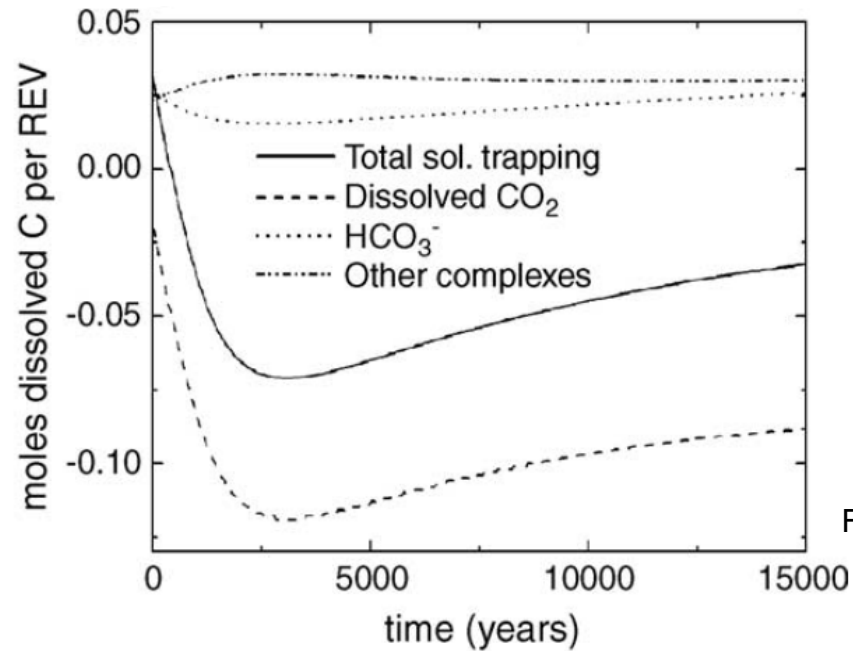


AQUA-DK

Geochemical response to CO₂ storage



From Gaus et al. (2005)

Claus Kjøller – GEUS Core Laboratory

Project sponsors – AQUA-DK

- **EUDP – The Danish Energy Agency**
- **DONG Energy**
- **Vattenfall**

Project team – AQUA-DK

● GEUS

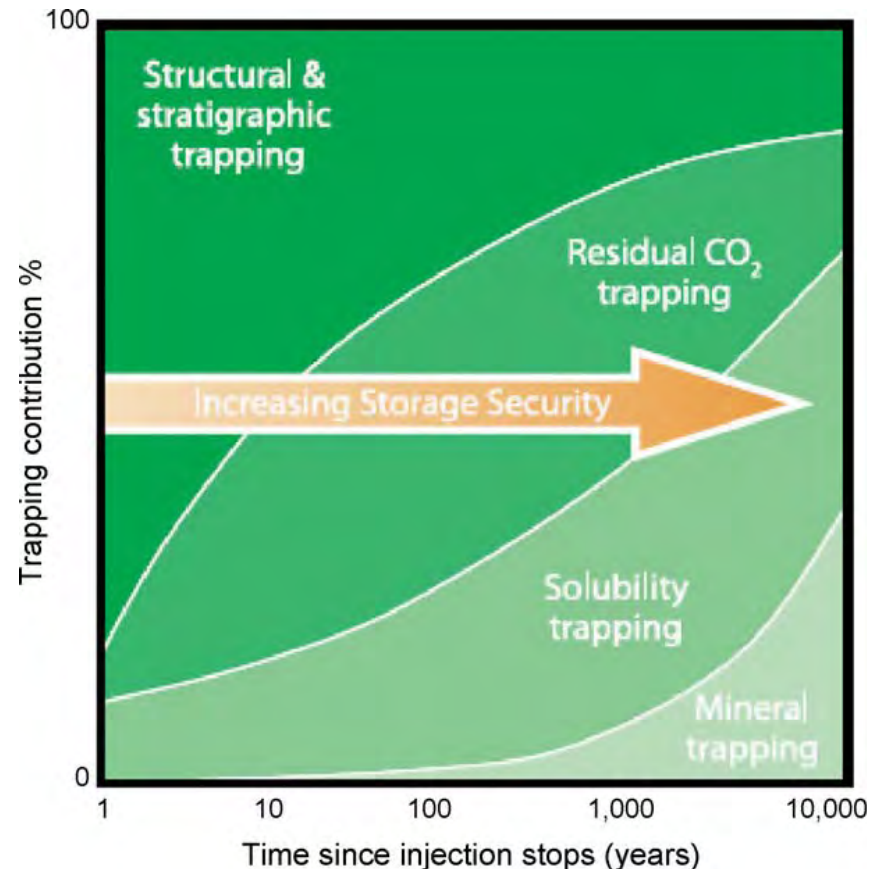
- Rikke Weibel Hansen – Petrography, mineralogy, geochemistry
- Lars Henrik Nielsen – Stratigraphy
- Niels Springer – Petrophysics, cap-rock analysis
- Troels Laier – Hydrochemistry, geochemistry
- Peter Frykman – Reservoir modeling
- Claus Kjøller – Hydrochemistry, reactive transport modeling

