IEAGHG Information Paper: 2015-IP20; Risk Management Network and Environment Research Network Combined Meeting Concludes

A Research Management Network and Environmental Research Network Combined meeting was held at the UK's National Oceanography Centre (NOC), in Southampton. The meeting was attended by 62 delegates from 11 countries. The three day meeting included themes on risk assessment methodologies, risk communication and mitigation strategies as well as environmental research. There was an emphasis on potential impacts of CO_2 in marine environments, natural variability and the unscheduled release of CO_2 from pipelines. Coverage also included formation fluid release, overburden features, international initiatives and environmental impact assessments notably the Peterhead – Goldeneye project. This capture-storage project has been the subject of a complex risk assessment processes which links a series of risks with related mitigation measures.

During the meeting representatives from National Grid explained the background to their Endurance project which will be Europe's first CO_2 superstore. A large deep saline aquifer off the east coast of England has been identified as a potential storage location for multiple carbon emission point sources in the Yorkshire-Humberside region.

Delegates from the Netherlands and the United States summarised projects that are designed to develop mitigation and remediation options based on currently available technology, pressure management and well remediation techniques. The EU funded MiReCOL projected is focused on deep subsurface CO_2 plume management. The comparable National Risk Assessment Partnership, supported by the US Department of Energy, is also developing tools and models to test their effectiveness. The aim of this research is to improve estimates of storage permanence and the identification of the key drivers of risk.

The environmental research topics highlighted by the meeting focused on the environmental changes caused by CO_2. Modelling clearly shows that in shelf seas with a high tidal flux, like the North Sea, there is rapid dispersion. The impact of CO_2 anomalies are, consequently, likely to be limited. There are also wide natural variations which need to be distinguished from any artificially induced changes. Experimental mesocosm studies have shown that infaunal species that live in sea-floor sediments are more sensitive to environmental change whereas epifaunal species that live above the sediment, or in the water column, are more tolerant. Investigation at a number of reference sites is important to be sure that any impact is not just attributed to natural variability.

The origin of CO_2 detected at the surface in terrestrial environments can be hard to attribute without rigorous appraisal. In an example presented at the meeting CO_2 measurements in the vicinity of the Weyburn site, could be interpreted as leakage. However, the application of complex multiple geostatisitical analysis demonstrated that CO_2 from different sites was not from the Weyburn Field. Ratios of CO_2 to O_2 were used to differentiate the origin CO_2. The ratios are consistent within biological respiration.

The risks and environmental impacts of CO_2 pipelines were included in the meeting. A series of R&D projects have been initiated under the COOLTRANS programme to assess these impacts. The programme has included full-scale experimental work including a series of fracture and shock tests. Pipeline failure can result in sudden, large but highly localised impacts or small leaks which are far less evident. The research will lead to best practice, safe and long-term conditions for CO_2 transportation.

Monitoring chemical parameters in seawater and the ability to record consistent data is an area of active research by NOC. It is now possible to record key chemical data simultaneously with salinity. Monitoring systems have been tested on platforms and gliders enabling wide spatial and temporal data acquisition, although data filtering will be necessary to pick up anomalies. Dissolved inorganic carbon (DIC) down to a 2µM limit of detection can now be measured but not rapidly or at depth. Oxygen can be accurately measured to a comparable level. The accuracy of measurements of other chemical parameters, for example nitrates, is more variable.

The importance of overburden characterisation above caprock and storage complexes with multiple seals has been recognised. Research in the Gulf of Mexico, the North Sea and the Bonaparte Basin of north-west Australia is beginning to show intricacies which are pertinent to CO_2 storage. P-cable seismic surveys in the Gulf of Mexico have suggested potential storage capacity but further investigation

necessary. Successive continental scale glaciations over northern Europe have produced large outwash glacial channels across the North Sea. The presence of tunnel valleys caused by this glaciation can cause seismic imaging artifacts. These surveys have revealed the complexity of channels and how they might influence potential migration pathways. A large number of chimney structures in are also evident in the South Viking Graben. These features can be 300-600m in width and 1km in height and could present a conceptual flow system. The internal structure of gas chimneys, and their permeability, is a topic for further investigation. Another feature, evident from a number of shelf areas are polygonal faults which are thought to form as sediments compact and dewater. The extent to which hydraulic conductivity occurs between them is unclear. All these features need to be thoroughly investigated because they will influence future monitoring strategies.

The meeting concluded that the risk assessment for CO_2 geological storage is maturing. If leaks do occur they are likely to have low environmental impacts. Wellbore issues are still the predominate risk. There are established technology solutions but more work to test and apply them was suggested. The meeting has clearly shown that great developments in understanding environmental aspects in the marine environment are taking place. Mobile sensor technology is also improving especially with the advent of long-range AUVs. Further research on the impact of formation fluid releases was encouraged. Pipeline failures in the marine environment was another area where additional effort was recommended. The meeting concluded on a successful note and clearly highlighted the advances in research on marine impacts around the world.

After the meeting some of the delegates visited two key sites on Dorset's Jurassic Coast. The guided tour's first destination was the Bridport Sands. The extensive cliff exposure of this formation shows clear evidence of bioturbated horizons within a shallow marine shoal sandstone. These horizons are known to coincide with low porosity calcified bands. This formation is an important reservoir rock for the Wytch Farm Oilfield further to the east near Bournemouth. The reservoir properties of this formation have revealed that the calcified bands act as baffles. Subsequent tectonic events have created vertical fractures which could allow vertical migration. These features are important to understand because they influence fluid movement and help to explain the challenge of monitoring CO_2 injected into similar reservoirs.

Field trip party study the Bridport Sands on Dorset's Jurassic Coast

Delegates to the Combined Network Meeting assemble in front of RRS Discovery; NOC's research ship

Delegates then visited Lulworth Cove where there is a succession from the Portland Limestone of the Upper Jurassic through the Purbeck Beds into the Cretaceous Wealden, Gault Clay, Greensands and finally Chalk. The location also displays evidence of significant folding caused during the Alpine Orogeny known locally as the Lulworth Crumple. These two locations, and other exposures along this World Heritage coast, enable geoscientists to gain a broader insight into subsurface complexities which are inferred from geophysics and wellbore sequences. The identification of secure, long-term storage reservoirs for CO_2 ultimately depends on understanding such geological complexities.

James Craig
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