ECO$_2$

Sub-seabed CO_2 Storage:
Impact on Marine Ecosystems

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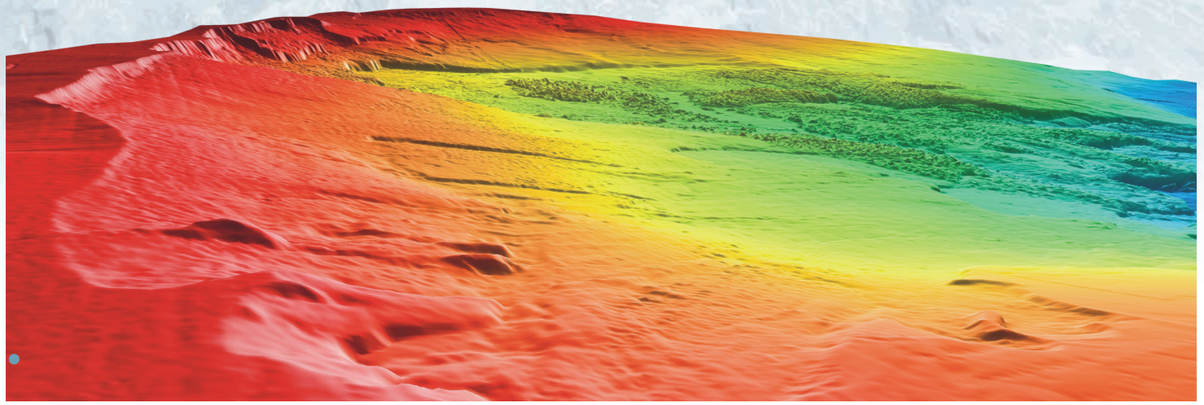
SEVENTH FRAMEWORK PROGRAMME

Introduction and Background

ECO_2 - Sub-seabed CO_2 storage: Impact on Marine Ecosystems is a large scale integrating collaborative project funded by the European Commission (EC) FP7 work program topic OCEAN.2010.3 Sub-seabed carbon storage and the marine environment. The ECO_2 consortium consists of 27 partners - 24 research institutes, one independent foundation (DNV), and two commercial entities (Statoil AS and Grupa Lotos) - from nine European countries (Germany, Norway, U.K., Italy, the Netherlands, Poland, Belgium, Sweden, France). The project is coordinated by GEOMAR in Kiel, Germany. The entire lifetime of ECO_2 is from 1st May 2011 to 30th April 2015.

Carbon dioxide capture and storage (CCS) is regarded as a key technology for the reduction of CO_2 emissions from power plants and other industrial facilities at the European and international level. Hence, the EC will support selected demonstration projects to promote, at industrial scale, the implementation of CCS in Europe. Consequently, several European states (U.K., Norway, the Netherlands, Italy) aim to store CO_2 below the seabed. However, little is known about the short-term and long-term impacts of CO_2 storage on marine ecosystems even though CO_2 has been stored sub-seabed at industrial scale in the Norwegian North Sea since 1996 (*Sleipner*) and in the Barents Sea since 2008 (*Snøhvit*).

In consequence of this lack of knowledge, the EC supports the ECO_2 project to assess the risks associated with storage of CO_2 below the seabed. The project evaluates the likelihood of leakage, the possible impacts on marine ecosystems, and its potential economic and legal consequences by studying existing sub-seabed storage sites in saline aquifers in the Norwegian North Sea and the Barents Sea, and a potential storage site in a depleted oil reservoir as well as natural seeps at the seafloor (North Sea, Barents Sea, Mediterranean Sea, Okinawa Trough).



Objectives

To give consideration to this complex assignment the ECO_2 consortium defined the following 5 key objectives:

1. **To investigate** the likelihood of leakage from sub-seabed storage sites
2. **To study** the potential effects of leakage on benthic organisms and marine ecosystems
3. **To assess** the risks of sub-seabed carbon storage
4. **To develop** a comprehensive monitoring strategy using cutting-edge monitoring techniques
5. **To define** guidelines for the best environmental practices in implementation and management of sub-seabed storage sites

Work performed within the first project half

ECO_2 studied the sedimentary cover and the overlying water column at CO_2 storage sites (Sleipner, Snøhvit, B3 field) to identify leakage pathways and locate seep sites. Cutting-edge monitoring techniques applied by ECO_2 failed to detect any CO_2 anomalies in bottom waters above the storage complexes and thus confirmed that CO_2 is safely stored at Sleipner and Snøhvit. However, high-resolution seismic data revealed a large number of vertical pipes and chimneys cutting through the overburden.

Work performed within the first project half

CO_2 release at the seabed was studied at three natural seep sites (Panarea, Jan Mayen vent fields, Salt Dome Juist) and via deliberated CO_2 release experiments conducted in the vicinity of the Sleipner storage complex. CO_2 gas bubbles and droplets were rapidly and completely dissolved in ambient bottom waters.

