

SUCCESS

SUbsurface **C**O₂ storage –
Critical **E**lements and **S**uperior **S**trategy



FME – Centres for Environment- friendly Energy Research

8 FME-centres announced
4. February 2009

The eight Centres for Environment-friendly Energy Research

CO₂ capture, transport and storage

Offshore wind technology

Offshore wind energy

CO₂ storage

Renewable energy systems

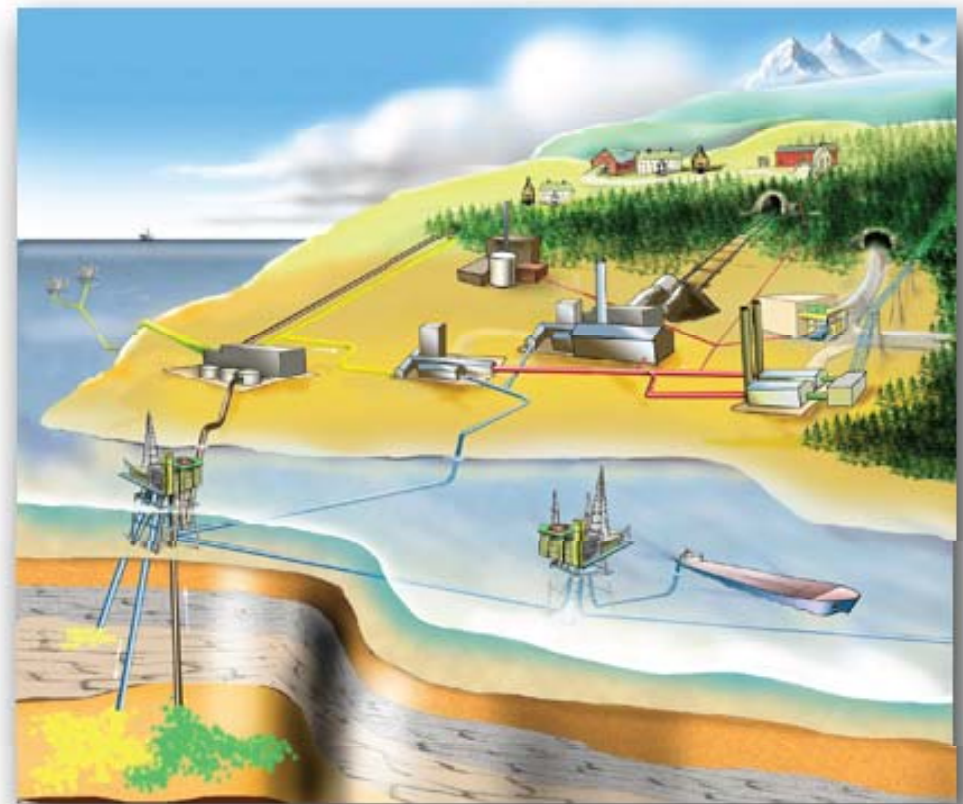
Zero emission buildings

Solar cell technology

