Underground storage of CO_2 – the only route to decarbonised fossil energy

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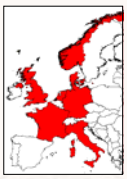
Breaking Ground- Dublin 11th Nov 2005

CO_2GeoNet is a "Network of Excellence"
13 Research Partners



Denmark
Geological Survey of Denmark and Greenland –GEUS

France
Bureau de Recherches Geologiques et Minieres- BRGM
Institute Francais du Petrole –IFP

Germany
Federal Institute for Geosciences and Natural Resources –BGR

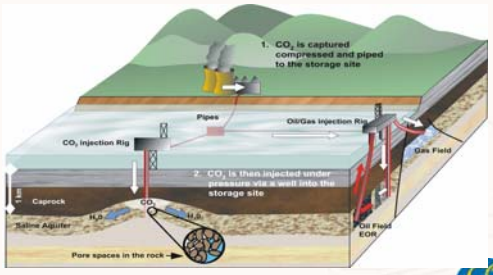
Italy
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale-OGS
Università di Roma "La Sapienza" -URS

Netherlands
Netherlands Organisation for Applied Scientific Research –TNO

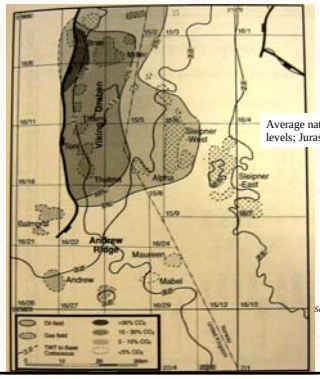
Norway
Norwegian Institute for Water Research –NIVA
Stiftelsen Rogalandsforskning-RF
SINTEF Petroleumsforskning AS –SPR

UK
Natural Environment Research Council-British Geological Survey-BGS)
Heriot-Watt University –HWU
Imperial College of Science, Technology and Medicine-IMPERIAL

Options for underground storage



Nature has been storing CO_2 beneath the N. Sea for over 50million years



Source Geol Soc Special Volume 2004

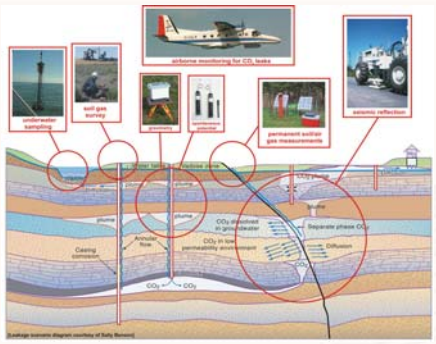
Potential CO_2 storage capacity under N. Sea

BGS led Joule 2 project 1992-5: a world first geocapacity study

Theoretical capacity Gt CO2					
Country	gas	oil	confined aquifers	open aquifers	Totals
Denmark	0.46	0.13			
Netherlands	0.82	0			
Norway	7.19	3.1	10.85	476	497.14
UK	4.88	2.62	8.56	240	256.06
Totals	13.35	5.85	19.41	716	754.61

UK sector of Irish Sea (BGS studies 2005)
Oil and gas fields of the East Irish Sea
(between the Isle of Man and Lancashire and North Wales coasts): 1Gt of CO_2 (Kirk *in press*)
Saline aquifers-East Irish Sea Basin: up to 0.63Gt of CO_2 (Kirk 2005)

UK annual emissions ~0.6Gt CO_2
of which power generation~ 0.2Gt



The latest EC research call addresses monitoring & verification

Themes for monitoring research

- Monitoring baseline conditions
- Monitoring caprocks and the overburden above storage intervals.
- Monitoring the potential impacts of near-surface leaks on both marine and terrestrial ecosystems.
- Use industrial, experimental and natural sites as test facilities for developing monitoring technologies.
- *Monitoring & verification will be vital for carbon trading, ecosystem protection, and safety, as well as for assurances for long-term reliability of the storage site*

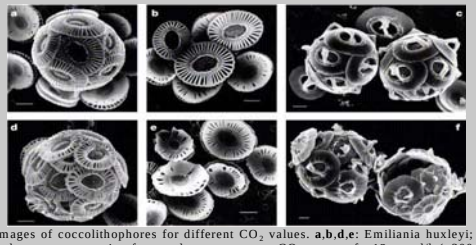
Some issues with respect to raised CO_2 levels & marine organisms

