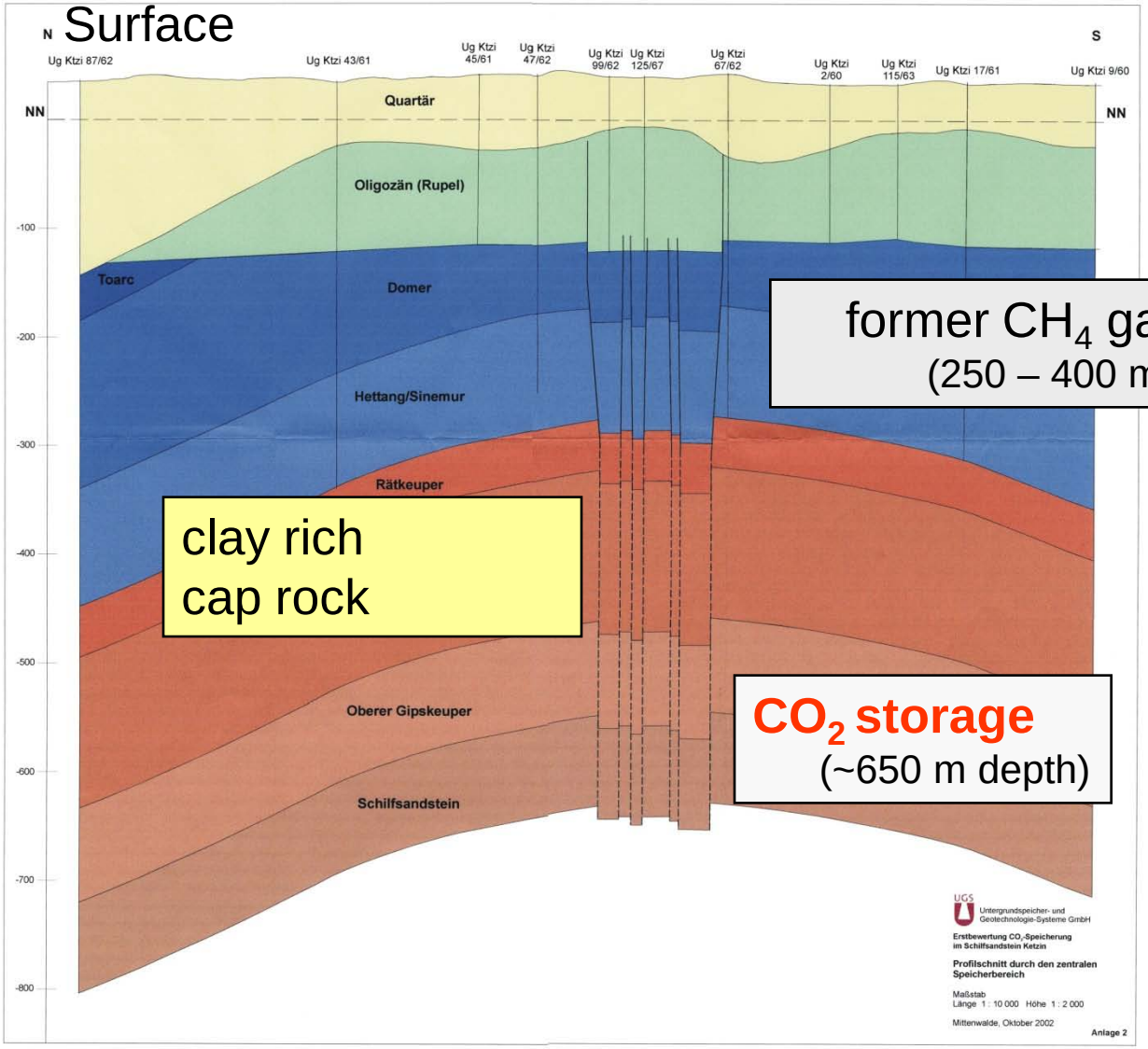
Federal Ministry of Education and Research

Federal Ministry of Economics and Technology

GFZ Helmholtz-Zentrum Potsdam

CO_2SINK

Geological Cross-Section through the subsurface near Ketzin



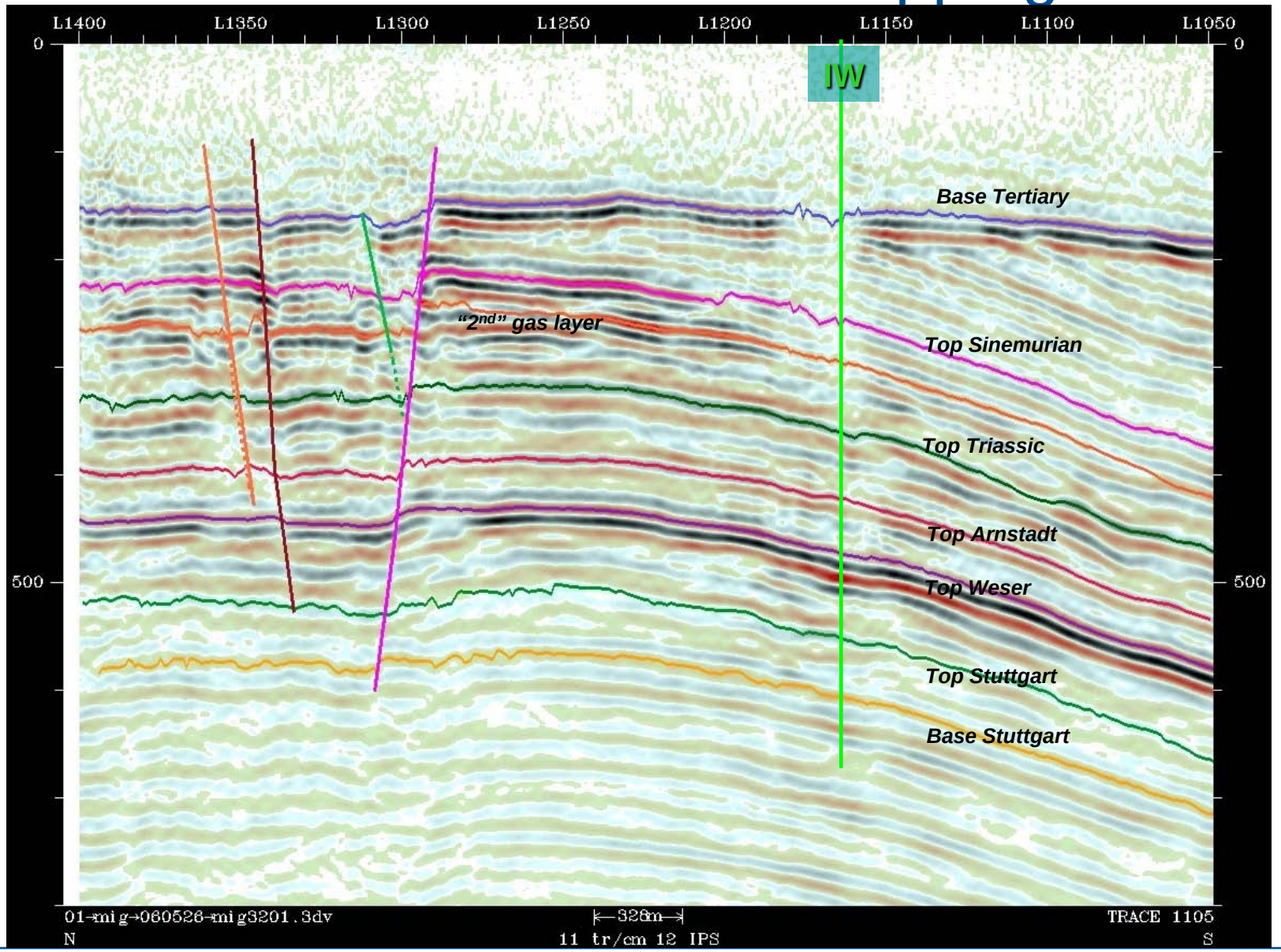
What / why do we monitor ?

