

PETROLEUM SCIENCE AND ENGINEERING

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Key research areas, focused on support for oil and gas production in the Asia Pacific region, include:

Basin Modelling

- Understanding hydrocarbon generation, migration and charge history of the Bass Basin
- Regional controls on hydrocarbon charge in the Cooper/Eromanga Basin.

Dynamic Modelling and Simulation

- Environmental problems: CO₂ sequestration, groundwater contamination, tracers, foam remediation
- Fluid flow dynamics in porous media: oil rims, stratified reservoirs, fractures, foams (blocking, polymers), flow of suspension and colloids
- Geomechanics: borehole stress and stability, fracture growth, formation compaction, faults
- Modelling methods: finite element, finite difference, particle and mesh free
- Proxy models: statistical, experimental design, gradients, networks
- Theory of multiphase continua and flow: diffusion and convection, up/down scaling, micro- and macro-models with averaging, different media and stiffness, mechanical-electrochemical coupling.

Enhanced and Improved (Petroleum) Recovery (E/IPR)

E/IPR processes target oil and gas reserves which remain unexploited in 'already-proven' reservoirs following the primary production phase - remaining reserves could be as high as 80 percent. Therefore, without an adequate and efficient E/IPR strategy, a vast amount of these proven reserves will remain unrecovered.

Current research areas:

- Enhanced coal-bed-methane (ECBM) Recovery through CO₂ and N₂ injection

- Enhanced methane recovery from methane hydrate reservoirs by CO₂ injection
- Enhanced oil recovery (EOR): CO₂ and air injection, microbial (MEOR) and chemical EOR
- Gas assisted gravity drainage (GAGD) process for the enhanced oil and gas recovery
- Improved oil recovery using horizontal wells
- Improved oil recovery using waterflood with fractured wells.
- Reservoir simulation and visualization
- Role of asphaltenes and waxes in petroleum production
- Tight-Gas reservoirs: Study of the reservoir and production engineering aspects.

Greenhouse Gas Technologies

- Carbon dioxide (CO₂) capture and geological storage (geosequestration)
- Developing safe and economical CO₂ geosequestration technologies to reduce greenhouse gas emissions
- Otway geosequestration research project in south-western Victoria.

Improved Business Performance

- Decision making and risk analysis
- Economic evaluation, real options, portfolio management
- Impacts on business performance of improved decision making and uncertainty assessment
- Psychological and judgemental aspects of eliciting expert uncertainty assessments and opinions.

Petroleum Geomechanics

- Major projects include the 'Australian Stress Map', 'Stress and Neotectonics of Borneo' and 'Geomechanics of CO₂ Sequestration'.
- FAST - Fault analysis seal technology
- Geomechanical theory – new non-linear 3D yield criteria
- Wellbore Instabilities
- Geomechanical numerical modelling.

Reservoir Analogues

- Definition and prediction of stratigraphic architectures and ranges of potential reservoir and heterogeneity geometries.
- Direct application of outcrop and subsurface data to hydrocarbon extraction issues.
- Documentation of modern and ancient reservoir analogues across a range of depositional environments (dryland, marginal marine, deep water) with the aim of improving hydrocarbon exploration and exploitation techniques.
- Lake Eyre Basin Research Group (LEBARG) - focussed on dryland reservoirs
- WAVE consortium - focussed on the prediction of reservoir geometries and heterogeneities in wave-influenced marginal marine systems. Impacts of depositional architecture on CO₂ migration and sequestration.

Reservoir Characterisation at Pore Level

- Petrology and diagenesis of reservoirs associated with petroleum and CO₂ sequestration
- Thin section analysis, cathodoluminescence, XRD, image analysis, pore Casting, SEM, electron microprobe, isotope analysis, quantitative chemistry, MICP, porosity, permeability, and CEC.

Current Project:

- Investigating CO₂-related diagenesis in the Otway, Gippsland and Cooper Basins.

Seals

- Characterising fine grained sediments in terms of mercury injection capillary pressure (MICP) seal capacity, scanning electron microscopy (SEM), X-Ray mineralogy and Gamma logs. Research in present day seal analogues also incorporated to gain a fuller understanding of seal thickness, areal extent and depositional environments.