- Inhibits calcification
- Stresses species which have high energy demands
- Reduces reproductive fertility
- Early part of lifecycles most sensitive

CO_2 Effects on Phytoplankon

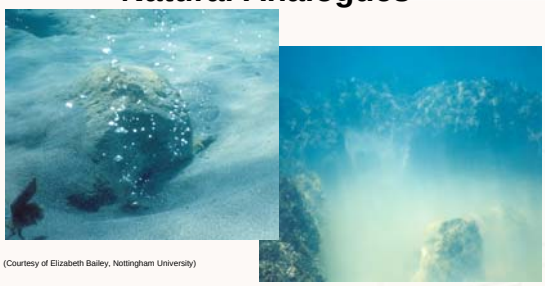
300 ppm

800 ppm



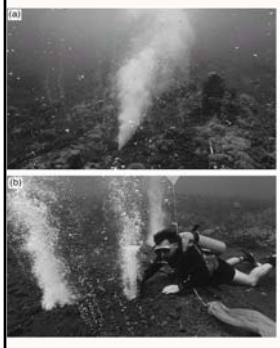
SEM images of coccolithophores for different CO_2 values. **a**,**b**,**d**,**e**: Emiliania huxleyi; **c**,**f**: Gephyrocapsa oceanica from cultures grown at CO_2 conc. of ~12 µmol/l (~300 ppmv) (**a-c**) & CO_2 conc. of ~30-33 µmol/l (780-850 ppmv) (**d-f**), (780-850 ppmv). Scale bars = 1 µm. *U. Riebesell et al. "Reduced calcification of marine phytoplankton in response to increased atmospheric CO_2", Nature, **407**, pg 364-7, 21 Sept., 2000.*

Natural Analogues



(Courtesy of Elizabeth Bailey, Nottingham University)

Natural CO_2 seeps to the sea bed, offshore Greece



Pichler *et al*. 1999: Tutum Bay-Papua New Guinea: 95% CO_2 natural seep into a coral reef

Ecosystem responses to CO_2 leakage

- Development and testing of techniques to monitor the potential impacts of a leak on terrestrial or marine ecosystems
- Identify appropriate indicator species
- Develop monitoring protocols
- Add environmental data layers to storage GIS for North Sea

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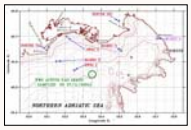
Monitoring of submarine CO_2 fluxes and ecological impact

- Feasibility study of automatic sampling and detection of offshore gas releases (OGS,BGR).
- Initial testing in Gulf of Trieste, using OGS meteo-oceanographic buoy.
- Supported by laboratory experiments on mussels and modelling of CO_2 seabed behaviour (NIVA).



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Monitoring of submarine CO_2 fluxes & ecological impact

Video clip with the divers in the Gulf of Trieste

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Summary

Nature has already emplaced CO_2 beneath the North & Irish seas for millions of years with no known negative effects. We can learn much from natural systems.

In NW Europe, rocks under the offshore continental shelf have the largest CO_2 storage capacity. Ireland has little scope for onshore storage- but offshore basins with storage capacity exist- these need appraisal. Collaboration between the UK and Ireland with a view to identifying potential shared CO_2 storage sites and infrastructure in the Irish and Celtic sea areas is desirable.

There is a very low risk that sub sea bed CO_2 storage could leak with resultant local or sub-regional consequences. It is prudent to know what the mode and impact of leakage could be and plan, operate and monitor CO_2 storage projects accordingly

Continuing to emit CO_2 to the atmosphere at the present rate (over 100x the maximum rate of change seen at least over the last 420,000 years) is extremely risky. Indications are that many types of marine organisms will be detrimentally affected globally. These effects will be amplified secondarily through ecosystem responses. Ireland with its important marine habitats, fisheries, and tourism industries is particularly vulnerable to this threat

More research is required to address uncertainties, but I believe that we know enough already to make a decision as to which of the above risks is worth taking.

Whilst we delay in implementing CO2 capture & storage we have 100% leakage!!!!

Nick Riley, Dublin, Ireland Nov 2005