- CO_2 migration (e. g., flow paths, fingering)
- CO_2 "fate" (e. g., hydrodynamic / solubility / mineral trapping / microbial reactions)
- injection process (e. g., pressure)
- caprock integrity
- reservoir integrity (cracks, faults)

→ reservoir management

→ risk assessment (numerical reservoir models: short and long term safety)

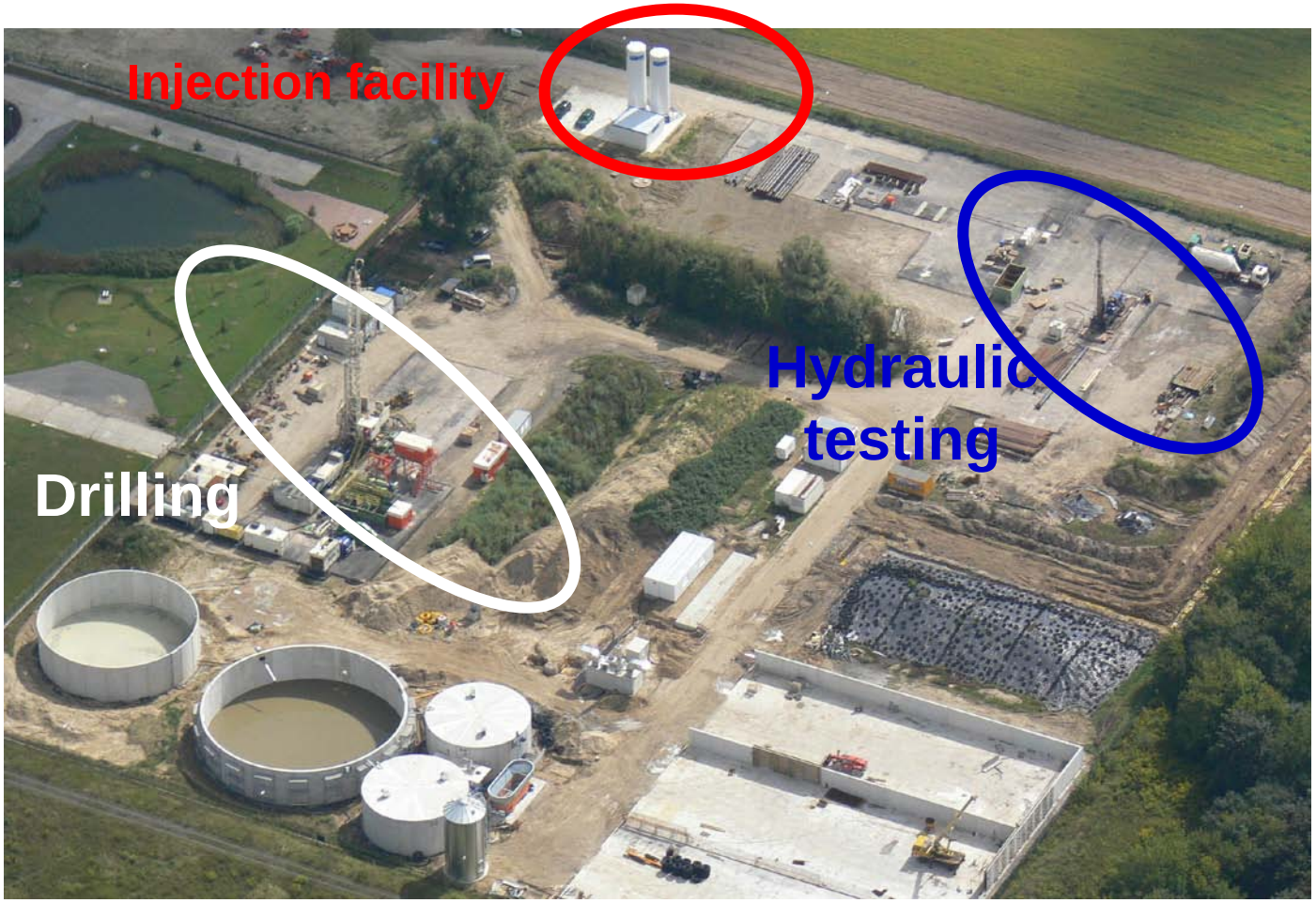
Horizon and Fault Mapping



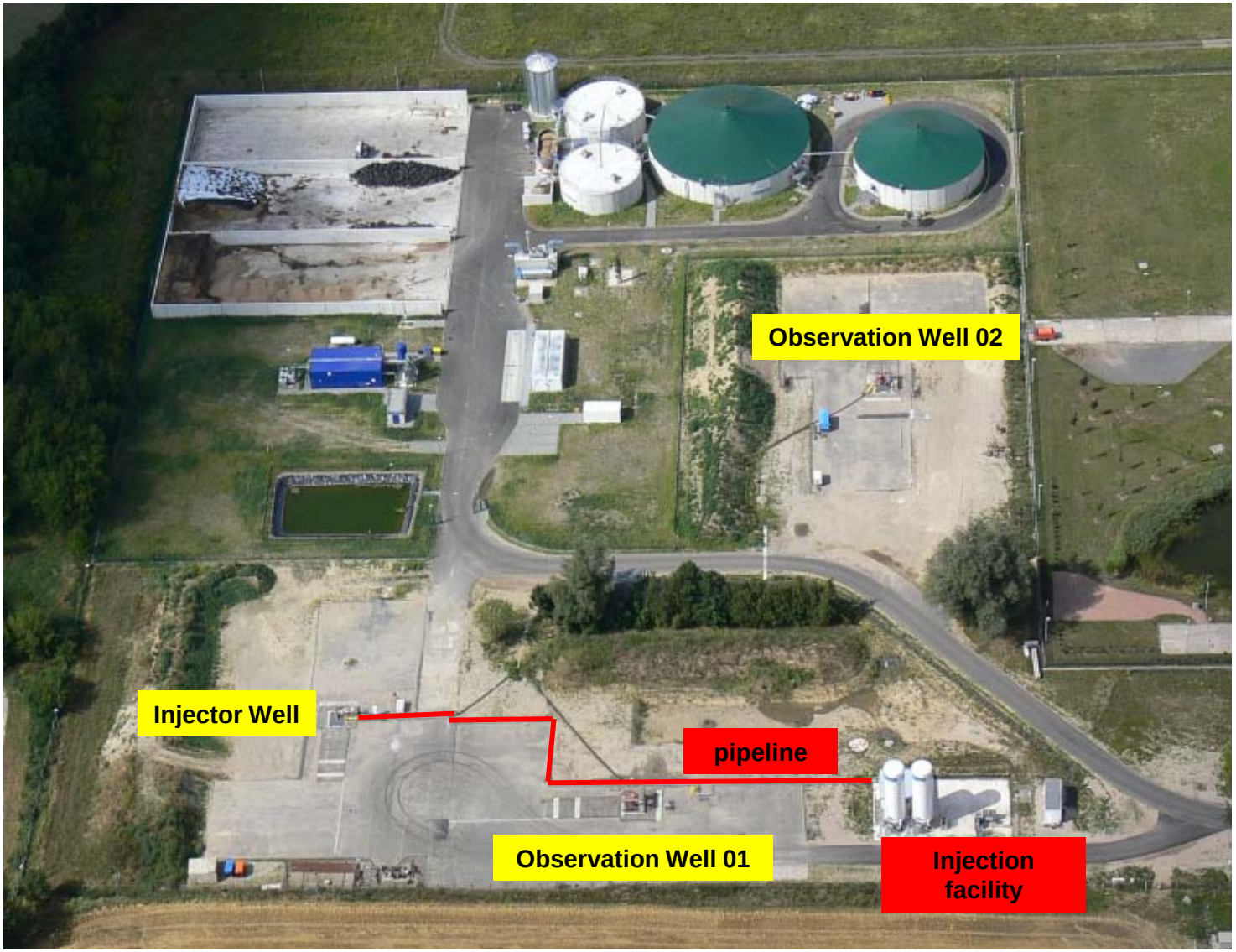
Juhlin et al. 2007

Prestorage operations completed @ Ketzin

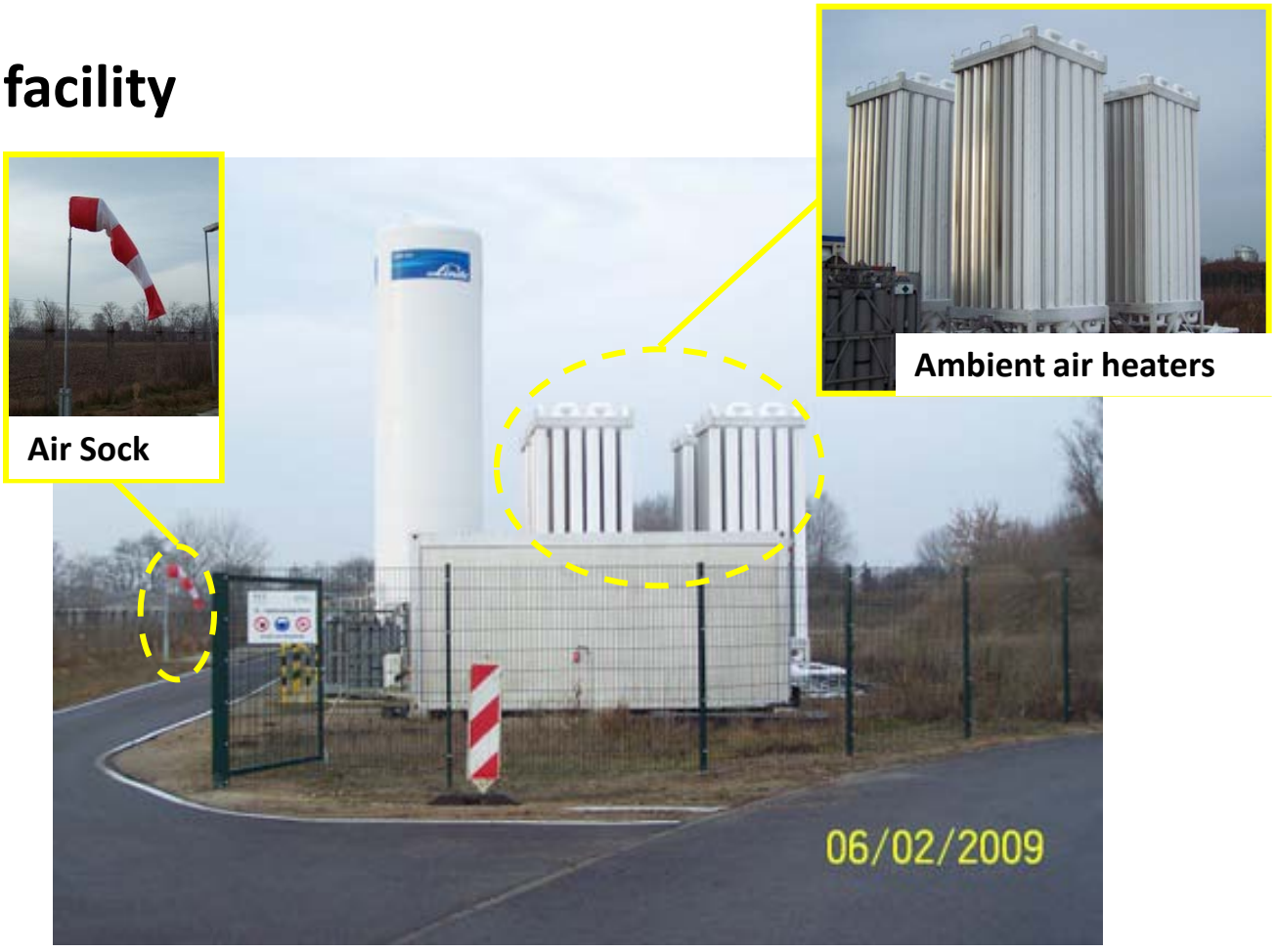
Completion of 3 wells with smart casing, Baseline Measurements