● BGS

- Keith Bateman – CO₂/rock interaction experiments

Why is chemistry interesting ?

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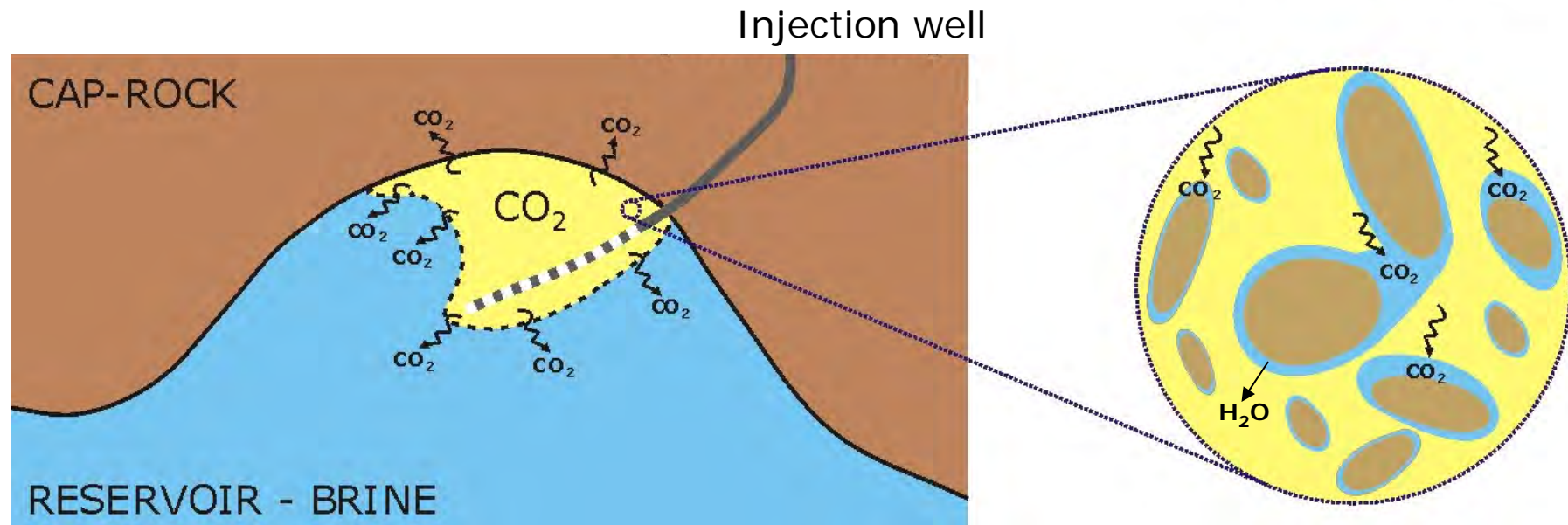


From IPCC (2005)

Why is chemistry interesting ?

RESERVOIR SCALE

PORE SCALE



Addition of acid and carbonate: $\text{CO}_2(\text{g}) + \text{H}_2\text{O} \leftrightarrow \text{H}_2\text{CO}_3 \leftrightarrow \text{H}^+ + \text{HCO}_3^-$

Evaporation of H_2O (not dealt with in AQUA-DK)

CO₂/mineral reactions and their effect

Reservoir

- Where is CO₂ stored - Brine, pore space, minerals ?
- Storage capacity – Larger, smaller or unchanged ?
- Rock physics – Dissolution of "important" minerals ?
- Injectivity – Risk of precipitation near well ?