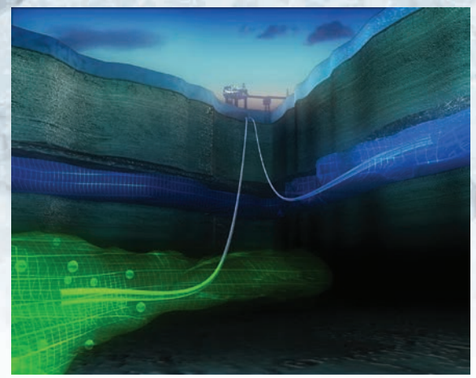
The response of different biota to bottom water and pore water acidification was studied at natural seep sites and in shore-based mesocosm experiments. A limited number of species, which are highly abundant at natural CO_2 seeps, are resilient to elevated pCO_2, other more species are trying to avoid and escape CO_2 affected areas. Harmful effects of CO_2 include alteration in early ontogeny of echinoderms, a phenomenon overlooked in previous studies. The field campaigns within the first 22 months included 17 marine expeditions to offshore storage and seepage sites with a total ship time of 240 days.

The environmental risks connected with CCS and how these may impact on the financial, legal, and political considerations accompanying future geological storage have been elaborated. Trust and context were investigated as two influencing factors regarding public perception.
The investigations of ECO_2 will result in the first comprehensive assessment of environmental risks associated with sub-seabed CO_2 storage; a novel and comprehensive monitoring strategy for sub-seabed storage sites; and cost estimation for monitoring and potential leakage mitigation programmes.

ECO$_2$ investigates storage sites and potential storage sites that cover the major geological settings to be used for sub-seabed CO_2 storage including depleted oil and gas reservoirs and saline aquifers on the continental shelf and upper continental slope. Fieldwork at storage sites will be supported by modelling and laboratory experiments at natural CO_2 seep sites.

CO_2 storage sites and potential storage sites

- *Sleipner* (North Sea) - in operation since 1996 by Statoil, stores ~1 Mt of CO_2 separated from natural gas per year within the Utsira sand formation (saline aquifer) in ~900 m sediment depth in ~80 m water depth. More than 48 million m^3 of CO_2 have already been injected.



Carbon storage at Sleipner; photo: Alligator film / BUG / Statoil

- *Snøhvit* (Barents Sea, Norwegian continental slope) - in operation since 2008 by Statoil, stores ~0.7 Mt of CO_2 separated from natural gas per year within a saline sandstone formation in ~2.6 km sediment depth in ~330 m water depth. The high pressures and low temperatures at the seabed allow for solid CO_2 hydrate formation.

- *B3 field site* (Polish Baltic Sea) - potential storage site in ~80 m water depth that is currently exploited for oil by the Polish companies Grupa Lotos and Petrobaltics; exploitations will be closed by 2016. The Polish operators plan to store CO_2 from a nearby oil refinery in the depleted B3 field site oil reservoir.

Natural CO_2 seep sites

- *Panarea area* (Southern Tyrrhenian Sea) - is part of the Aeolian Arc north of Sicily; it is a submarine exhalative field located east of Panarea Island. The gas vents are aligned along tectonic features and emit CO_2 originating from degassing magma.

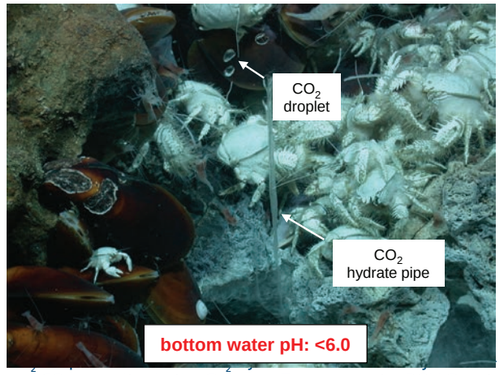
Eddy correlation experiments at Panarea, D. F. McGinnis et al., Eurofleets Project PaCO2 with RV Urania

Study Sites

- *Jan Mayen vent fields* (North Atlantic) - are situated on the Western Jan Mayen fracture zone in ~550 to 700 m water depth; its hydrothermal fluids are characterised by high carbon dioxide but low methane and hydrogen concentrations.

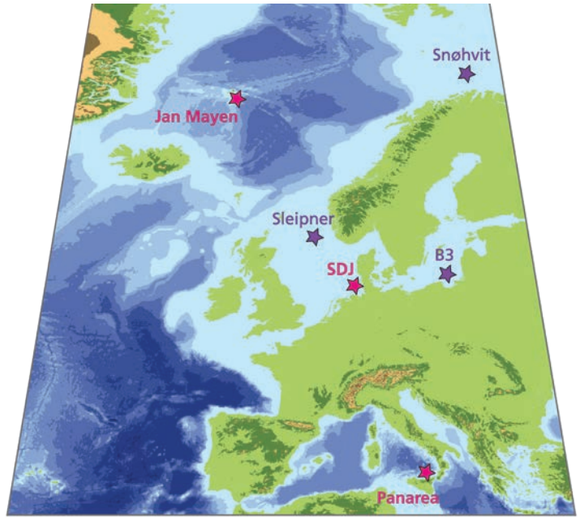
- *Salt Dome Juist* (SDJ; North Sea) - is located in the southern German North Sea in ~30 m water depth above a Salt Dome; it is a sedimentary seep where CO_2 levels are ~10-20 times above background.