Bioenergy

BIGCCS Centre – International CCS Research Centre

- CO2-catch
- Transport
- Storage



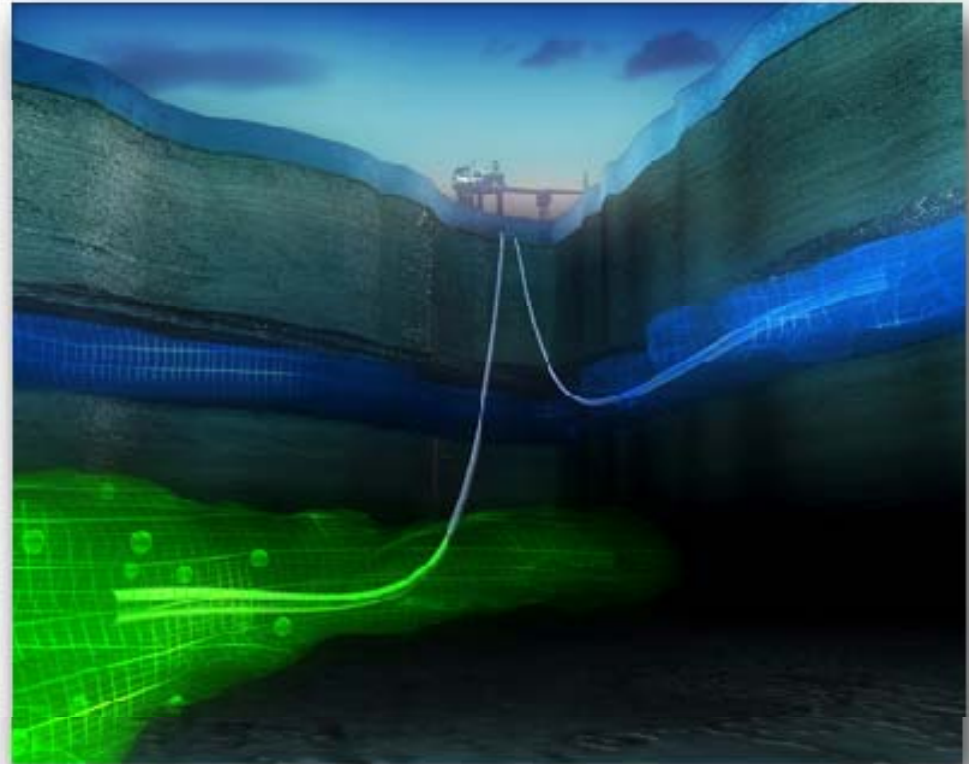
Host institution: SINTEF
Energiforskning

Subsurface CO2 storage – Critical Elements and Superior Strategy (SUCCESS)

- CO2 storage, with focus on
 - Storage geo-characterization
 - Storage flow
 - Seal
 - Monitoring
 - Operations

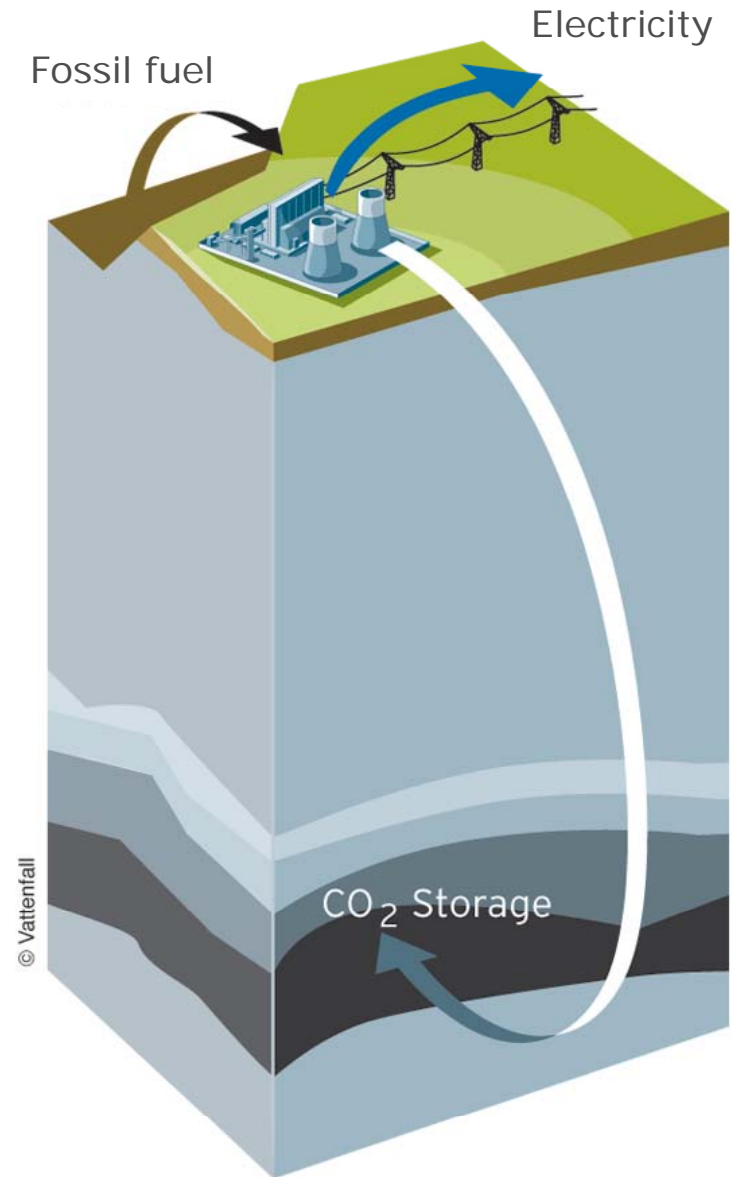
Host institution: Christian
Michelsen Research
(CMR)