Cap-rock

- Rock physics – Dissolution of "important" minerals ?
- Porosity and permeability – Change in properties ?

CO₂/mineral reactions and their effect

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All effects are site specific (depositional history, mineralogy, etc.)

=> need for investigations at every site !!!

AQUA-DK objectives

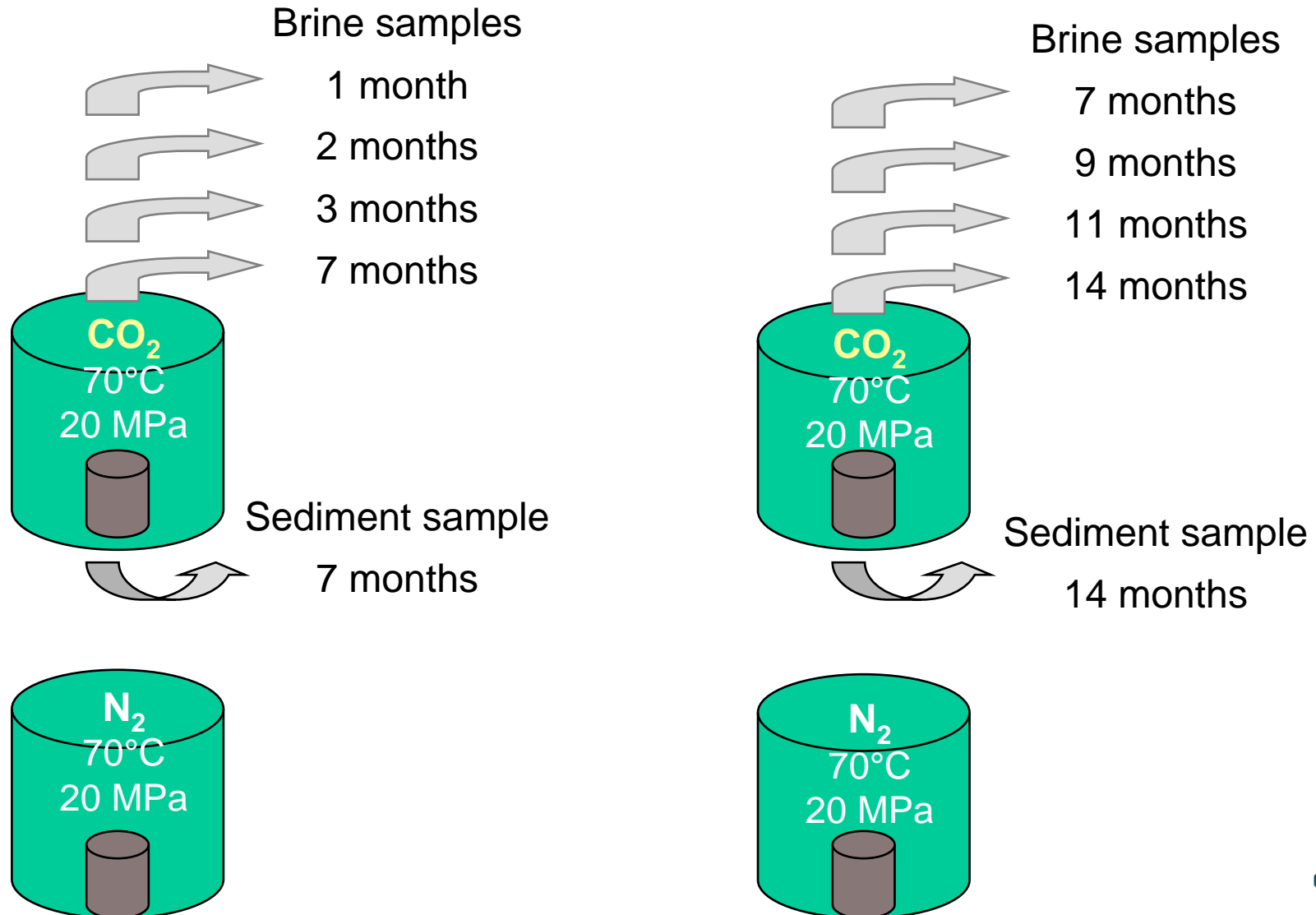
- **To study the possible chemical effects on reservoir rock and cap-rock of long-term CO₂ storage in saline aquifers in Denmark**
- **If possible – to distinguish between site specific effects and more general effects**

