

# eReport

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## ANLEC R&D Report Summaries

The following reports are available from the ANLEC R&D website:

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### Surat Storage

#### *Monitoring vegetation condition for detection of subsurface environmental influences*

This project explores remote sensing of vegetation and soils as a tool for hypothetical pasture growth monitoring. Several studies have shown plants are sensitive to high CO<sub>2</sub> concentrations in soil, with prolonged exposure leading to the vegetation disintegrating. Researchers in this study characterised the temporal dynamics of vegetation cover from 1988 to 2017, using time series data from the Landsat (satellite) sensor. With remote monitoring they evaluated the spatial variability in vegetation condition (including cover, chlorophyll content) at a high resolution using an hyperspectral aerial imagery. These data sources show that vegetation cover is highly variable in the spatial and in the temporal dimensions following environmental and human-induced drivers in the study area. The time series satellite data show how vegetation changes within a season and between seasons and the specific trends over time. It is also possible to identify areas within the Glenhaven Station which were cropped in the past and other areas which have had other type of disturbances. The hyperspectral imagery provides a much more spatially detailed picture of the vegetation condition at just one moment in time.

More information: [Vegetation condition monitoring](#)

#### *Transport-reaction models to inform long term water quality monitoring in the Surat Basin storage complex*

Researchers in this study have developed reactive-transport models for assessment of water quality. The models simulate changes from important geochemical reactions, along with solute plume migration and dissolution of the greenhouse gas stream. The study identifies what properties determine buoyancy-dominated CO<sub>2</sub> migration occurs in channelised flow paths as opposed to one homogeneous conduit. It also explores what controls the reactions of injected species within the reservoir, and whether there are particular zones of mineral dissolution and carbon mineralisation. The reactive-transport models used in this study are highly complex because of the high-resolution grid and the large number in geochemical variables. Three zones with distinct differences in water composition and geochemical reactions are proposed. It also suggests discrete zones of changes in the water composition and the respective geochemical processes within a CO<sub>2</sub> storage reservoir. The results provide guidance for validating the modelling and ultimately informing the design of a water chemistry monitoring program.

More information: [Evolution of the solute plume composition at the Glenhaven site \(Queensland\)](#)

#### *New 3D model for fine-scale convective mixing in the Surat Basin*

This project contributes to the application of numerical simulations for CO<sub>2</sub> storage assessment, looking at the nuances of quantity and time scale when capturing the essential physical processes. The researchers built on their previous 2D modelling of the convective mixing process to create a 3D model applicable to field scale simulations in the Surat Basin's Precipice Sandstone. Using massively parallel simulations at a large scale, the study showed the Precipice can be adequately represented by a simplified anisotropic homogeneous model for the purpose of examining enhanced dissolution due to convective mixing.

More information: [Dissolution rate of CO<sub>2</sub> due to convective mixing for fine-scale convective mixing process](#)

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## Gippsland Storage

### *Modelled changes in reservoir water composition from CO<sub>2</sub> storage in the Gippsland basin*

This project studies the geochemical changes in mineral and water composition in the Latrobe Group reservoir upon the injection of CO<sub>2</sub> with and without impurities. The results showed that the injection of CO<sub>2</sub> would initially lower the pH as a consequence of CO<sub>2</sub> dissolution and the oxidation of the dissolved SO<sub>2</sub> and NO<sub>2</sub> in the presence of O<sub>2</sub>. However, alkalinity of the formation water and additional dissolved carbonate from siderite and dolomite dissolution would provide a buffer capacity leading to a rapid stabilisation of the pH. SO<sub>2</sub> and NO<sub>2</sub> were captured relatively close to the injection well and did not spread into the wider reservoir. This study is one of the first attempts that tries to predict the interactions between CO<sub>2</sub>-saturated fluid and coal. The results showed that siderite dissolution and hematite formation would be the main mineral reactions due to the relatively high dissolution rate of siderite. The water composition in this case will stabilise after approximately 5 years. It also suggests dissolution and precipitation of other minerals in the coal and the corresponding changes in concentrations of dissolved ions will be insignificant.