2 clusters: Oslo & Bergen



SUCCESS

- Vision
To provide a sound scientific base for CO₂ injection, storage and monitoring, to fill gaps in strategic knowledge, and provide a system for learning and development of new competency



Research partners

- Christian Michelsen Research (CMR)
- Institute for Energy Technology (IFE)
- Norwegian Institute for Water Research (NIVA)
- Norwegian Geotechnical Institute (NGI)
- UNI Research (CIPR)
- University of Bergen (UiB)
- University of Oslo (UiO)
- University Centre in Svalbard (UNIS) - UNIS CO2 LAB



Industry partners

- CGGVeritas
 - ConocoPhillips
 - Dong Energy
 - RWE-DEA
 - Statoil
- Large companies and SMEs
 - Oil & gas Operators
 - Energy companies
 - Technology and service providers



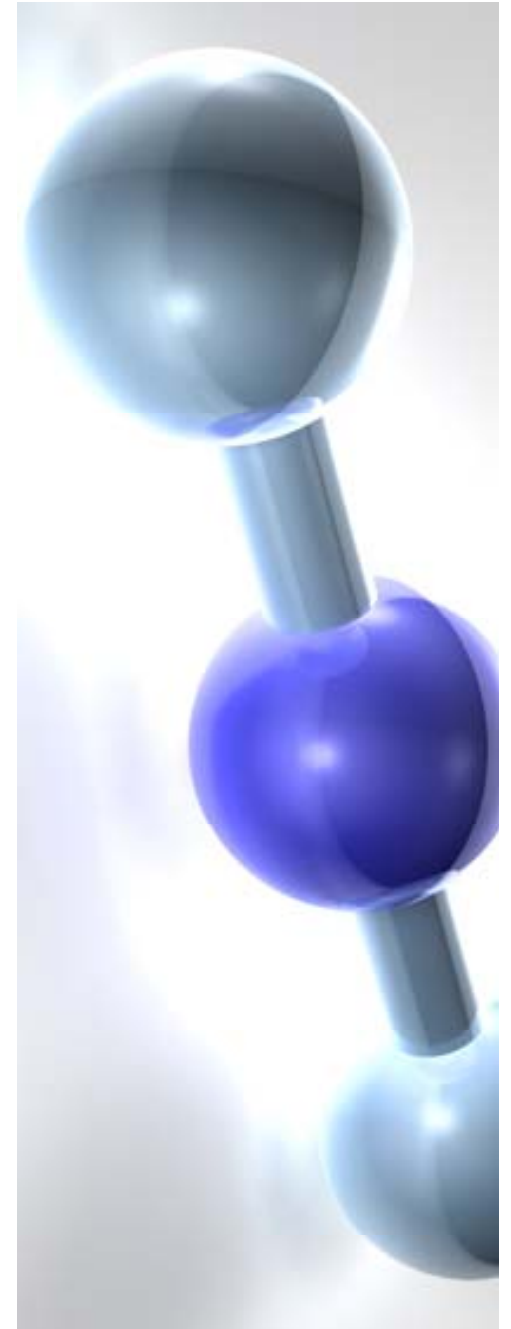
International cooperation

- GEO-CARB
- DELTA-MIN
- MIN-GRO
- Midwest Consortium
- BigSky Partnership
- Lawrence Berkeley NL
- Los Alamos NL
- University of Wyoming
- University of Iceland
- GFZ Potsdam
- Nancy University
- NETL
- IFP
- BRGM
- GEONET
- LMTG/CNRS
- Stanford University
- Colorado School of Mines
- Erlangen-Nurnberg University
- Stuttgart University
- Princeton University
- Montana State University