AQUA-DK "toolbox"

- Rock samples from 5 potential storage reservoirs and 2 cap-rocks
- Knowledge about site specific porewater chemistry
- Knowledge about depositional history/stratigraphy
- CO₂/rock interaction batch and column experiments at reservoir conditions (20 MPa and 70°C)
- Thorough petrographical/mineralogical analysis of sediments prior to and after experiments (XRD, SEM, BET, CEC, etc.)
- Reactive transport modeling – including upscaling considerations
- Detailed cap-rock analyses

Laboratory experiments

Batch experiment



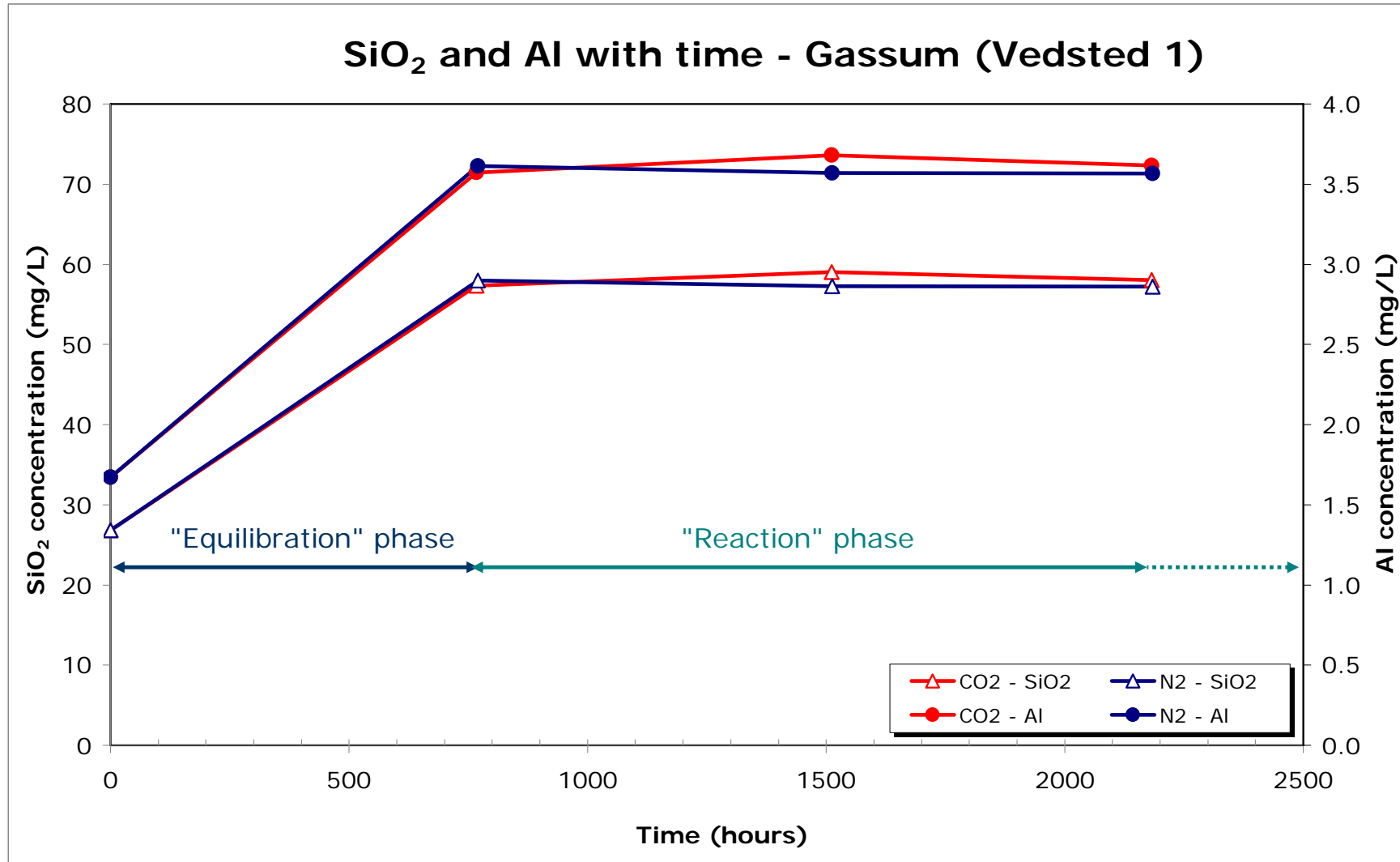
Laboratory experiments

Batch experiment



Batch experiments – reservoir rock

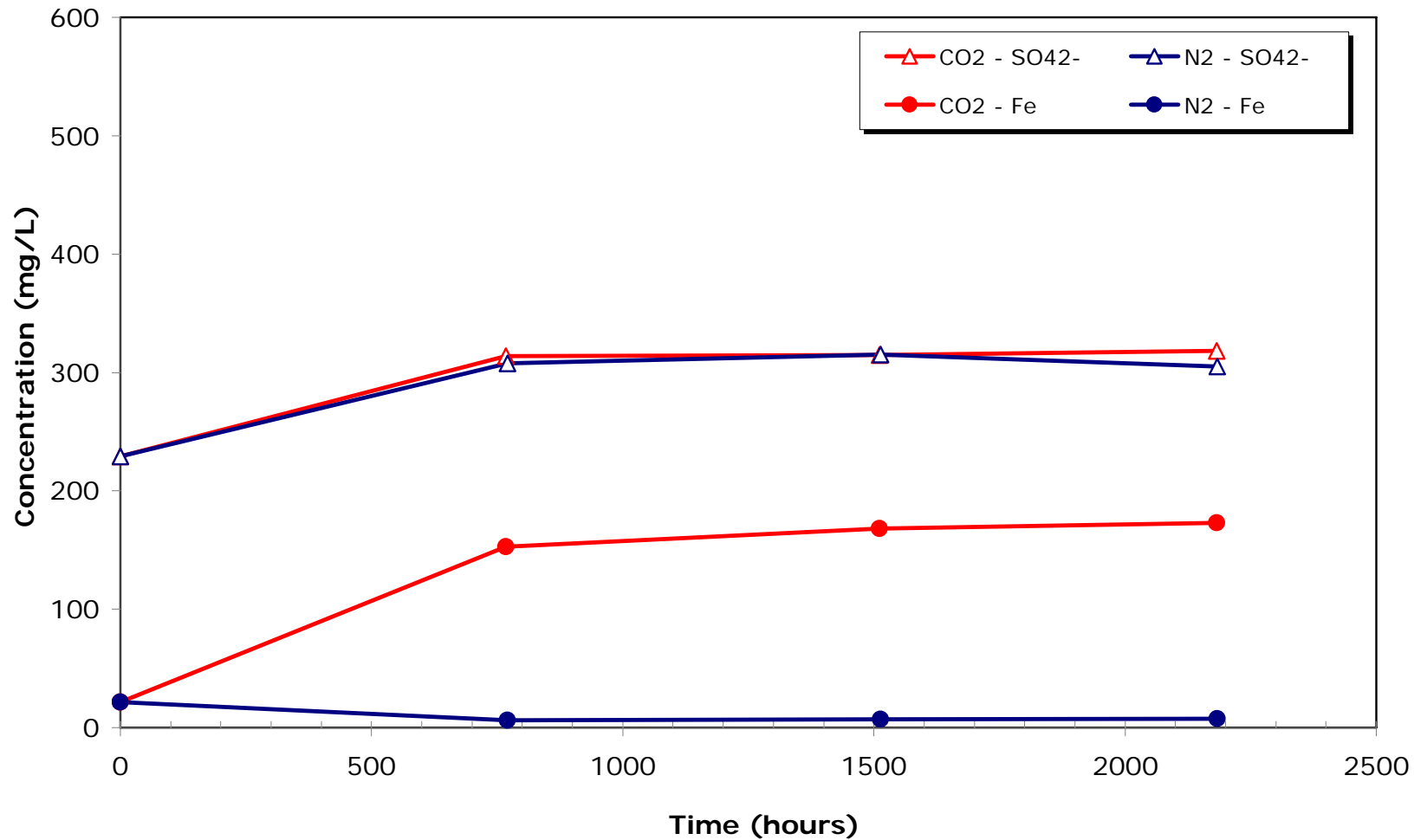