- *Southern Okinawa Trough* (NE off Taiwan) - is a back arc basin hosting several hydrothermal fields. Three of these seeps emanate liquid CO_2 droplets at a water depth of ~1300 m and CO_2-hydrates form in the surface sediments.



mal CO_2 seep sites in the Okinawa Trough; photo: ROV Quest, MARUM Bremen

European ECO$_2$ study sites at a glance



CO_2 storage sites and potential storage sites
natural CO_2 seep sites

Plus potential CO_2 storage sites off Australia and natural seeps off Japan

Research Expeditions conducted

Study site	Research vessel	Cruise	Date	Lead institute
Sleipner / SDJ	RV Alkor	AL374*, 1	17 days - May/June 2011	GEOMAR
Panarea	Small Boat	ECO2-2*	17 days - May/June 2011	MPI
Jan Mayen vent fields	RV G.O. Sars	CGB-ECO2-2011*	14 days - June 2011	University of Bergen
Sleipner	RV G.O. Sars	CGB-ECO2-2011-B*, 2	9 days - June/July 2011	University of Bergen
Snøhvit	RV Helmer Hanssen	2011003*	14 days - July 2011	University of Tromsø
Panarea	RV Urania	PaCO2#, 3	6 days - July/Aug 2011	GEOMAR
Sleipner / SDJ	RV Heincke	HE377#	9 days - April 2012	MPI
Panarea	Small Boat	ECO2-3*	20 days - June 2012	MPI
Panarea	Small Boat	ECO2-4*	6 days - June 2012	Uni Roma1 / OGS
Sleipner	RV G.O. Sars	CGB-ECO2-2012A*, 2	9 days - June 2012	University of Bergen
B3 field	RV St. Barbara	StBar-2012-1/2/3*	35 days - June 2012	Uni. Gdansk / Gr. Lotos
Jan Mayen vent fields	RV G.O. Sars	CGB-ECO2-2012B*	12 days - July/Aug 2012	University of Bergen
Sleipner / SDJ	RV Celtic Explorer	CE12010#, 1	18 days - July/Aug 2012	GEOMAR
Panarea	Small Boat	ECO2-5*	5 days - Aug 2012	Uni Roma1 / OGS
Sleipner	RV James Cook	JC077*, 4	27 days - Sep 2012	NOC
Panarea	Small Boat	ECO2-6*	13 days - Oct 2012	Uni Roma1 / OGS
Eckernförder Bay	RV Alkor	AL404*	8 days - Nov 2012	GEOMAR
Sleipner / Blow out site	RV Alkor	AL412*, 1	18 days - Mar/Apr 2013	GEOMAR

*national funding

#EuroFleets funding

[1]This research expedition was conducted in cooperation with the site survey 22-4b (Blow out site British North Sea) assigned by DECC.

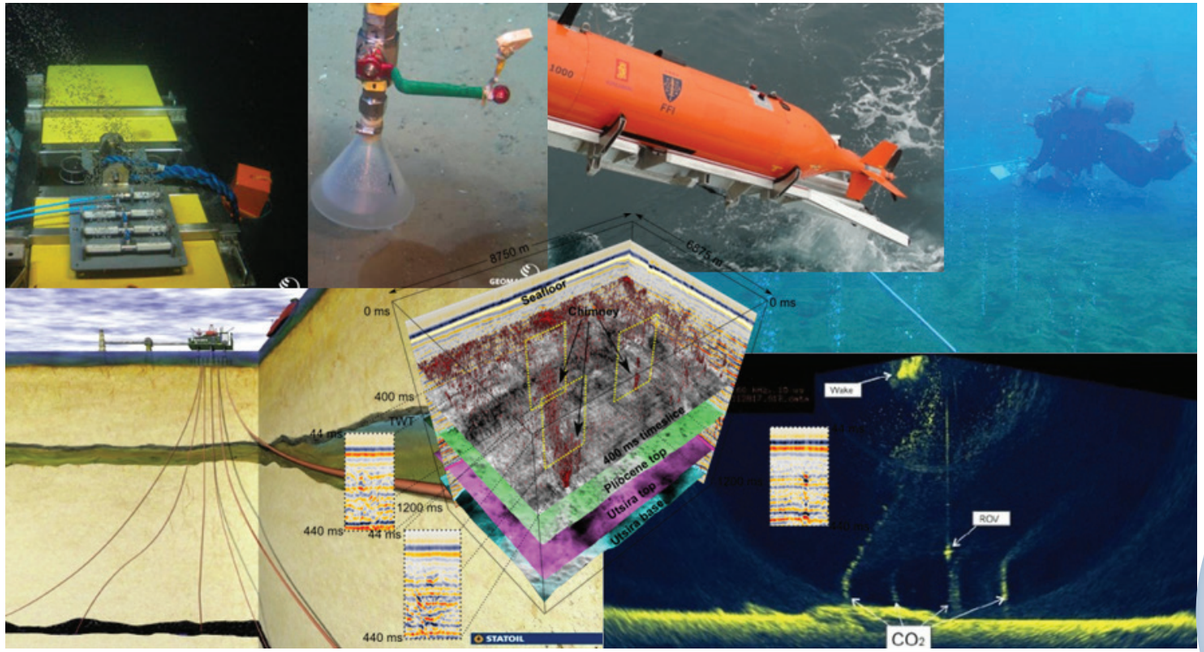
[2]This research expedition was conducted in cooperation with the Norwegian project SUCCESS (SUbsurface CO_2 Storage- Critical Elements and Superior Strategy).

[3]These research expeditions were conducted in cooperation with the FP7 funded project RISCS (Research into Impacts and Safety in CO_2 Storage).

[4]Japanese researchers from the National Institute of Advanced Industrial Sciences and Technology and the University of Kyushu were participating in this research cruise.

