

An Indian-Australian research partnership

Project title: Geo-Sequestration of carbon dioxide in coal seams

Project number: IMURA0054

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Research Academy theme/s

List only the research academy theme/s that is relevant to the project

1. Infrastructure engineering
2. Clean Energy

The research Problem Project Title

The concept of sequestering CO₂ into deep underground environments such as deep unmineable coal seams, saline aquifers, and depleted gas and oil reservoirs, is considered to be the most potentially viable method of achieving the Kyoto Target of 108% of 1990 emissions, while maintaining the competitiveness and sustainability of Australian industry and protecting many Australian jobs. Recent field applications in the USA, Norway and Japan have shown that there is great potential for greenhouse gas mitigation using this technology. However there is still a lack of understanding of the fundamental geomechanical behaviour of some sedimentary rocks (e.g., coal) with the injection of supercritical CO₂. The existing theories for multiphase fluid flow and mass transport in porous/fractured rocks may not be applicable for sedimentary rocks such as coal, since they do not account for the sorption and other geomechanical and physico-chemical properties of coal. In Australia, research on the flow, transport and deformation characteristics of sedimentary rocks in aquifers and oil and gas reservoirs have been conducted. However, further research is still needed in getting a better understanding of the effects of moisture on the sorption and diffusion properties of coal; the effects of stress on absolute and relative permeabilities; the effects of temperature on the phase change of injected CO₂ and their consequent change in flow properties, and the potential leakage of sequestered gas back into the atmosphere. It is important to fill this gap in our existing knowledge in order to assess the feasibility of storing carbon dioxide in deep unmineable coal seams.

Project aims

The main aims of the project

The aims of the project are:

- 1) To study the effect of moisture on the adsorption and gas diffusion properties of coal.
- 2) To examine the effect of temperature on phase change and the flow properties of injected CO₂.

- 3) To study the effects of in-situ stress and pore fluid pressure on absolute and relative permeabilities of coal, taking into account the effects of coal matrix swelling and shrinkage.
- 4) To understand the effects of supercritical CO₂ on the swelling and strength behaviour of coal, resulting from potential plasticization of coal under high pressure.

Expected outcomes

- 1) Assess the long-term safe storage of CO₂.
- 2) Improve understanding of the flow properties of CO₂ in gaseous and supercritical forms in coal and the effects of moisture and insitu stress levels.
- 3) Identify the effects of temperature and pressure by the potential plasticization of coal caused by absorption of CO₂ into polymeric structure of coal.
- 4) Establish the applicability of a coupled thermo-geomechanical-reservoir simulator.

Strengthen international cooperation in research into geo-sequestration of CO₂.

Which of the above Theme does this project address?

This project will address the main research themes on (1) Infrastructure engineering and (2) Clean Energy

How will the project address the Goals of the above Themes?

One of the most critical environmental issues facing society is that of global warming. A major driver of global warming is the increasing concentration of carbon dioxide in the atmosphere. To tackle this problem a range of strategies will be required which are expected to include the use of renewable fuels, improved energy efficiency, carbon sequestration and increased conservation. Most experts agree that no single solution is likely to provide a satisfactory answer to the problem, and that a rational combination of the above strategies will need to be followed. This project is concerned with clean energy and infrastructure engineering.