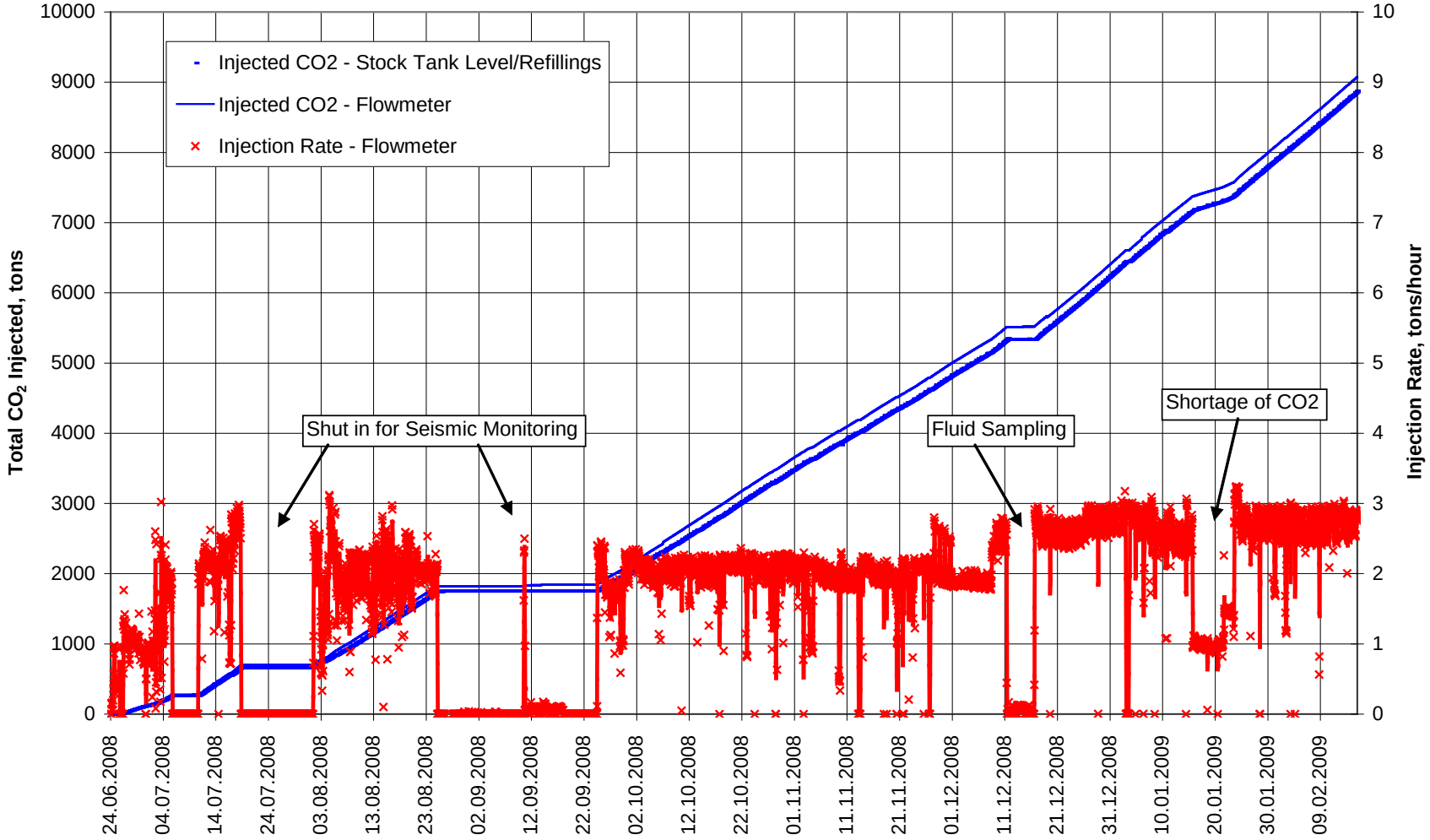
CO_2SINK in Ketzin

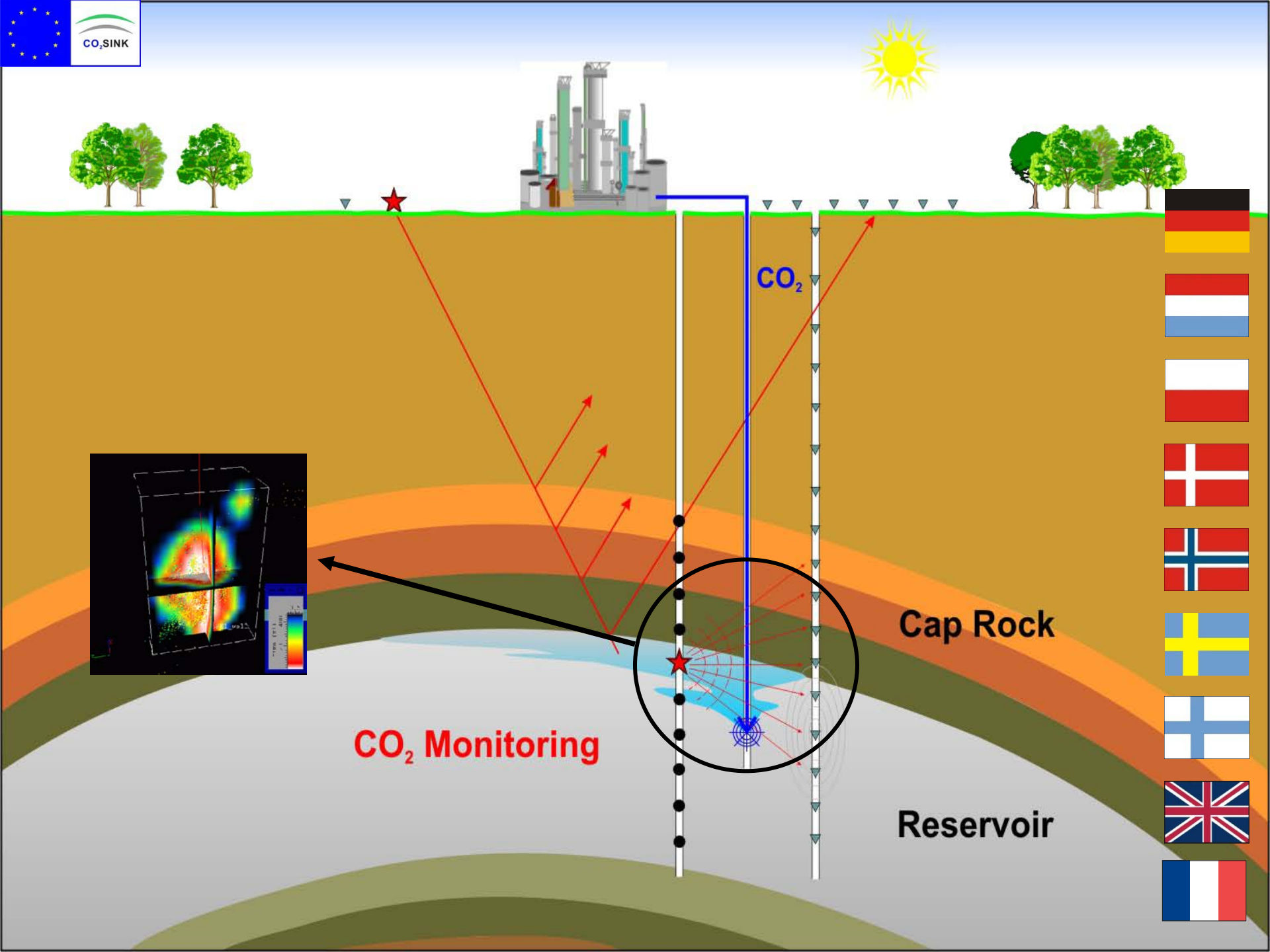


Injection facility



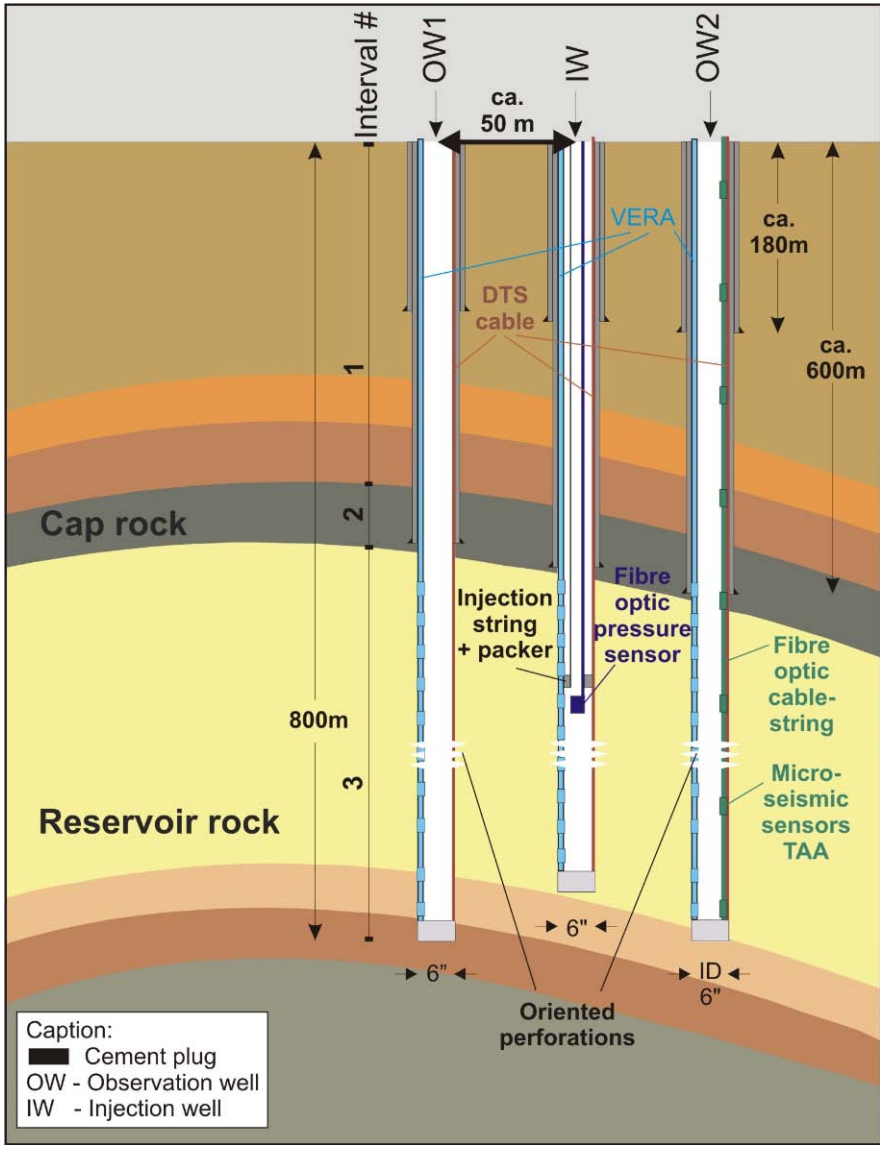
Injection Rates and Amount of CO_2 injected (mass)