Equipment used at Sea

During the 18 research expeditions conducted so far, ECO_2 scientists investigated the sedimentary cover at active and potential CO_2 storage sites using novel geophysical baseline studies and monitoring techniques to better understand the mechanisms of CO_2 migration. The project evaluates the effects of leakage of CO_2 through the sediments at storage sites and natural analogues and quantifies the fluxes across the seabed and into the water column by means of sophisticated monitoring techniques.



Compilation of figures illustrating the operation of technical equipment and monitoring procedures during research expeditions with figure contributions from University of Bergen, HYDRA, GEOMAR and Statoil.

Scientific Work Structure

The ECO_2 investigations cover a wide range of approaches from basic marine research to ocean governance. The work is divided into seven work packages (WPs) and four cross-cutting themes (CCTs) forming a matrix structure. The WPs are cross-cut by four themes to support information flow and strengthen cooperation across the WPs. Additionally, the CCTs provide vital ECO_2 products by integrating and evaluating the results of the individual WPs.

WP1: Integrity of the sedimentary cover

WP2: Fluid and gas flux across the seabed

WP3: Fate of emitted CO_2

WP4: Impact of leakage on ecosystems

WP5: Risk assessment, economic & legal studies

WP6: Public perception

WP7: Coordination & Data Management

CCT1: Monitoring techniques & strategies

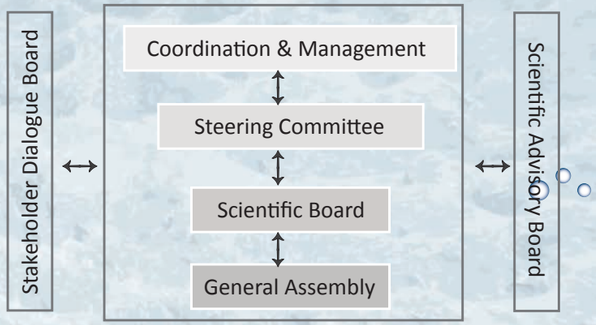
CCT2: Numerical Modelling

CCT3: International collaboration

CCT4: Best environmental practices

Management and Communication

The **Project Coordinator** will be supported by the **Project and Data Management Office**, the **Steering Committee** and the **Scientific Board** to ensure the project remains focused.

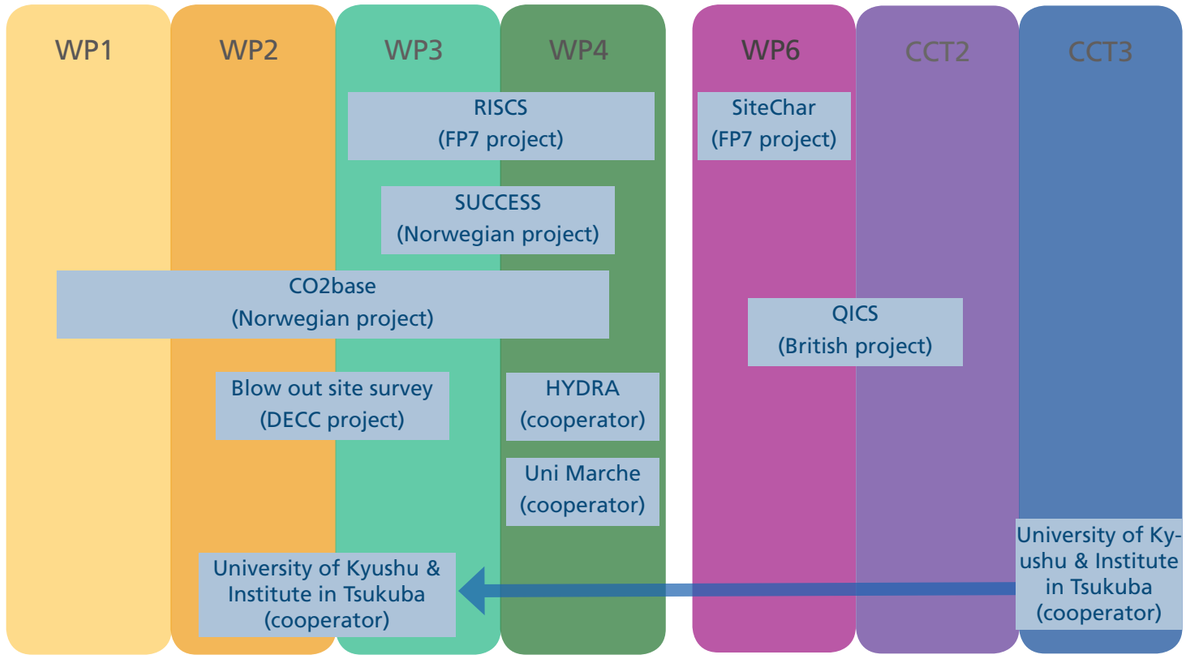


Management and governance structure of the ECO_2 consortium

The internal management structure will be supplemented scientifically by the **Scientific Advisory Board** (renowned scientists covering the ECO_2 research fields) and politically by the **Stakeholder Dialogue Board** (high-level policy consultative group).