Preliminary results after 3 months



Batch experiments – reservoir rock

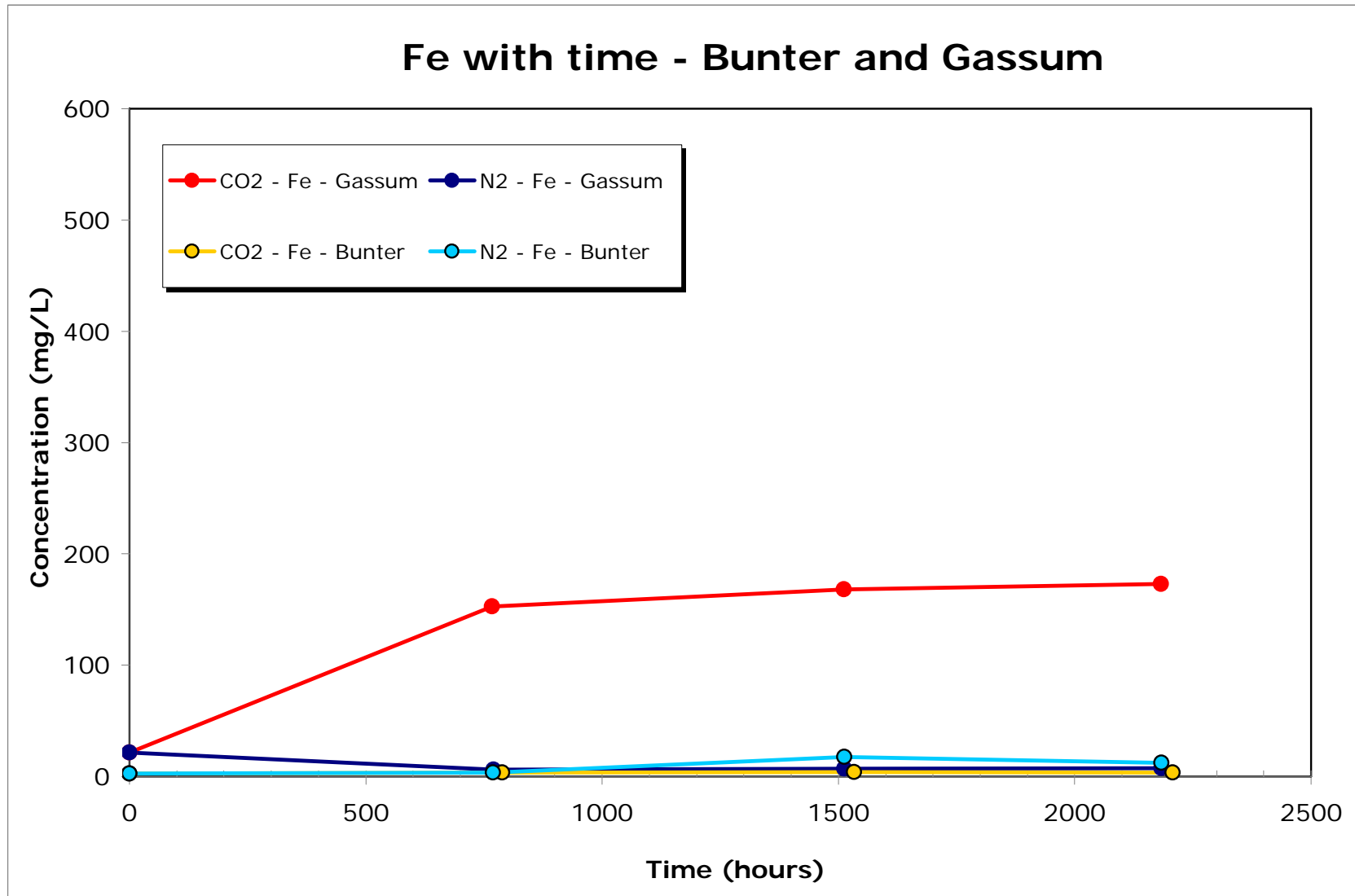
Preliminary results after 3 months

SO₄²⁻ and Fe with time - Gassum (Vedsted 1)



Batch experiments – reservoir rock

Preliminary results after 3 months



To be continued....

- **Project ends October 2010**
- **See you again in 2011 ?**