Identification and development of techniques and methods for the detection, monitoring and quantification of potential leakage of CO2 from sub-seabed storage sites into the marine environment.

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Health Warning!

- These slides are the result of a draft report from a “brainstorming” workshop and are not intended as anything other than a snapshot of some current techniques.
- Potential use of any of these techniques in a monitoring situation will need much greater discussion and a link to risk assessment.

Surface seismic techniques

- Highly developed, widely deployed
- Capable of imaging CO2 movement by time lapse in certain geologies
- Imaging generally poorer through Karst, beneath salt and beneath gas

Borehole seismic techniques

- Site specific
- Can give early warning of leakage
- Highly developed & widely deployed
- Limited in areal coverage

Marine acoustics

- Can image bubble streams – optimum method
- Bubbles may dissolve in shallow water columns
- Bubble streams may be missed by single survey

Electrical / electromagnetic

- Seismic signal generates an EM signal which can by analysed to give info. on composition of rock around well
- May be possible to track CO2 esp. if CO2 is in supercritical phase
- Low cost
- Research stage
- Potentially low resolution

Geophysical

- Changes in injection rates / pressure / temperature can indicate leakage during injection
- Current and standard commercial practice
- Gives no information on where leak is occurring or on migration

Geochemical - 1

- Logs / rock samples / tracers / fluid chemistry
- Can be used to identify movement / migration of CO2
- Difficult to access
- Can be expensive

Geochemical - 2

- Measurement of CO2 in sediment
- Ship time needed – costly
- Can confirm leakage
- Pressure correction necessary

Hydro-chemical

- Measurement of CO2 in seawater
- Very localised testing
- Equipment may be left in situ but is expensive (£5-10k each).
- pH – very localised but highly mobile and does not require highly trained staff

Ecological – Grab sampling

- Grab sampling used for biological analysis can also provide chemical data
- Some microbes are more sensitive than others to CO2 / pH changes
- Grab sampling is costly and analysis is time-consuming
- Techniques well understood but species sensitivities are not.

Ecological – others

- Bio-assay can indicate faunal health
- Quick and cheap
- No specific understanding of specific detection or reaction limits of effects of CO2
- Remote sensing may detect appearance / disappearance of organisms on sea bed
- Can cover large areas quickly

Atmospheric - 1

- Long open path infrared laser
- Measures absorption by CO2 in air of a specific part of the infrared spectrum
- Needs development but may estimate +/- 3% of ambient or better
- Only applicable above sea surface

Atmospheric - 2

- Eddy covariance – equipment mounted on platform or tower
- Gas analysed to calculate CO2 flux
- Can survey large areas and detect leaks
- Several instruments / towers needed to cover whole site

Atmospheric - 3

- Portable hand held IR gas analysers
- Can be used on offshore platforms
- Resolution around 100ppm
- <$1000 per unit
- Not sufficiently accurate for monitoring CO2 leakage

Visual techniques

- Visual detection of CO2 bubbles
- SPI camera can be used to detect bubbles in sediment and change in chemistry
- Site specific
- Not sufficiently accurate for quantifying CO2 leakage