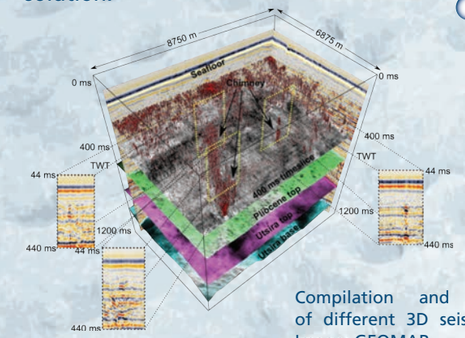
Cooperations and interactions

ECO_2 built up various cooperations and interactions within the different work packages with several FP7 and national projects as well as with expert groups at well-established research institutes.
The EuroFleets cruise with RV Urania in 2011 was conducted in cooperation with the FP7 project RISCS and the scientists accomplishing the RV James Cook cruise in 2012 invited two Japanese colleagues to deploy and test high-end sensors. The partner University of Bergen established cooperation with two Norwegian projects, SUCCESS and CO2base (environmental baseline study at Sleipner). Work package 4 established cooperation with the Polytechnic University of Marche regarding mesocosm experiments and with HYDRA regarding investigations at Panarea. Work package 6 and CCT2 partners established cooperation with the British project QICS (Quantifying and Monitoring Potential Ecosystem Impacts of Geological Carbon Storage). WP6 furthermore established cooperation with the FP7 projects SiteChar (Characterisation of European CO_2 Storage) and NearCO2 regarding public perception research.



WP1 - Caprock Integrity

Architecture and Integrity of the Sedimentary Cover at Storage Sites
will undertake geophysical acquisition, modelling, and hydro-acoustic monitoring to characterise the range of performance and efficiency of sub-seabed geological CO_2 storage, including existing and potential storage sites as well as natural CO_2 seepage sites. State-of-the-art technology will be employed for an enhanced imaging of the seafloor and its sub-surface at unprecedented resolution.



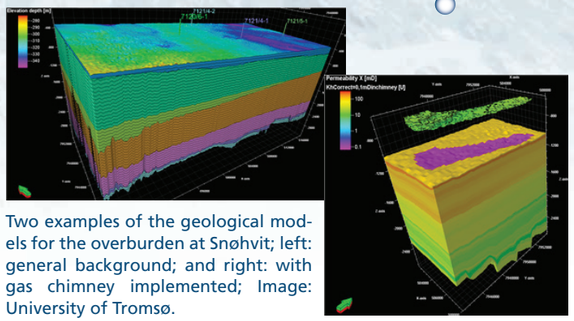
Compilation and interpretation of different 3D seismic data sets; Image: GEOMAR

Objectives:

- to characterise the sedimentary cover to better assess CO_2 migration mechanisms and pathways
- to optimise existing techniques and tools for monitoring CO_2 migration
- to provide a catalogue for possible leakage scenarios, to document the key elements of effective risk management
- to constrain potential leakage pathways

Highlights in WP1

- Interpretation of fluid flow features at Sleipner (North Sea) and Snøhvit (Barents Sea) based on 3D seismic data
- Development of geological models of the overburden at Sleipner and Snøhvit based on 3D seismic data for implementation in fluid flow simulations
- High-resolution baseline study at Sleipner with swath bathymetry, sediment echo sounder and hydro-acoustics
- Development of a new method for automatically detecting and localizing gas seeps at the seafloor
- Hydro-acoustic baseline study at Field B3 (Baltic Sea)
- Compilation of models to simulate multiphase-multicomponent flow and transport processes, geomechanical processes, and CO_2 dispersion, dissolution and hydrate formation



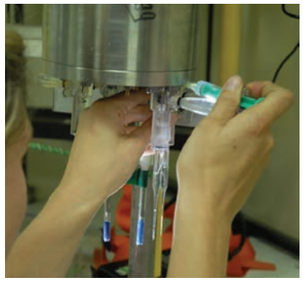
Two examples of the geological models for the overburden at Snøhvit; left: general background; and right: with gas chimney implemented; Image: University of Tromsø.

WP2 - Fluid and Gas Flux Across the Seabed

Fluid and Gas Fluxes across the Seabed at Storage Sites and Natural CO_2 Seeps
will carry out a program of fieldwork at existing storage sites as well as natural CO_2 seeps, including analysis of the chemical composition of reservoir fluids. Fieldwork will be supplemented by laboratory studies focussing on CO_2-induced mobilization of toxic metals and the ability of CO_2-hydrate formation to seal leaks. A key part of the work will be to assess the utility of various high-end sensor systems.

Objectives:

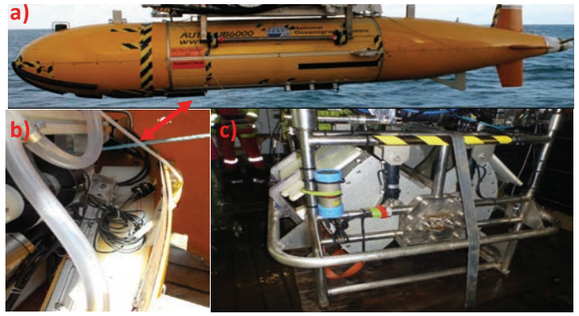
- to identify effective tracers of leakage
- to develop a monitoring strategy to quantify leakage rates
- to assess the potential for mobilisation of toxic metals
- to quantify fluxes of CO_2 and other chemicals across the seabed and reactions in the surface sediments



Biogeochemical Observatory (left figure) Microsensors (right figure); photos: GEOMAR

Highlights in WP2

- Measurement of benthic fluxes of chemical species at two natural CO_2 seep sites, Panarea and Salt Dome Juist
- Investigation of fluid and gas seepage from seafloor fractures and abandoned wells in the vicinity of the Sleipner CO_2 storage site