CO2SINK
CO2
Cap Rock
CO2 Monitoring
Reservoir

Permanent Downhole Monitoring

- Pressure (+ Temperature)
  - Fibre optic sensor
- Temperature
  - Distributed Temperature Sensing (DTS)
- Resistivity
  - Vertical Electrical Resistivity Array (VERA)



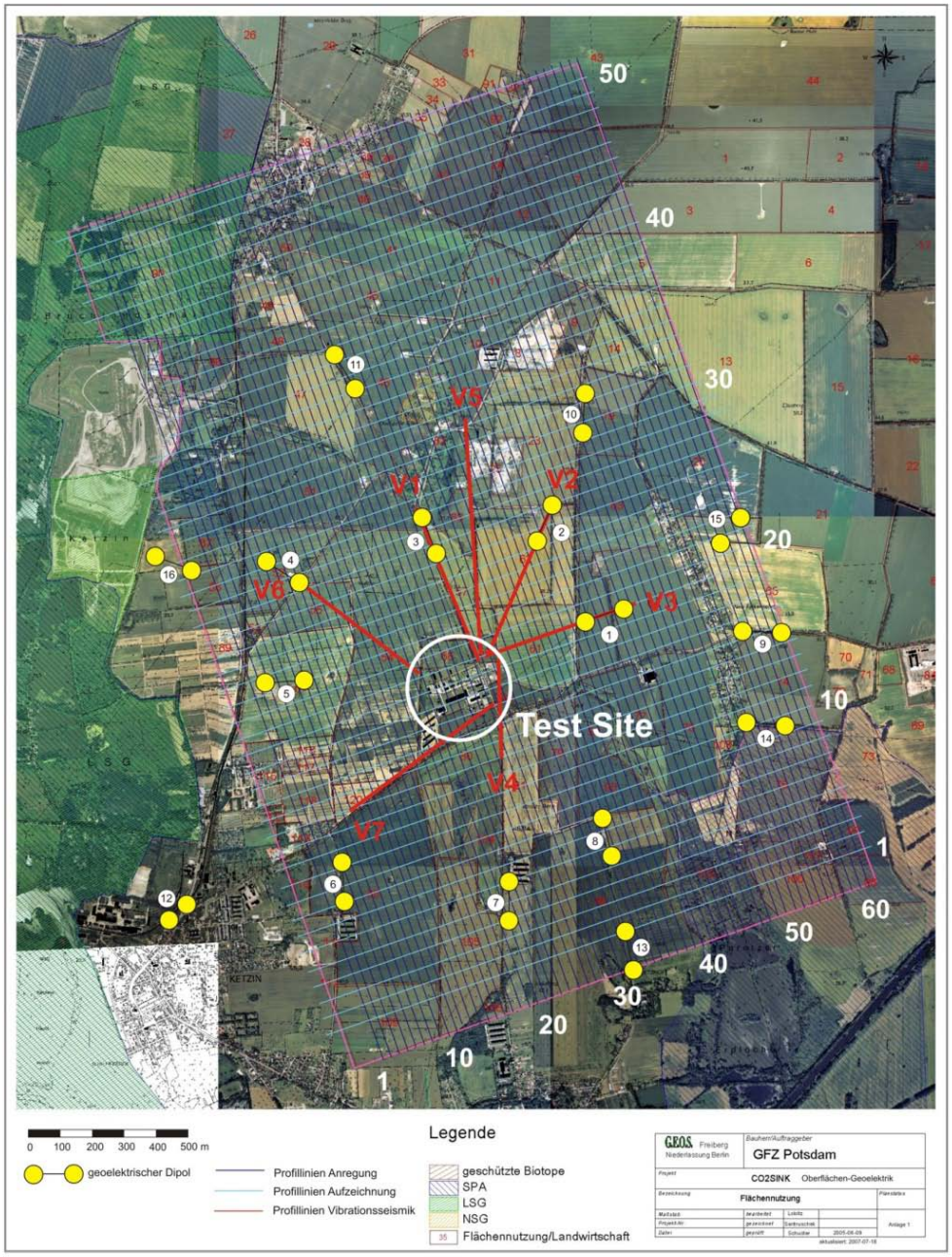
Smart Casing Concept

- Sensors placed behind the well casing

  1. Fully cemented in the annular space between casing and rock formation
  2. Special protector systems help to avoid damaging the fiber optic cables and sensors

- This concept has a number of advantages:

  1. High data quality due to small distance between the sensors and the target (injected CO_2)
  2. Same coupling conditions in all repeat measurements (time-lapse measurements)
  3. High repetition rate



Monitoring Concept of ERT and Seismics

16 Dipoles for ERT surface measurements (yellow dots)

X-hole (ERT & Seismic), MSP

3D seismic survey, smaler 3D repeats
Seismic star experiment (red lines)

Joint field experiments

- Measurement in the pre-injection phase
- Measurement after CO_2 arrival
- Measurement in the post-injection phase

