Approach for a sound environmental risk assessment of sub-seabed CO2 storage

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Research Project ECO2 preStorage of carbon dioxide in the offshore sea bed as part of a Carbon Capture and Storage (CCS) strategy is often discussed as a means to reduce further the increase of carbon dioxide to the atmosphere. Funded by the European Union, the ECO2 project developed recommendations for the selection and monitoring of submarine storage sites as well as an approach to a sound environmental risk assessment (ERA). 27 partner institutions from nine European countries cooperated in the project that has been coordinated by GEOMAR Helmholtz Centre for Ocean Research Kiel from May 2011 to April 2015. The outcome of ECO2 helps to adjust CCS regulations and to operate sub-seabed CO2storage sites more safely.

Can carbon dioxide (CO2) be stored safely below the seabed? A broad variety of experts from 27 institutions in nine European countries investigated possible risks of marine carbon dioxide capture and storage (CCS) and their consequences. The work of the multi-disciplinary consortium was coordinated at GEOMAR Helmholtz Centre for Ocean Research Kiel and funded by the European Union within its 7th framework programme with 10.5 million Euros.

During expeditions to the Norwegian storage sites Sleipner and Snøhvit and to several natural CO2 seepage sites (e.g. Aeolian Sea, Barents Sea, North Sea), ECO2 scientists identified possible pathways for CO2 leakages, monitored seep sites, traced the spread of CO2 in bottom waters and studied the responses of benthic animals and plants to CO2. Their results and conclusions are compiled in a guide for the selection

and monitoring of storage sites that has now been presented to the European Union.

ECO2 developed a generic approach for estimating consequences, probability and risk associated with sub-seabed CO2 storage based on the assessment of the environmental value of local organisms as indicated for example by the Natura 2000 network of nature protection areas or the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), the vulnerability of environmental resources and possible impacts on them as well as consequences and risks. The major new element of this approach is the "Propensity to Leak Factor" which has been developed by ECO2 combining a compact description of the storage complex and heuristic techniques accommodating for the large number of parameter uncertainties. "It is not possible to simulate all relevant geological features, processes and events with reservoir modelling software currently available", Todd Flach, principal research engineer at DNVGL explains. "We therefore found a way to realistically estimate how likely a storage complex is to leak."

For site selection, ECO2 recommends to avoid geological structures that may serve as conduits for formation water and gas release, geological formations containing toxic compounds and low-energy hydrographic settings with sluggish currents and strongly stratified water column. Also, storage sites should be established distant to valuable natural resources or areas in which biota is already living at its tolerance limits.

Based on its extensive field programme, ECO2 recommends that overburden, seabed, and water column should be monitored with 3-D seismic techniques, high-resolution bathymetry or backscatter mapping of the seabed, hydro-acoustic imaging of gas accumulations and outlets, video and photo imaging, chemical detection of dissolved CO2 in ambient bottom waters. "Most of the monitoring technology is available

or developed and will soon become state-of-the-art", Klaus Wallmann, coordinator of the ECO2 project, points out. According to the ECO2 consortium, additional targeted studies have to be conducted if formation water or gas seeps and if pockmarks with deep roots reaching into the storage formation occur at the seabed. Wallmann: "It is important to check emission rates of gases and fluids and make sure that seepage is not invigorated or pockmarks are re-activated by the storage operation."

"Geophysicists, geologists, biologists, geochemists, oceanographers, legal experts, social scientists and economists worked closely together to create a multi-layered assessment of sub-seabed CO2 storage", Wallmann summarizes. "We hope that our results help to update and adjust existing CCS rules and to develop new regulations. The knowledge we have gained is also very useful for companies planning or realizing CCS. And it can help to substantiate the discussion about CCS."

More information: For more information, see www.eco2-project.eu/

Provided by Ghent University

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