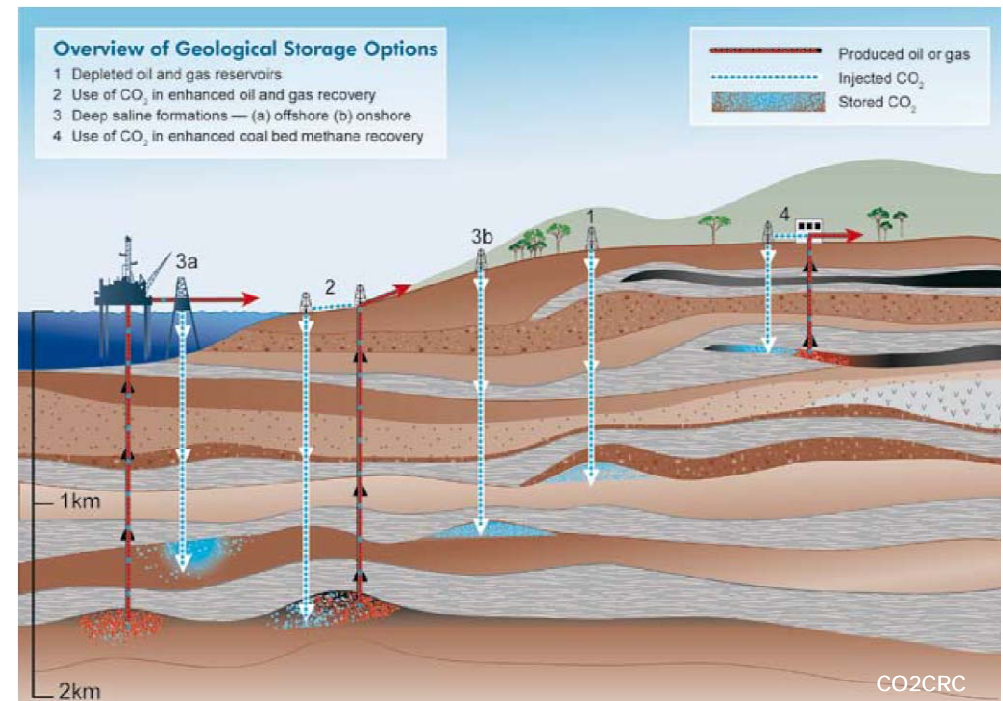
Research objectives

- Quantification and modelling of reactions and flow in storages
- Relation between flow, reactions and geomechanical response
- Flow and reaction in faults and fractures
- Integrity and retention capacity of sealing materials
- Test, calibrate and develop new monitoring techniques
- Ecological impact of CO₂ exposure - marine monitoring methods
- Extensive high quality education for CO₂ storage



Local reference and global solutions

- The SUCCESS centre has substantial expertise and reference to the Norwegian Shelf/North Sea
- The centre focus is on basic and fundamental research
- The results and solutions, therefore, will be global