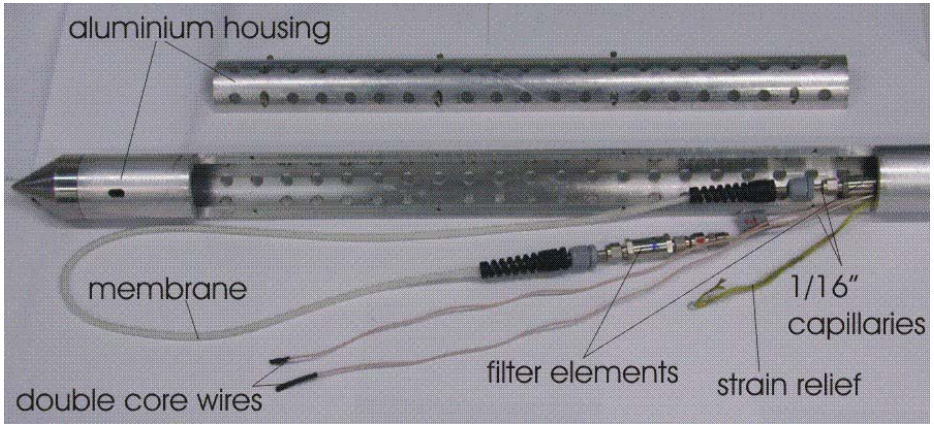
Passive Seismic Monitoring

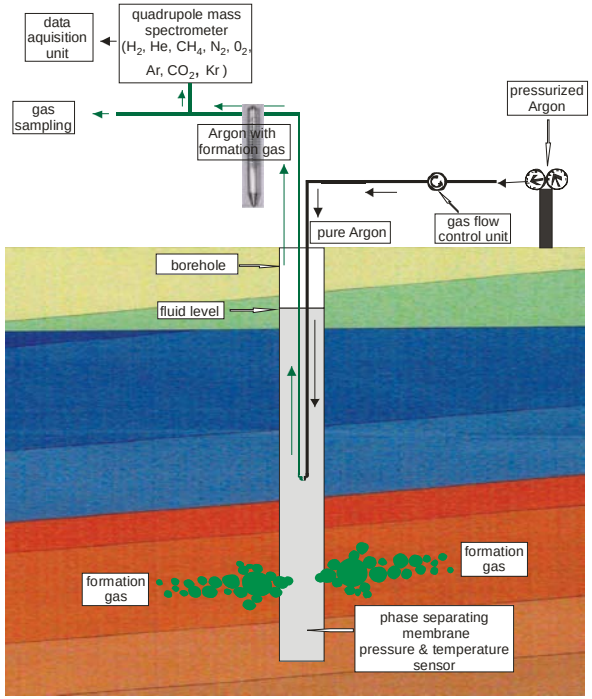
- Measurements from the surface:
  Prof. Kern, Universität Leipzig

- Combined Measurements: borehole / surface
  Giuliana Rossi, OGS Trieste


Start of CO_2 Injection
End of June 2008

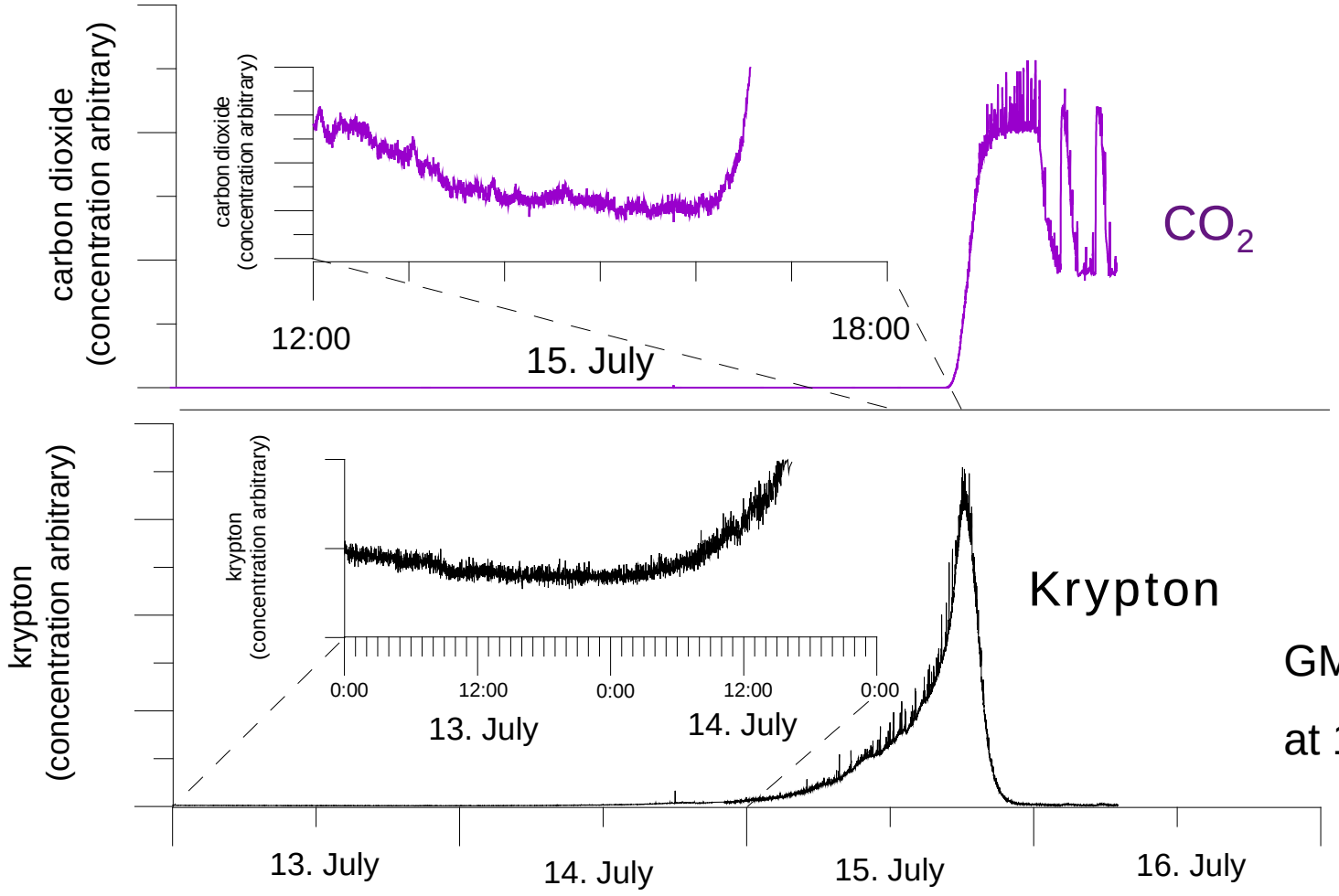
Gas Membrane Sensor





Zimmer *et al*. 2008

Arrival of CO_2 in Ktzi 200 (OW1): CO_2 and Kr (Tracer)

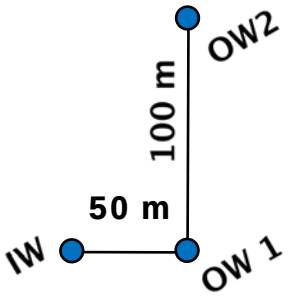


GMS Sensor

at 150 m depth

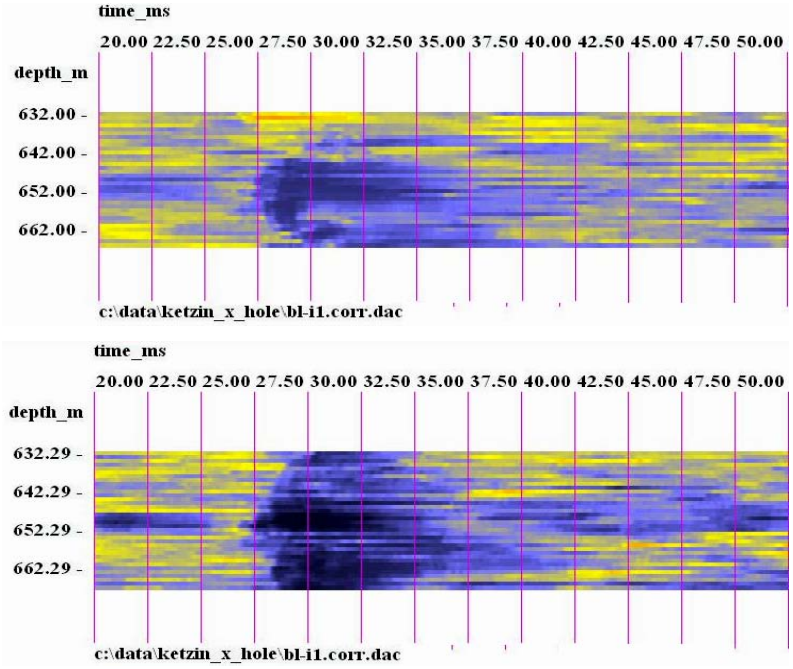
Zimmer *et al*. 2008

Amount of CO_2 injected

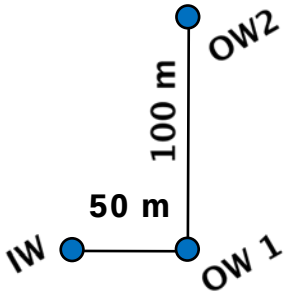


	Date:	injected CO_2:
Facility test & preparation	24.06.2008	test amount of CO_2, Kr-tracer, N_2
Start of CO_2 injection	30.06.2008	~ 0 t CO_2
Arrival of CO_2 at OW1 (Ktzi 200)	15.07.2008	531,5 t CO_2
Expected Arrival at OW2 (Ktzi 202)	????	~ 3.600 t CO_2
Today	04.03.2009	~ 9.800 t CO_2

