

An Indian-Australian research partnership

Project Title:	CO₂ enhanced geothermal systems: THMC investigation	
Project Number	IMURA0683	
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Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?

(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1. Clean Energy
2. Advanced computational engineering, simulation and manufacture

The research problem

Geothermal energy is considered an environmental friendly source of the renewable/clean energy. It has become a significant source of electricity for some countries (USA, Iceland, New Zealand, Turkey, Japan, France, Germany, Indonesia etc.). However the development is mainly restricted due to loss of the injected water in many geothermal fields. This problem may be eliminated through use of super critical CO₂ in place of water.

However, injection CO₂ into geological reservoir, involves the chemical interactions with reservoir fluids along with thermal and mechanical induced deformations. These processes are

coupled to each to others. This leads to decrease in the effective stress of the reservoir and bring the system closer to failure conditions. Also, the failure of caprock develop new pathway by reactivation of fracture within the reservoir or caprock itself to migrate the CO₂ plume. The CO₂ brine is also amicable to react with rock mineral and can cause alteration of permeability of the reservoir. The formation of fingers can cause short-circuit of supercritical CO₂ plume to high permeable flow paths in a fractured reservoir and finally leakage from the reservoir.

All these, clearly indicate the complexity of the problem and suggest the importance of thermal-hydro-mechanical-chemical analysis of CO₂ sequestration.

Project aims

The project aims are as follows:

- 1) Detailed understanding of the spreading of supercritical CO₂ inside the rock-systems.
- 2) To understand the geo-mechanical behavior of a reservoir with a blanketing caprock with consideration of thermo-elastic deformation of porous rock.
- 3) Investigate porosity and permeability changes in dominant flow conduits.
- 4) Investigate the dissolution of CO₂ into saline brine, mixing and phase change during operational periods.
- 5) Develop numerical models on THMC changes in rocks under reservoir conditions.
- 6) Generation and propagation of fractures at variable pressure regimes will be modelled

Expected outcomes

It is understood that, coupled thermo-hydro-mechanical and chemical processes take place during carbon sequestration/heat extraction, and the present study would help for long-term assessment of safety and reliability of carbon sequestration. The study would help to understanding of the spreading of CO₂ inside the reservoir. It would also help to understand the effect of mechanical and chemical changes in the reservoir while injecting CO₂ in its long term stability.

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

This project addresses the themes like clean energy, and advanced computational engineering, simulation and manufacture.

Capabilities and Degrees Required

Capability in laboratory experiments and numerical modelling with a background in engineering geology, civil or mining engineering is desired.

Potential Collaborators

Please provide a few key words relating to this project to make it easier for the students to apply.

THMC experiments, numerical modelling, geomechanics, geothermal systems