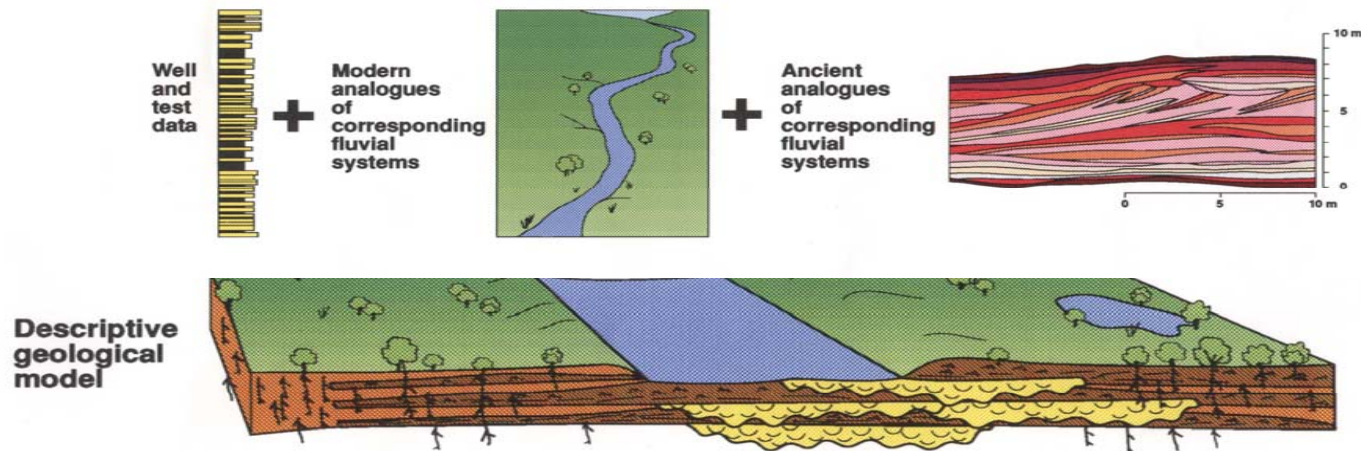
Research activities

- WP1: Storage - Geo-characterization and geochemical/ geomechanical response
- WP2: Storage - Fluid flow and reservoir modeling. Unstable displacement.
- WP3: Sealing properties
- WP4: Monitoring of reservoir and overburden
- WP5: The marine component
- WP6: Operations
- WP7: CO2 SCHOOL



WP1: Storage — geo-characterization

- Geologically and geophysically consistent reservoir models
- Analogue field studies
- Faults and fractures
- Storage capacity, porosity
- Heterogeneties on all scales
- Mineralogical composition
- History matching – model improvements



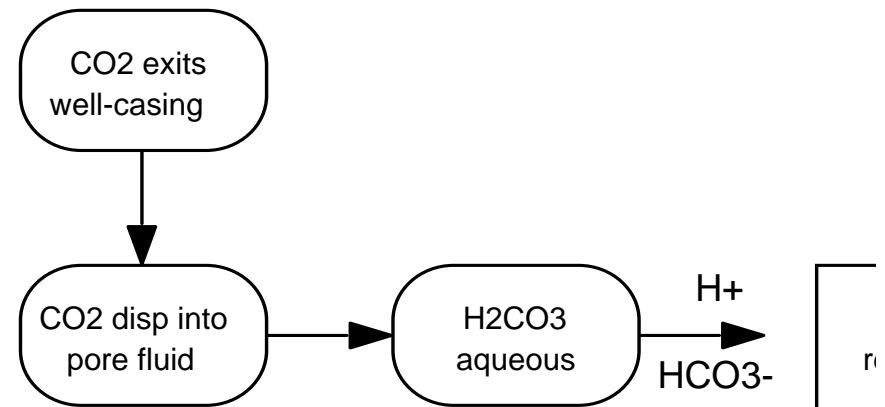
WP1: Storage — geo-characterization

- Geochemical controls on CO₂ immobilization
 - Solution trapping
 - Mineral trapping
 - Residual trapping - surface tension
- How natural and anthropogenic impurities affect CO₂ behavior
- Changes in flow and geomechanical properties caused by mineral dissolution and precipitation (incl salt precipitate)

CO₂ sequestration -processes

Hydrodynamic trapping

Aqueous trapping

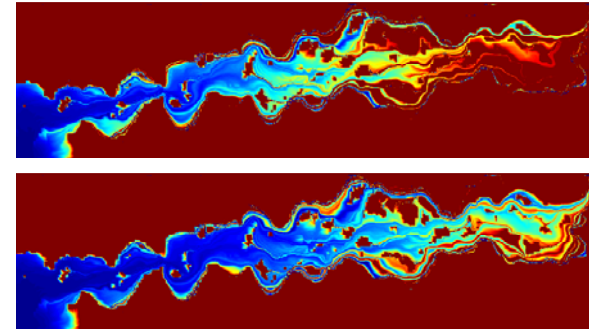


Large differences in time scales on fluid displacement, dissolution & diff
mineral-water reactions