Crosshole Seismics – first results



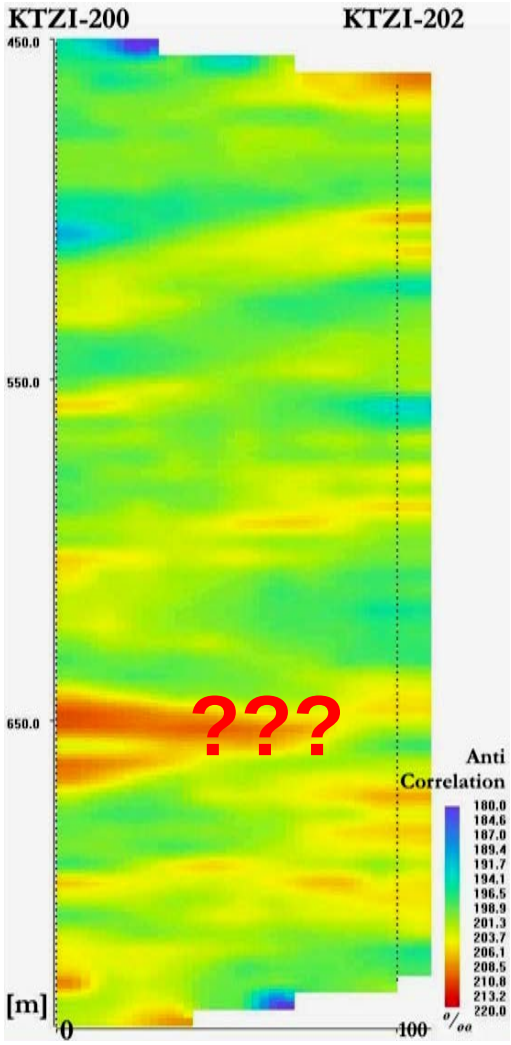
To date no change in seismic velocity,
only in coda of first break



Inversion of correlation
Amplitudes of time-lapse measurements

Cosma et al. 2008

OW 1 OW 2

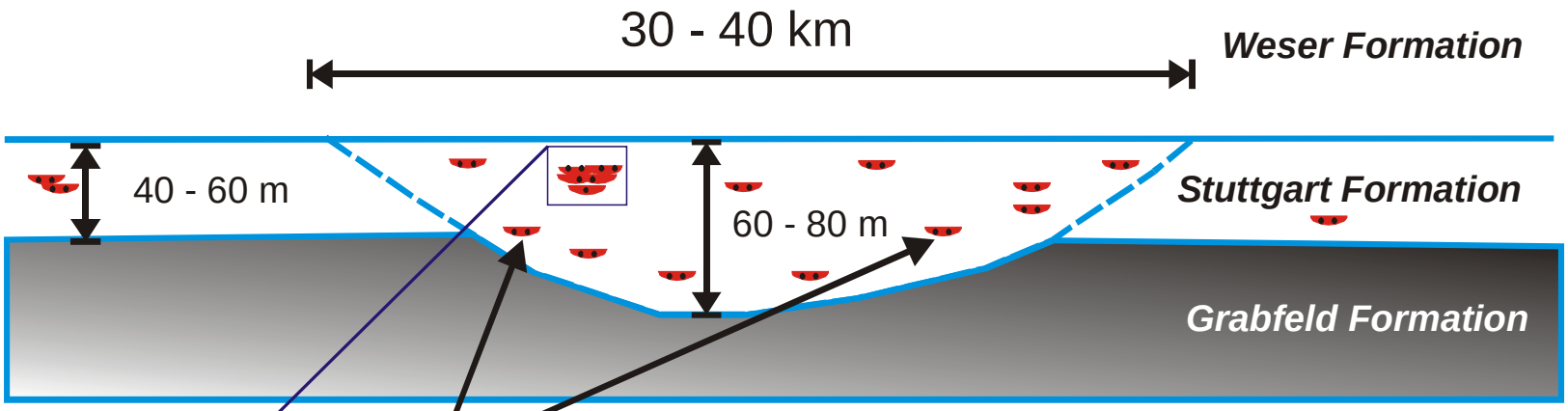


„Sand“ channels in channel facies

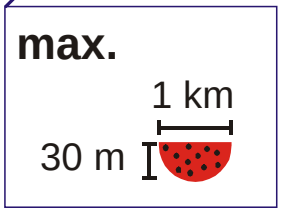
flooding facies
(Überflutungsfazies)

channel facies
(Strangfazies)

flooding facies
(Überflutungsfazies)

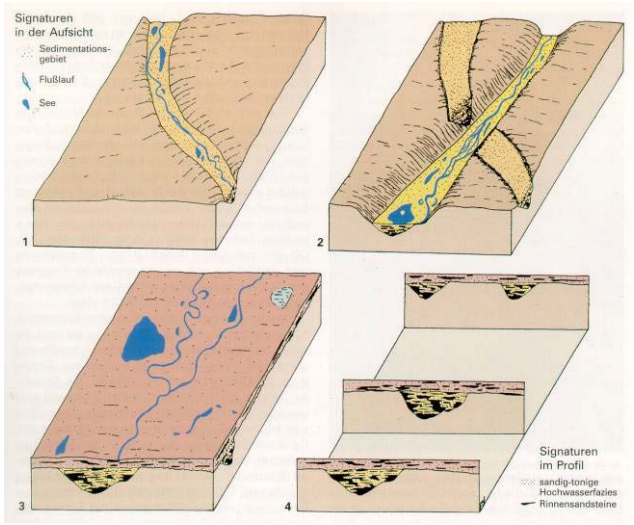


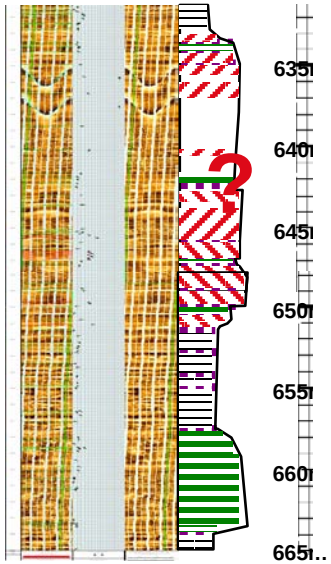
channel sandstone
(Rinnensandstein)

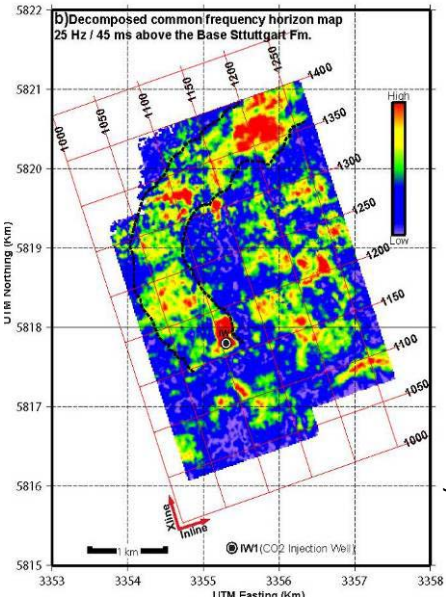


internal structure ?

