SUBSURFACE GAS STORAGE

Our Capabilities:

- Analogue studies for subsurface gas storage (CO_2, Hydrogen, Natural gas)
- Chemical gas-water-rock interaction
- Geomechanics of subsurface gas storage
- Formation damage and fines migration (laboratory studies and mathematical modelling)
- Multiscale mathematical modelling (fluid flow in porous media)
- Reactive transport modelling
- Storage site assessment and selection
- Well completion and repurposing.
- Well injectivity and integrity
- Data Analytics and Machine Learning
- Reservoir Simulation

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Selected Research Topics:

- A Novel Method to Determine Relative Permeability and Capillary Pressure from integrated Corefloods Experiments
- Multiscale physics for site selection of geological storage of CO2 and Hydrogen
- Experimental and Geochemical Modelling of Well Integrity
- Semi-analytical integrated reservoir-well model for storage of CO2 and Hydrogen
- Advanced mathematical modelling of microbial growth and geochemical transport during sequential injection and production of hydrogen
- Multiscale predictive modelling of well injectivity during CO2 and Hydrogen storage
- Design of cushion gas slug during UHS
- Optimization of Integrated Hydrogen Supply and Underground Storage Systems for Industrial Hubs and Export
- The impact of cyclical loading on wellbore integrity for underground storage of hydrogen

Our Researchers:

Assoc. Prof. Abbas Zeinijahromi
Discipline Lead
Enhanced Oil & Gas Recovery
Carbon Capture Utilization & Storage (CCUS)
Reservoir Modelling

Assoc. Prof. Manouchehr Haghighi
Enhanced Oil & Gas Recovery
Reservoir Simulation
Data Analytics

Dr Alex Badalyan
Flow in Porous Media
Gas Adsorption
Fluid Properties
Real-time process monitoring

Prof Pavel Bedrikovetsky
Enhanced Oil & Gas Recovery
Carbon & Hydrogen Storage
Matched Lab and Math Modelling and Upscaling
Formation Damage

Dr Alireza Salmachi
Drilling and well completion
Production data analysis
Rate transient analysis
Underground hydrogen storage
Unconventional resources

Dr Thomas Russell
Flow in Porous Media
Formation Damage
EOR and CCS

Mrs Maria Gonzalez Perdomo
Director of Teaching
Hydraulic Fracturing
Data Analytics
Production Optimisation

Dr Themis Carageorgos
Flow in Porous Media
Formation Damage

Emeritus Professor Steve Begg
Decision Making
Critical thinking
Project economics and portfolio evaluations

Emeritus Professor John Kaldi
Carbon Capture and Storage
Seal Capacity
Carbonates

GeoEnergy & Storage - Laboratories

Our laboratory has the flexibility to be modified for special analytical requests. We also provide modelling services for all tests performed at our facilities.

Core characterization
- Wettability (Amott test)
- Mineralogy (CT, NMR, SEM, XRD)

Routine Core Analysis
- Porosity
- Gas Porosimeter
- Liquid Porosimeter
- Permeability
- Gas permeability
- Liquid Permeability

Special Core Analysis
- Capillary pressure
- Mercury injection
- Porous plate
- Relative permeability (Water, Oil,Gas, H2 and CO2)
- Un-steady state
- Steady State
- Formation damage
- EOR
- Contact Angle and Wettability Index
- X-ray Diffraction (XRD)

Adelaide Microscopy
- Scanning Electron Microscopes (SEM)
- X-ray Micro-Tomography (Micro-CT)

Core Flood Laboratory

Multiscale laboratory-based modelling of multi-phase flow in porous media requires the reliable measurement of static and transport properties of targeted geological formations at pore- and core-scales that must be obtained under in-situ pressure and temperature conditions, and through core flood experiments.

Core flood tests conducted on reservoir and seal samples have applications in petroleum engineering, mining, hydrology and subsurface gas (e.g. CO_2, H_2) storage.

Our laboratory holds six (6) core flood systems that can provide analyses on reservoir core plugs.

Formation Damage and EOR Core Flood

- Irregular-length cores-1.5-inch diameter and 0 – 12 inch length.
- Consolidated and Unconsolidated cores
- Max pressure – 6,000 psi
- Max Temp - 200°C
- Fluids - oil, gas, CO_2
- Flowrate - 0.001 to 50 ml/min

Additional equipment includes:
- Cross flow core holder
- Amott cell for imbibition and drainage tests
- Colloidal flow visualisation system
- Core cleaning (DEAN STARK)
- Particle counter - Micro (0.5 to 18 mm) and Nano (10 nm to 2 mm) range
- Porous plate system for Pc measurements

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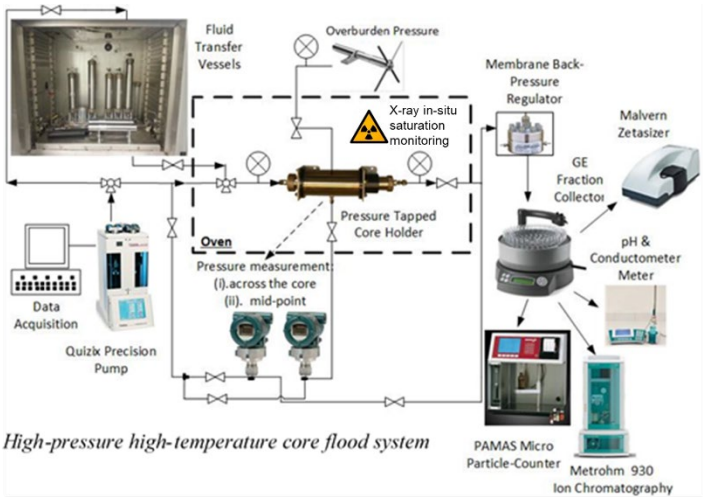
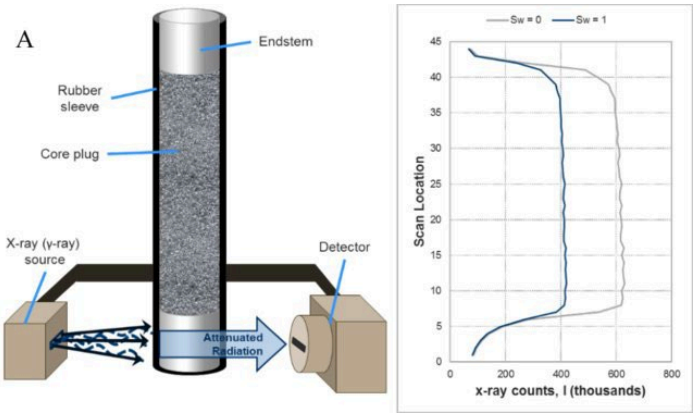