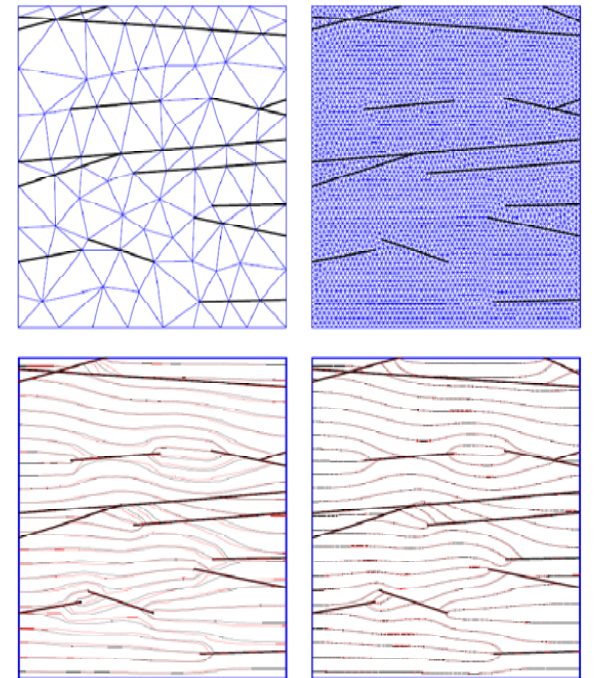
WP2: Storage - flow

- Fingering of CO2 in heterogeneous reservoirs
- Injection enhanced techniques (e.g. water altering CO2 injection)
- Near well fingering; risk for fluid channeling or collapse
- Increase of salinity in near-well environment; corrosion; formation damage
- Impurities and phase behavior

Unstable displacement

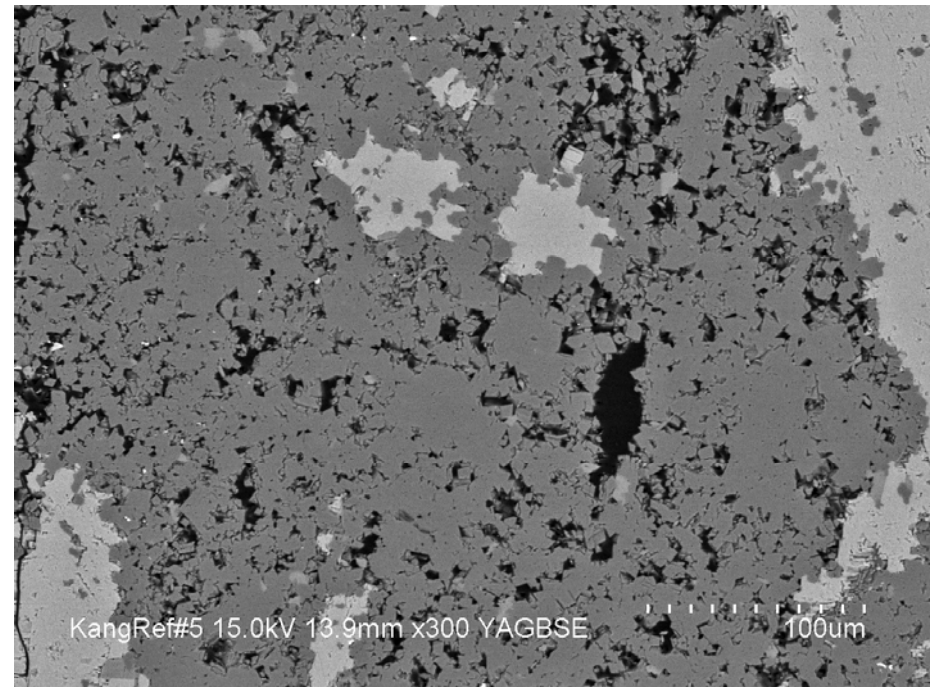


Flow in fractured media



WP3: Sealing properties

- Modelling of migration in porous elements connecting to the surface
- Fault behaviour: sealing or conducting
- Embrittlement, shale fracturing and fracture flow
- Alteration of petrophysical properties of clays and shales
- Gas impurities and depth regime of supercritical CO₂ behaviour
- Hydrates as a shallow barrier
- Well integrity



