Gas Monitoring in Ketzin

The Bore Hole Gas Membrane Sensor (GMS)

Martin Zimmer, Jörg Erzinger, Christian Kujawa, Peter Pilz, Alexandra Szizybalski
Objectives

To determine the fluid geochemistry in general and to characterize existing surface and subsurface gases in order to:

• register changes during the storage process to detect the arrival of CO$_2$ at the observation wells and

• monitor the CO$_2$ fluxes and concentration at the surface for safety reasons
Network of Surface and Shallow Subsurface Monitoring Sites

- **Meteorological station**
- **CO₂ soil flux determination**
- **Multi sensor in groundwater well**
- **CH₄ determination (in 2 m deep wells)**
- **Isobaths of the storage horizon**
- **Test site**

Map showing monitoring sites with various symbols for different types of data collection.
Ketzin Test Site

- **CO₂-sensors** below base plate
- **Li-COR accumulation chambers**

**Observation well 1**

**Observation well 2**

**Injector well**
Riser Tube in Well 1

- Lubricator
- Needle valve
- Gas analyser
- 6 mm stainless steel tubing
- 40 μm filter
- 8 ltr./min
- 640 m
Gas Analysers

gaschromatograph

mass spektrometer

photo acustic sensor
The Bore Hole Gas Membrane Sensor (GMS)

- Data acquisition unit
- Quadrupole mass spectrometer ($H_2$, $He$, $CH_4$, $N_2$, $O_2$, $Ar$, $CO_2$, $Kr$)
- Gas sampling
- Argon with formation gas
- Pure argon
- Gas flow control unit
- Borehole
- Fluid level
- Phase separating membrane
- Pressure & temperature sensor
- Formation gas
- Perforated casing

Patent No.: US 7,523,680 B2
Installation of the GMS in Ktzi202/07 and 200/07

19. June 2008
Injection of 6925 l STP Krypton  
(20. June 2008 7:25 - 9:00)
Arrival of Kr and CO$_2$ in Well 1 and Well 2

Observation well 1
Ktzi 200/07
(50 m distance)

Observation well 2
Ktzi 202/07
(112 m distance)

Injected CO$_2$, 500 tons

Injected CO$_2$, 11,000 tons
Cleaning Injection Well
(15th - 17th June, 2008)

N₂-lift with 30,000 m³(STP)N₂
KCl Injection and Pressurizing the Well

(17th - 20th June, 2008)

- Injection of 30 m$^3$ KCl solution
- Injection of 6.925 m$^3_{(STP)}$ Kr gas tracer
- Injection of 128 m$^3_{(STP)}$ N$_2$
Bioactivity in the filter screens:

- Methanogenetic archaea produce CH$_4$
- Sulfate reducing bacteria produce H$_2$S reacting with the casing to FeS and H$_2$
First CO₂ Injection
(24th June, 2008)

Displacement of the gas through the injection of CO₂
Summary

• The GMS system is a cost-effective gas monitoring tool for long term direct gas investigations.

• The arrival of injected CO$_2$, technical N$_2$ and the Kr tracer at the observation wells were detected with the GMS systems.
Outlook:
Drilling a Third Observation Well
Third Observation Well

gas samples

fluid samples

pressure

monitoring string

gas-membran-sensor (temperature, pressure)

U-tube