Sensors mounted on (a, b) an AUV and (c) a ROV for monitoring of pH, pCO_2 in the benthic boundary layer and water column; photos: NOC

- Direct sampling of gases emitted from the seafloor at the natural CO_2 seep Jan Mayen vent fields
- Monitoring of pCO_2 emissions from the seafloor at the natural CO_2 seep site Panarea
- CO_2-fluid-sediment interaction experiments under in-situ conditions

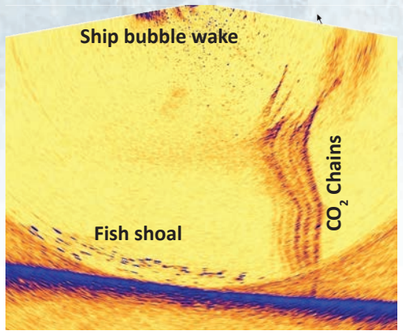
WP3 - Fate of Emitted CO_2

Fate of CO_2 and other Gases emitted at the Seabed

will conduct process studies and model simulations to underpin impact assessments of potential leakage from CO_2 storage sites in the water column. An Ocean General Circulation Model (OGCM) considering the various processes will be used to simulate local and regional oceanic dispersion of CO_2. Natural CO_2 seeps, as analogues of storage leakage, will be used to improve process and model understanding, and to test instrumentation.

Objectives:

- to understand CO_2 transport mechanisms
- to develop appropriate monitoring methods for leak detection and CO_2 flux quantification
- to develop a simulation framework for impact assessment
- to develop best practices for detecting CO_2 leakage to the water column

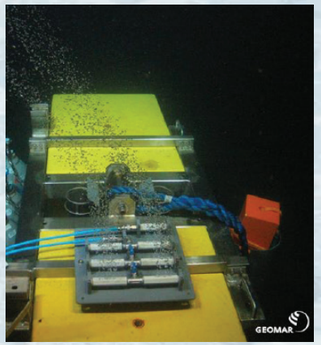


Multibeam echosounder water column image showing natural release of CO_2 bubbles at Panarea (Italy); image: Eurofleets Project PaCO$_2$

Highlights in WP3

- Characterisation of the carbonate systems at Panarea
- Strong temporal variability of gas emissions at Panarea control the distribution of dissolved CO_2 within the water column

CO_2 release experiment, Carbon dioxide and Krypton were released on top of the elevator lander over 10 to 15 hours at varying flux rates; photo: GEOMAR

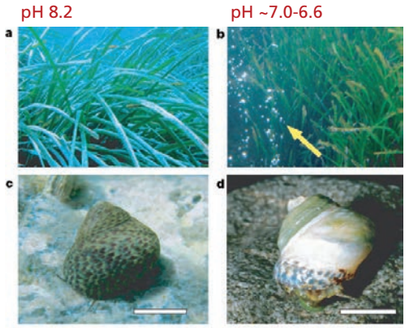


- Investigation of the rapid nature of mixing and dilution of the CO_2 signal within the water column
- Visual and hydro-acoustic investigation of bubbles rising through the water column at Sleipner and Jan Mayen vent fields
- Conduction of a CO_2 release experiment in the Norwegian North Sea
- Development of a priority list of parameters for model development and quality check
- MetOcean data for Sleipner compiled and test runs performed

WP4 - Impact of Leakage on Ecosystems

Impact of Leakage on Benthic Organisms and the Marine Ecosystems

will determine the biological impacts and risks associated with CO_2 leakage by controlled exposure experiments or in-situ observations at natural seeps, and identify appropriate methods to monitor the marine environment above a storage site.



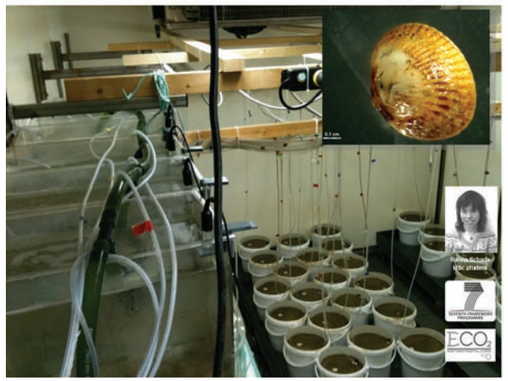
Benthic ecosystems may be affected by local acidification; figure: Hall-Spencer et al., 2008, Nature 454, 96-99

Objectives:

- to quantify the consequences of CO_2 leakage for the health and function of organisms
- to assess the ability of organisms to adapt to locally elevated CO_2 levels
- to increase our capability to predict ecosystem response to leakage
- to identify biological indicators for CO_2 leakage
- to formulate environmental best practices for monitoring, protection and management of marine biota at offshore CO_2 storage sites

Highlights in WP4

- Observation of some species that are highly resilient to elevated pCO_2
- Exposure to elevated pCO_2 can induce alterations in early ontogeny of echinoderms
- Behavioural avoidance of high pCO_2 plumes appears to be a consistent behavioural biomarker that might be used for monitoring
- Identification of microbes specifically adapted to a high CO_2-low pH environment
- CO_2-rich hydrothermal plume collected at the Jan Mayen vent fields revealed a planktonic fauna distinctive from the surrounding waters
- Development of an explicit depth structured benthic model component of ERSEM



Laboratory experiments on benthic infauna bivalve communities, the bivalves show high mortalities coupled to intensive shell dissolution upon exposure to 10,000 µatm pCO_2; image: GEOMAR

WP5 - Risk Assessment

Risk Assessment, Economics, Legal Studies and Policy Stakeholder Dialogue
will consider the environmental risks associated with CCS and how these risks may impact on the financial, legal, and political considerations surrounding the future geological storage of CO_2.