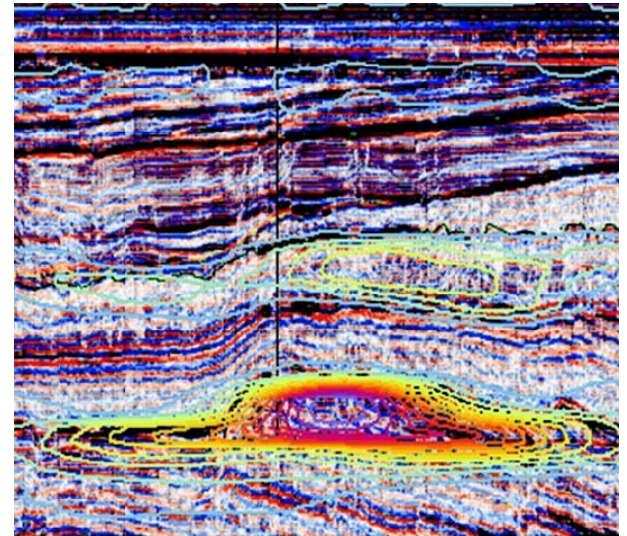
WP4: Monitoring

- Distinguish fluid effects versus stress changes
- Map baseline variations
- Calibrate geophysics against geochemistry; sensitivity
- Use of geochemical and chemical tracers
- Well leakage monitoring
- Electromagnetic monitoring
- Large areas monitoring (InSar radar, airborne EM, others)

In-well monitoring

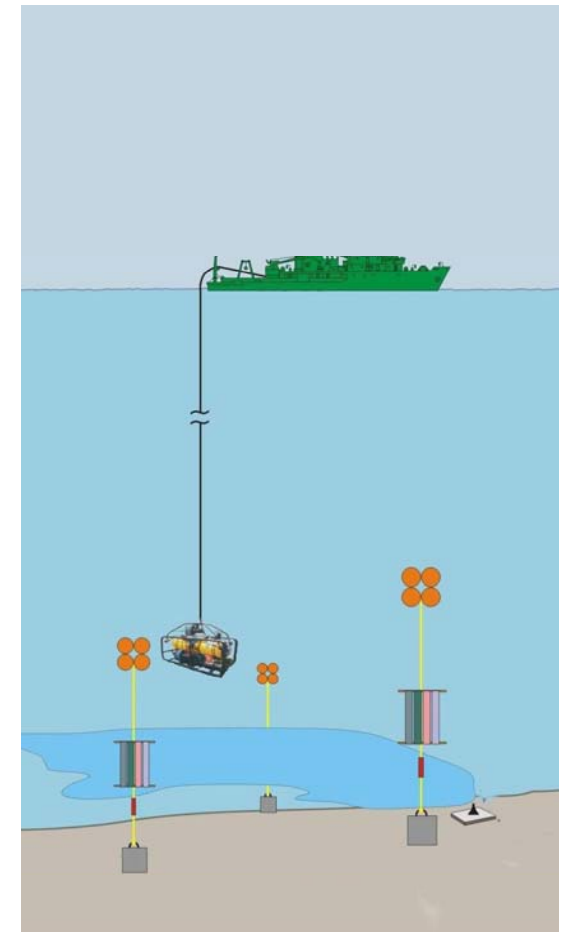


Seismic and EM



WP5: The marine component

- Effects of CO2 leakage on the subsurface biosphere
- Interaction and processes between shallow sediments and the water column
- Consequences of leakage on marine benthic ecosystems (macro- and microbiota)
- Monitoring (Marine)



WP6: Operations

- Fluid pressure increase and potential fracturing during injection; injection strategy
- Monitoring the injection performance (direct and indirect methods)
- Well integrity, completions, corrosion, interfaces



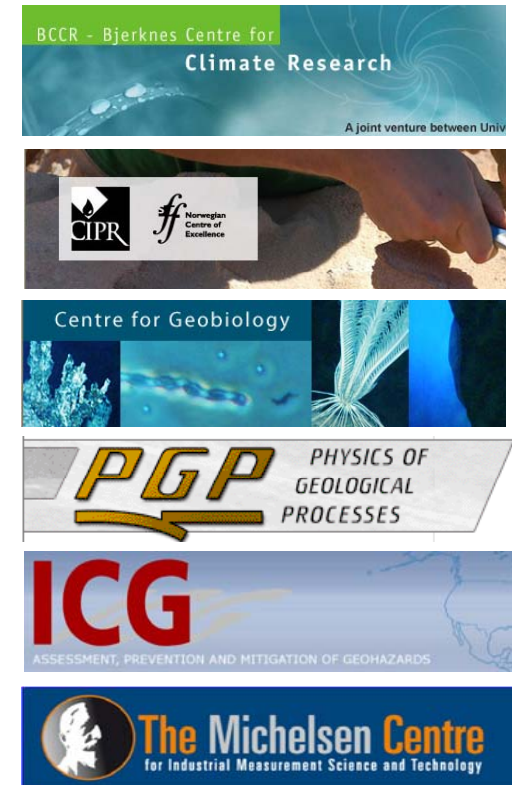
WP7: CO2 SCHOOL

- High quality PhD courses and master programmes on CCS
- Summer schools
- Nordic research school on CCS?
- Research and education relationships with CO2 industry?