High-pressure high-temperature core flood system

CCS Core Flood

State-of-the-art fully automated core flood system for CCUS studies. The system can perform both unsteady and steady state tests with CO2 (gaseous, liquid and supercritical), brine, oil and natural gas and is equipped with:

- Linear X-ray scanning system for in situ saturation monitoring,
- Two-phase fluid separator
- Pressure-tapped core holder
  - Core length: up to 1 m
  - Core diameter:1.5-inch
  - Max pressure – 10,000 psia
  - Maximum Temp - 150°C
  - Fluids - oil, gas, CO_2
  - Flowrate - 0.001 to 30 ml/min



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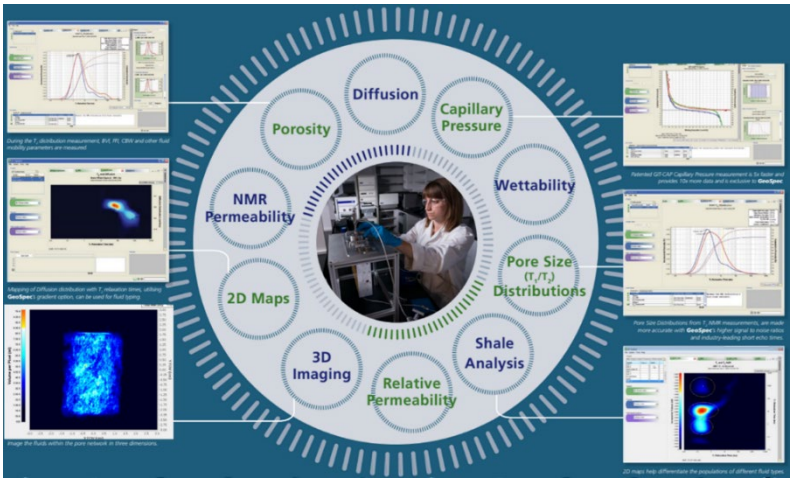
H2 NMR Core Flood

A unique core flood system certified for Underground Hydrogen Storage studies. The system can perform both unsteady and steady-state tests with Hydrogen, brine, oil and natural gas and is equipped with:

- OXFORD GeoSpec 12/53 NMR rock-core analyser equipped with GIT Systems Advanced Imaging with 3-D MRI capability to measure.
  - relative permeability and pore-size distribution
  - capillary pressure (Pc)
  - Saturation profile
- Two-phase fluid separator
- Pressure-tapped core holder
  - Core length: up to 12 in
  - Core diameter:1.5-inch
  - Max pressure – 5,000 psia
  - Maximum Temp - 150°C
  - Fluids - H_2, oil, gas,brine
  - Flowrate - 0.001 to 30 ml/min



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PVT Cell (400/1000 FV Sanchez Technologies):

- Max. Working pressure: 1000 bar – 15 000 psi
- Accuracy on pressure: 0.1 bar
- Volume of the cell: 400 ml
- Visual volume: 400 ml
- Working temperature: ambient to 200°C
- Accuracy on temperature: 0.1°C
- Bubble/dew point – repeatability: +/- 0.35 bar
- Resisting corrosive abilities: CO2, H2S
- Stirring by magnetic coupling
- Automatic valves
- CCD digital video camera system
- Data acquisition and processing system

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Video-Based Optical Contact Angle Measurement System

Wettability is a tendency of the liquid to spread on or adhere to a solid surface. In enhanced oil recovery (EOR) or subsurface gas storage, wettability plays an important role as it determines the interactions between the solid (rock) and the liquids in the reservoirs (crude oil, brine). Wettability of a solid surface can be quantified by contact Our research laboratory is equipped with a video-based optical contact angle measuring system manufactured by DataPhysics Instruments. In the system, a high-resolution camera with up to 6x zoom lens is used to capture the profile of a liquid droplet on a solid surface. The base line and boundary line of the droplet profile can be manually or automatically defined. The angle at the 3-phase boundary when liquid, gas and solid intersect is measured as the contact angle and analysed by the in-house Software Composition Analysis (SCA) automated process.

Our system is capable of measuring the wettability of cores, sidewall cores and cuttings with different mixtures of water and brine. The contact angle measurement can be static or dynamic with the movie function (for fast processes of adsorption and absorption).

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Drilling Fluids Laboratory

Our drilling fluids laboratory can provide a wide range of analysis on water-based drilling fluids at standard and high-pressure, high-temperature (HPHT) conditions. It can further provide training services for up to 20 participants.

This lab offers the following services:
Drilling mud design
Density measurements
Measurement of viscoelastic properties
Mud filtrate measurement at standard and high temperature conditions
Drilling mud cake characterisation
Measurement of drilling fluid properties at HPHT conditions

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