More information: [Characteristic trends in the evolution of reservoir water composition during CO<sub>2</sub> storage](#)

### *Marine field surveys profiles features of the nearshore Gippsland Basin*

Researchers in this project are conducting field surveys to identify unusual or unique sub-sea surface features in the Gippsland Basin, in the vicinity of the proposed CarbonNet geological storage project. This report details two surveys in late 2017 and early 2018. The first of these gathered acoustic, visual and geochemical data in 16 identified sites. The second collected biological data at 19 sites, including representative samples of the different substrate types and remote underwater video recordings of fish communities. Fish communities were surveyed using stereo remote underwater videos (RUV) at 14 of the 19 survey locations. To investigate differences in the abundance and types of bacteria and infauna in sediments, four 6 cm diameter and four 10 cm hand cores respectively, were collected at each of the biodiversity study sites by divers, who also collected macrofauna, seagrass and algae samples. The sediment samples have been processed for bacterial and infaunal analysis and DNA extractions.

More information: [Seabed Processes in the Nearshore Gippsland Basin](#)

### *Open-path near infra-red system for atmospheric monitoring*

Effective CCS monitoring requires that novel measurement techniques are investigated to establish their capability and proper configuration as fit-for-CCS purpose. This project aims to establish appropriate atmospheric monitoring to help discriminate between detected environmental signals. Researchers are looking to identify the optimal instrument combination and configuration to carry out such a survey. This first report evaluates a newly developed open-path Fourier Transform InfraRed (OP-FTIR) spectrometer, operating in the near infrared (NIR) region. Following optimisation and initial characterisation, researchers concluded the open-path NIR system showed potential. More robust modelling of the atmospheric characteristics of the Gippsland environment is necessary. The system would most effectively be deployed as part of a network of instruments measuring CO<sub>2</sub> and other related atmospheric tracers, especially CO and isotopic ratios in CO<sub>2</sub>.

More information: [Performance of OP-NIR system for measurement, monitoring and verification of influences on atmospheric state](#)

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## South Perth Storage

### *A comprehensive geophysical analysis of the Lesueur Sandstone Formation*

This project integrates all available geophysical data for the South West Hub's Harvey wells in the Lesueur Sandstone Formation. It provides a comprehensive geophysical analysis of rock property distribution, with conclusions, with conclusions of the inversion results. The Wonnerup Members seismic character appears to change towards the Harvey 4 well possibly due to the overlapping depth trends of the reservoir/baffles facies types.

More information: [The Lesueur, SWH: Improving seismic response and attributes](#)

### *Yalgorup Member paleosol samples have stronger than expected capacity for storage and sealing*

This project investigates the nature of the Yalgorup Member, in Western Australia's Lesueur sandstone formation. The report looks at a study of three samples from the Harvey 3 well that were, in their native preserved state, exposed to

long-term coupled geomechanical and CO<sub>2</sub> transmissivity tests. It was anticipated that, under increasingly differential stress from the testing, the samples would fracture and allow a breakthrough of the pressurised upstream CO<sub>2</sub> into the downstream reservoir. Unexpectedly, in all three samples no CO<sub>2</sub> breakthrough occurred, even beyond the nominal failure point (peak differential stress), and into the early stages of faulting (slip). This suggests both the CO<sub>2</sub> storage and sealing capacity of the rock is greater than expected. That said, the lateral continuity of such layers is limited and they will act as baffles as opposed to seals.

More information: [Chemical and geomechanical reactivity to CO<sub>2</sub> of samples from the Yalgorup Mbr at Harvey-3](#)

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## Capture

### *First approximation cost estimates for innovative aqueous CO<sub>2</sub> capture*

A novel aqueous dissolution process for post combustion capture (PCC) of CO<sub>2</sub> was assessed. Results suggest it may be feasible for Australian coal power plants, from both an engineering and economic perspectives. Researchers found that while the concept is technically sound, there are residual issues that need to be resolved in any detailed design phase. The sub surface aspects of the process are expected to require a smaller footprint and also provide an option to recover energy from the system. The proposed technology appears to be comparable in cost performance to traditional amine-based CO<sub>2</sub> scrubbing processes.

More information: [PI-Innovation aqueous CO<sub>2</sub> removal: process modelling and costing](#)

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ANLEC R&D is a member of the following IEA implementing agreements. For access to their reports, please contact [admin@anlecrd.com.au](mailto:admin@anlecrd.com.au)

## IEA Clean Coal Centre Reports

1. Baruya, P (2018). "[Production and supply chain costs of coal](#)".
2. Mills, S (2018). "[The use of coal-derived wastes as a source of energy](#)".
3. Barnes, I (2018). "[Hele perspectives for selected Asian countries](#)".