Relevant and supporting research centres with the SUCCESS partners

- The Bjerknes Centre for Climate Research (UiB)
- Centre for Integrated Petroleum Research (UiB)
- Centre for Geobiology (UiB)
- Centre for Physics of Geological Processes (UiO)
- International Centre for Geohazards (NGI)
- The Michelsen Centre for Industrial Measurement Science and Technology (CMR)



The SUCCESS centre possesses well equipped, state of the art laboratories

- Materials and fluid lab at the University of Oslo
- Materials and fluid lab at the University of Bergen
- Materials and fluid lab at IFE
- Rock mechanical lab at NGI
- Sensor and instrumentation lab at CMR, NGI
- Marine lab at NIVA
- Marine lab and vessels at the University of Bergen, Univ. Of Oslo
- CO2 field lab at UNIS

Organisation

Gene
All partners

Exec
Majority from

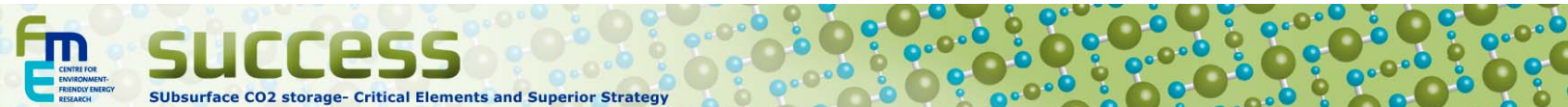
Scientific advisory committee
External members

Cent
Administrative
Two sc
Per Aagaard



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Subsurface CO2 storage- Critical Elements and Superior Strategy





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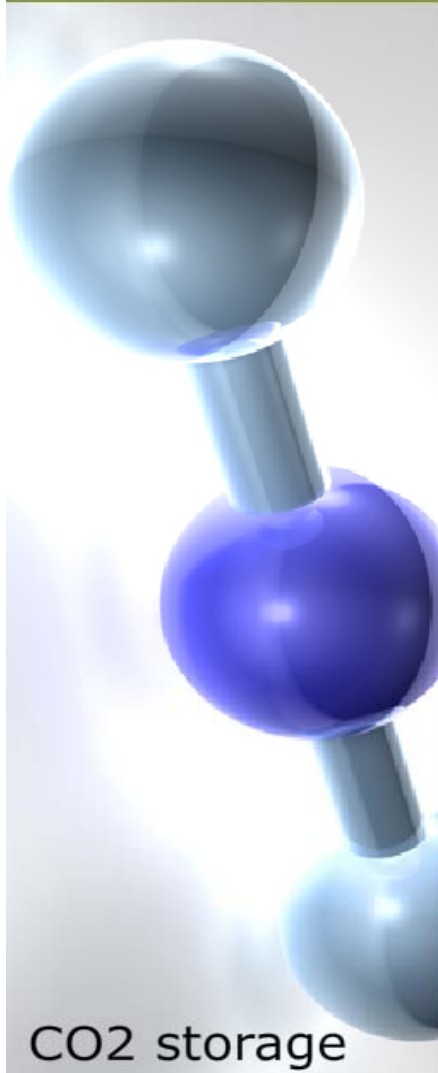
SUBsurface CO2 storage- Critical Elements and Superior Strategy

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VISION

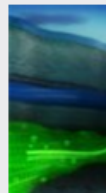
PARTNERS

FOCUSAREAS



CO2 storage

Two CEER centres



CMR awarded with two centres for environmental energy (CEER).

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Virtual centre

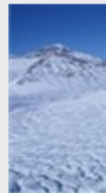


The brightest heads and the best experts from all around the world works together through virtual reality.

[read more >>](#)

- www.fme-success.no
- External communication from and about the centre
- Internal communication on Extranet

A pilot plant



CMR provides studying and testing new technologies related to CCS: coal, a coal power plant and potential subsurface storage.

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Research institutions



SUCCESS is built on research cooperation between norwegian and foreign institutions.

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