Objectives:

- to conduct an environmental risk assessment (ERA) including the entire operational life cycle, closure and post-closure of the reservoir
- to estimate the potential costs associated with monitoring, intervention in the case of CO_2 leakage, compare against the economic and environmental benefits deriving from CCS activities, and assess the financial risks
- to review the existing legal framework with respect to the precautionary principle and the polluter pays principle
- to determine the potential applicability of liability with respect to CCS activities
- to communicate the knowledge produced in ECO_2 to relevant implementation bodies to improve transparency of decision-making for CCS

Highlights in WP5

- Hazard identification workshop undertaken with participation from WP1 to 5
- Consequence methodology workshop undertaken with representatives from WP2 to 5
- Preparation of a propensity to Leak Model
- Development of a model to economically assess carbon dioxide storage under uncertainty
- Extension of an existing modelling framework to cover very long-time perspectives
- Development of a comprehensive review on the development and legal situation of marine CO_2 storage and on liability rules under public international law
- Compilation of the first two ECO_2 briefing papers
- Scientific briefing event held in the European Parliament to inform stakeholders about ECO_2 and the scientific progress regarding offshore CCS

WP6 - Public Perception

Public Perception Assessment
will investigate two important factors influencing the configuration of public perception patterns: trust and context. Intensive interaction with the public and major stakeholders will be sought to promote dialogue, while at the same time increasing knowledge and awareness of the different public and stakeholders' perspectives. As a result of this process a common framework for CO_2 storage communication and understanding will be proposed.

Objectives:

- to agree and clarify the use of CO_2 storage research terms and concepts to facilitate effective communication
- to explore the use of novel methods for capturing and understanding CO_2 storage public perception
- to identify the social processes involved in the formation of public perception of CO_2 storage
- to understand how the scope and the characteristics of the CO_2 storage technology and its costs-benefits are perceived by different social agents
- to provide guidance on public and stakeholder communication activities to meet information needs and concerns

Highlights in WP6

- Development of a glossary to improve communication about offshore CO_2 storage
- On-going reflection on literature blind spots with regard to public issues on CO_2 storage

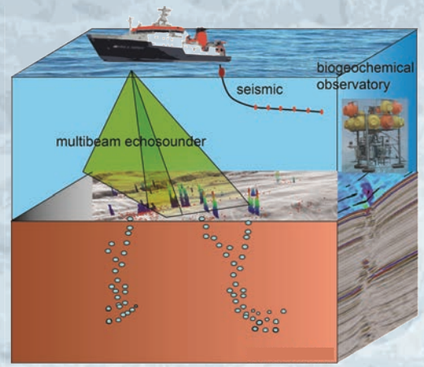
Discussion about CCS perception; photo University of Edinburgh

- Interviews with members of the public in Italy and Scotland to investigate the relevant emotional and content dimensions evoked by CCS
- Exploration of the cultural dimensions implied in the perception of CO_2 storage and identification of areas for exchange, discussion and learning
- Empirical study of public perception of a real-world CO_2 intentional release in a sub-sea context in cooperation with the British project QICS
- Exploration of perceptions of CCS with science communicators (science writers/journalists and master students of 'Science and Communication')

CCT1 - Monitoring Techniques & Strategies

Monitoring Techniques and Strategies

will provide a focus for the synthesis and integration of knowledge towards the optimisation of monitoring methods for different scenarios of CO_2 leakage.



Sketch illustrating different monitoring techniques; figure: GEOMAR

Objectives:

- to coordinate the development of monitoring technologies within ECO_2
- to develop guidelines for innovative and cost-effective monitoring strategies to detect and quantify potential leakage of CO_2 from storage sites and its effects on the marine ecosystems

Highlights in CCT1

- Definition of a basic set of parameters to be measured during all ECO_2 cruises

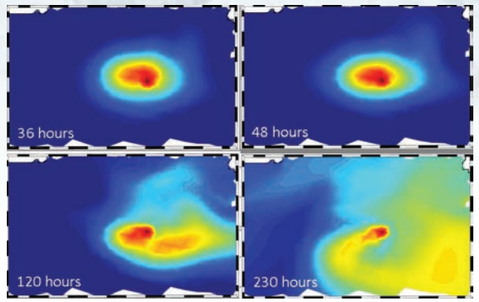
CCT2 - Numerical Modelling

Interfacing of the Numerical Models

intends to model the whole system from reservoir leakage through to CO_2 transfer into the ocean and to the atmosphere, including biological impacts. Subsequently, the physical, chemical and biological knowledge will be transferred into an economic valuation of the costs of leakage, monitoring, and mitigation measures as well as underpin a concept for risk management.

