

Petroleum geoscience: Hydrodynamics

CSIRO’s capabilities in petroleum hydrodynamics are applied to industry challenges in oil and gas exploration, hydrocarbon migration, geological storage of CO₂, geothermal energy, and evaluation of impacts from conflicting uses of the basin pore space.

The hydrodynamics team characterises, quantifies and predicts hydrodynamic processes in the subsurface in order to assist resource industries reduce their exploration risk and protect the environment. We are the only petroleum hydrodynamics team in Australia. The team specialises in the use of both multiphase and single phase fluid flow models for simulating hydrodynamic processes related to oil and gas production (including unconventional gas), CO₂ storage, geothermal and groundwater resource development.

Through analysis and numerical modelling techniques, we address problems in:

- ♦ fault and top seal capacity for oil, gas and CO₂
- ♦ hydrocarbon migration
- ♦ oil and gas field compartmentalisation and depletion
- ♦ geological storage of CO₂, including monitoring and verification of geochemical processes
- ♦ coal seam gas
- ♦ deep groundwater resources
- ♦ geothermal energy
- ♦ resource conflicts within multi-use basins.

In addition, our team has developed a hydrogeological database for storage, visualisation and analysis of subsurface formation pressure, temperature, rock properties and water chemistry data. This software is available to industry free of charge.

Our research supports Australia’s resource industry to help reduce exploration risk and mitigate climate change and environmental impacts.

Expertise

The hydrodynamics team has a unique combination of expertise in:

- ♦ basin-scale assessment and modelling
- ♦ multiphase fluid flow in porous media
- ♦ petroleum hydrodynamics
- ♦ inorganic geochemistry
- ♦ geology
- ♦ mass transport.

We can holistically address issues in hydrodynamics with widespread applications, providing a capability that is unique in Australia. The team also has significant expertise in hydrogeological database development for storage and analysis of subsurface data.

Facilities

PRESSUREPLOT™

CSIRO has built a unique, quality-controlled database and visualisation system to house and analyse subsurface data, including formation pressure, temperature and water chemistry data. This free software is available at: www.pressureplot.com

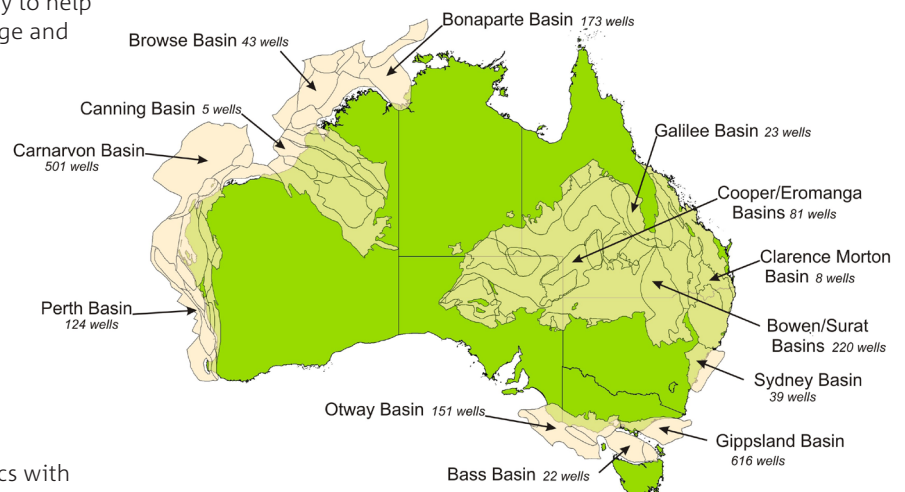
This system forms the only publicly-available digital hydrodynamic data set in Australia, and has been adopted and applied to similar data sets in New Zealand and the Netherlands.

MODELLING

We are developing numerical modelling techniques for application to geological seal capacity prediction and issues related to the geological storage of CO₂, conventional and unconventional hydrocarbon production, and impacts on groundwater resources. The hydrodynamics team has expertise in the use of a range of commercial modelling software such as USGS Modflow, SEAWAT, FEFLOW, TOUGH2 and Eclipse.

MONITORING SYSTEMS

In collaboration with the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) and the Lawrence Berkeley National Laboratory, the team has developed unique geochemistry sampling systems for monitoring and verifying CO₂ geological storage. We have also designed tracer injection systems and programs for chemically tracking injected CO₂.



Distribution of Australian wells contained in the hydrodynamics quality-controlled sub-surface database and visualisation system.

Case study

The hydrodynamics team has a strong track record of industry work in seals analysis and geological storage of CO₂. As a spin-off from the Integrated Predictive Evaluation of Traps and Seals (IPETS) industry consortium, the team has worked on several applications of its technology with BHP Billiton, Woodside, Origin Energy, Chevron and Anadarko.

Through participation with the CO₂CRC, we have provided the hydrodynamic input to develop Australian protocols for site characterisation and storage capacity estimation for CO₂ geological storage. The team has been involved in the estimation of CO₂ storage capacity and containment security for Chevron, Strike Oil, the Coal Futures Group and AVIVA. We have an ongoing involvement in the CO₂CRC Otway Project in characterisation, monitoring and verification activities.

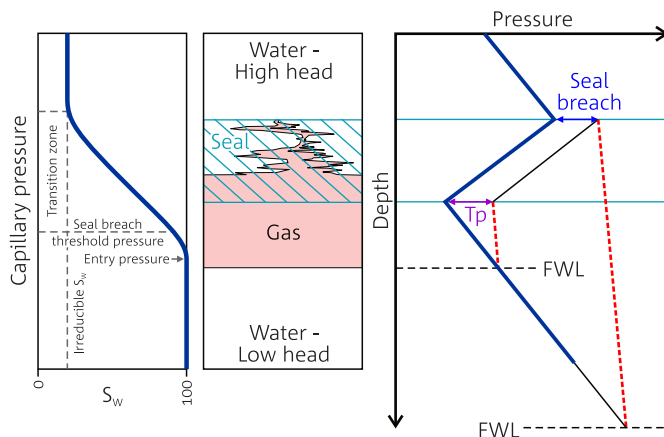
We have collaborative links with other international research institutes such as TNO in the Netherlands and Alberta Innovates in Canada, and work with Australian State and Federal geological surveys as well as the British Geological Survey, GNS Science in New Zealand and the Alberta Geological Survey in Canada.

We also have close working relationships with many national and international oil and gas companies, coal companies and power generators, through research partnerships and delivery of commercial services.

Getting involved

The hydrodynamics team actively participates in commercial-in-confidence, joint industry partnership and international collaborations. We also participate in student internship programs.

We licence our PressurePlot™ and PressureDB visualisation software and hydrodynamic database for free to registered users.



Membrane seal capacity diagram showing how hydrodynamic flow across an aquitard can increase the hydrocarbon trapping efficiency of a top seal.

Our collaborators

We partner with a number of research groups within CSIRO to deliver multi-disciplinary research outcomes through the Wealth from Oceans, Energy Transformed, and Water for a Healthy Country Flagships.

We are involved in CRC programs as well as joint industry partnerships. We collaborate with universities in Australia and internationally including The University of Adelaide, The University of Western Australia, Curtin University, Simon Fraser University, Aachen University, University of East Anglia and The University of Leeds.

Key contacts

Ms Allison Hortle
Petroleum Hydrogeologist
Oil, Gas & Fuels Program
t +61 8 6436 8743
e allison.hortle@csiro.au

CONTACT US

t 1300 363 400
+61 3 9545 2176
e enquiries@csiro.au
w www.csiro.au

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