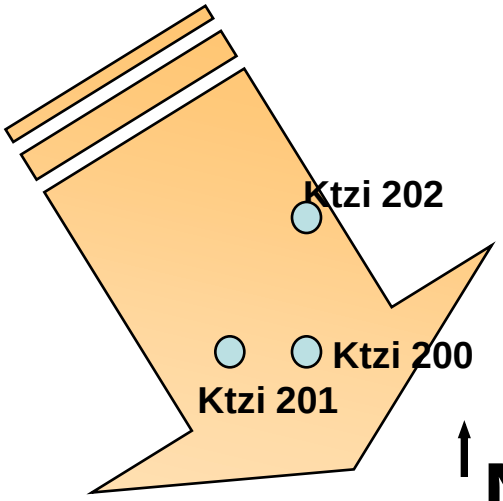
- **fluviatile origin**
- **large lateral and vertical variations of the reservoir conditions in the Stuttgart formation**

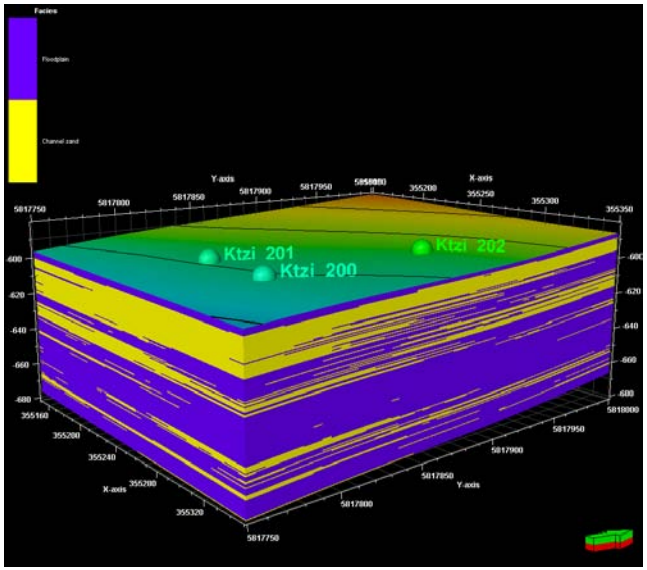


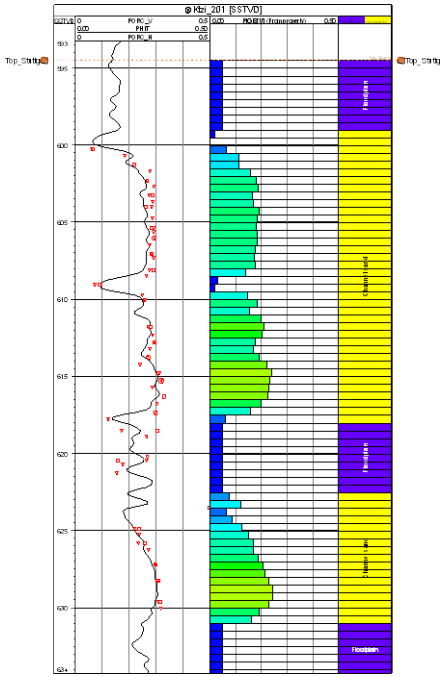




Kazemeini et al., 2007





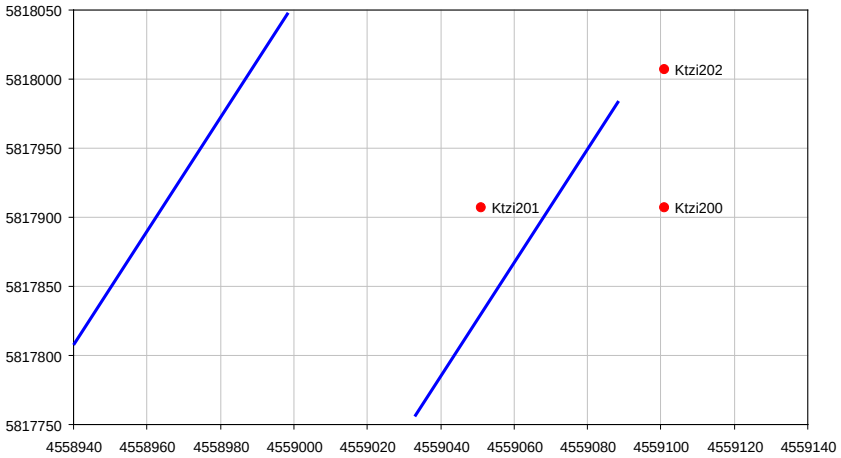


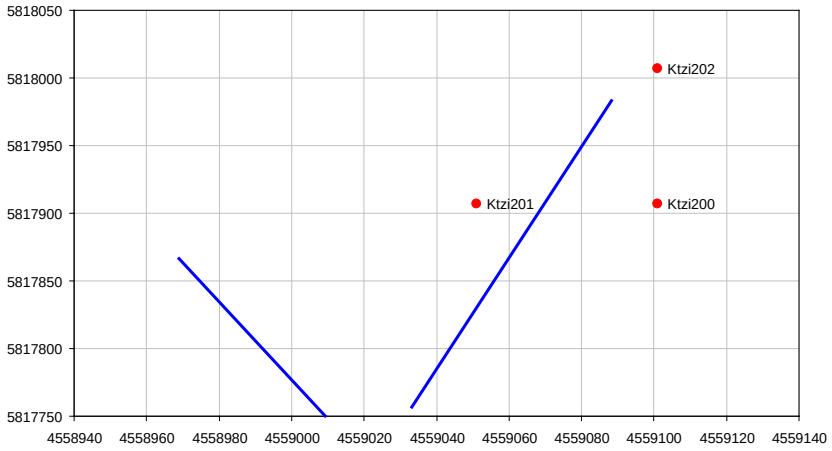
03.03.2008

WP 3.2 B. Norden

Interpretation of Hydraulic Tests

Possible configurations of impermeable boundaries





Pumptests showed a permeability between 50 and 80 mDarcy

Würdemann & Golder Associates 2007

In-situ R&D Laboratory for Geological Storage of CO_2
- CO_2SINK Integrated Project -

GeoForschungsZentrum Potsdam (D)
G.E.O.S. Freiberg Ingenieurgesellschaft (D)
Geological Survey of Denmark and Greenland (DK)
Mineral and Energy Economy Research Institute (PL)
Det Norske Veritas (N)
StatoilHydro (N)
Shell International Exploration and Production (NL)
University of Stuttgart (D)
Vibrometric Finland (SF)
University of Kent (GB)
Uppsala University (S)
RWE Power AG (D)
International Energy Agency – Greenhouse Gas Programme (GB)
Vattenfall Europe Generation (D)
Verbundnetz Gas AG (D)
Siemens AG Power Generation (D)
E.ON Energie AG (D)
Schlumberger Carbon Services (Fr)

CO_2SINK and related projects

18.02.2009 – 12 th Project Meeting of CO_2 SINK