Objectives:

- to define common leakage scenarios that will enable the delivery of integrated risk assessments, economic valuation and the development of conceptual monitoring practices
- to identify model synergies, overlaps and interfaces, and the development of the appropriate computational coupling tools to support data transfer
- to quantify and evaluate the geological, physical, chemical and ecological risks, impacts and associated uncertainties of key CO_2 leakage scenarios



Dispersing CO_2 plume (domain: ~ 4x7 km²); graphic: PML

Highlights CCT2

Highlights in CCT2

- Definition of 'end to end' model chain covering CCS integrity, i.e. geophysical flows - sediment chemistry - ecosystem impacts - economic costs
- Definition of a scenario baseline, identifying the range of plausible scenarios

CCT3 - International Collaboration

International Collaboration

will enhance the international profile of European environmental CCS research.

Objectives:

- to enhance collaboration with Australian CCS research groups, with specific topics of sub-seabed storage monitoring technology and legal concepts and principles, including environmental liability
- to expand collaboration with Japanese CCS research groups, with specific topics of theoretical modelling of CO_2 plume and deep-sea biogeochemistry of natural CO_2 vent sites in Japanese waters
- to strengthen collaboration with US CCS research groups, particularly those working on experimental submarine CO_2 release and theoretical CO_2 buoyancy constraints and benefits of sub-seabed storage at water depth of >3000 m.

CCT3 - International Collaboration

Highlights in CCT3

- Presentations and collaborative meetings in Australia at the major Australian CCS research groups
- Presentations and collaborative meetings in Japan at the major Japanese CCS research groups
- Participation of two Japanese researchers on the RV James Cook research cruise 2012 to deploy newly developed Japanese chemical sensors

CCT4 - Best Environmental Practices

Framework of Best Environmental Practices of Offshore CO_2 Injection and Storage

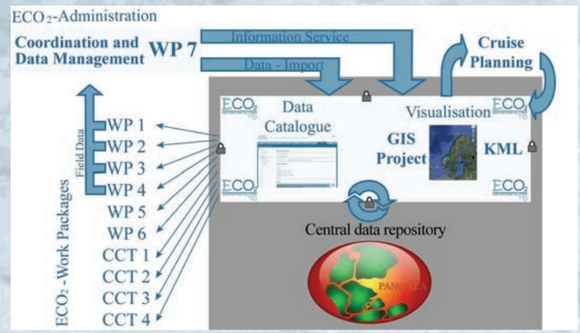
will utilise the knowledge of the ECO_2 consortium to identify considerations associated with operating storage facilities and managing the potential environmental impact of CO_2 storage.

Objectives:

- to construct a Framework of Best Environmental Practices in the preparation, operation and management of offshore storage sites.
- to review and test the applicability of the draft Framework of Best Environmental Practices guidance.

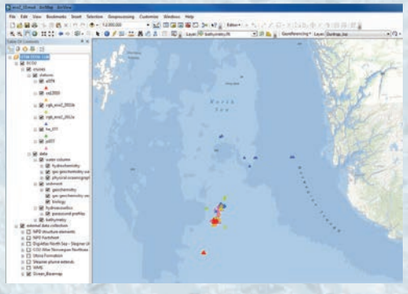
Data Management - PANGAEA

The data management facilitates the flow of data from field work, lab experiments and numerical simulations to all WPs and CCTs. The central data repository is part of the PANGAEA data library with all benefits through a distribution via web services, search engines, portals and library catalogues. Two years subsequent to the end of the project all ECO_2 data will be public.



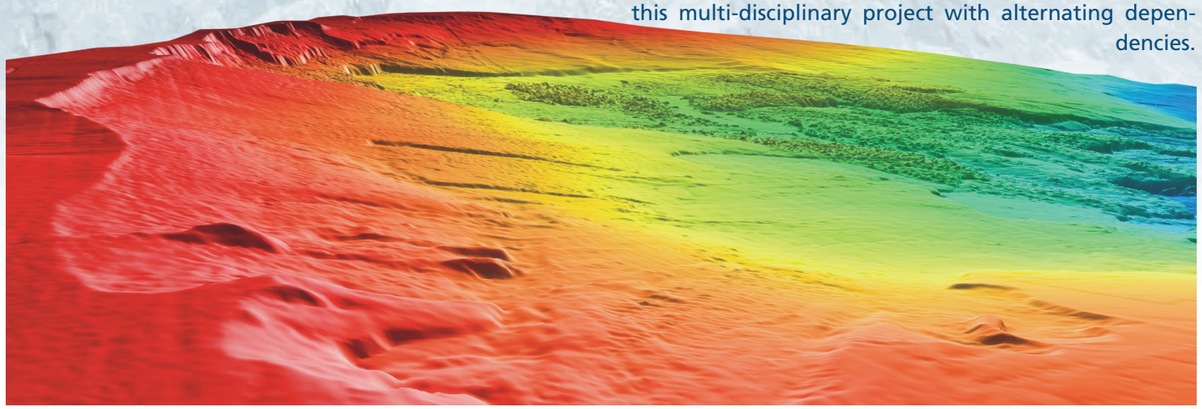
ECO_2 data management concept; illustration: GEOMAR

To support all ECO_2 scientists conducting research expeditions a KML file for Google Earth has been compiled including all ECO_2 data and external data sets available for ECO_2 study sites. Furthermore, a collobarative ArcGIS project combining all data of the CO_2 storage site Sleipner, which is one of the main targets of ECO_2 investigations, has been initialized.



ArcGIs project ‚Sleipner'; illustration: GEOMAR

Data management is combined with project management to guarantee the required data delivery for this multi-disciplinary project with alternating dependencies.



ECO_2 Consortium

ECO_2 consortium; photo: GEOMAR