ASET SIG Workshop

Geomechanics in the Energy Transition

Tuesday, 4th November 2025 (Online)
09:00 – 12:00 GMT (3:00 – 6:00 AM CDT)
Chair: Gerold Tischler

09:00 – 09:10	Welcome & Opening Remarks – Gerold Tischler
09:10 – 09:40	Geomechanics for Conventional Geothermal Resource Development *Irene Wallis, Cubic Earth Ltd* (Recording consented) Q&A: 09:40 – 09:50
09:50 – 10:20	Effects of Injection Pressure and Temperature on Fault Integrity *Frans Mulders, Geoactive* (Recording consented) Q&A: 10:20 – 10:30
10:30 – 11:00	The Role of Subsurface Geomechanics in the Green Energy Transition *Professor Adriana Paluszny, Imperial College London* (Recording consented) Q&A: 11:00 – 11:10
11:10 – 11:40	Geomechanics Considerations for UKCS CCS Projects *Tim Wynn, TRACS* (No recording – presentation available) Q&A: 11:40 – 11:50
11:50 – 12:00	Final Discussion, Questions & Closing Remarks

Dr. Irene Wallis

- Since transitioning from mining to geothermal, Dr Wallis has accumulated more than 15 years of experience in medium- and high-temperature resources in New Zealand, Chile, USA, Djibouti, Indonesia, Iceland, and the Philippines. Her experience is broad and interdisciplinary, having been a technical contributor, team leader, and advisor on a range of resource evaluation and development projects. She completed doctoral research into the geologic controls on hydrothermal fluid flux from sub-meter to kilometre scale. Her open-source contributions include borehole image analysis and geomechanics tools, reservoir engineering workflows, and Python training. Since 2023, Dr Wallis has focused on borehole image interpretation and geomechanics consulting, completing a range of projects in geothermal and natural hydrogen resources.

Abstract: *Geomechanics for Conventional Geothermal Resource Development*

A conventional geothermal system is one in which hot fluid percolates through natural, pre-existing permeability. In contrast, an engineered geothermal system (EGS) requires the creation of new permeability. Historically, geomechanics has played a key role in EGS but has rarely been applied during the exploration and development of conventional geothermal systems. This is now changing, partly because recent exploration and development targets comparatively complex systems. To generate actionable insight into these complex, heterogeneous, and dynamic systems, a geomechanical study must be fully integrated with the broader program of resource evaluation. This talk describes how such integration can be achieved and addresses barriers to applying geomechanical workflows in conventional geothermal systems.

- Frans Mulders is currently a Software Product Champion Geomechanics with Geoactive, based in Kuala Lumpur, Malaysia. In his current role, Frans drives the development of the geomechanics module within the software IP, and provides consultancy services, technical support and training to operating companies on a range of geomechanical issues. Frans has more than 21 years of working experience as a geomechanics consultant and reservoir engineer in Europe and the Asia Pacific Region. He holds an MSc degree in Engineering Geology from Aachen University in Germany, and a PhD in geomechanics from Delft University in the Netherlands. Frans has published a number of papers on various topics, predominantly in the fields of CO2 storage and geomechanics.

Abstract: *Effects of Injection Pressure and Temperature on Fault Integrity*

Changing pore pressures has a direct effect on effective stresses in the subsurface. Effective stress changes cause rock deformations, which can in turn lead to fault reactivation. Similar effects happen because of temperature changes via the thermal expansion coefficient of the rocks.

This presentation will give a brief overview of poro-thermo-elastic principles in a subsurface reservoir subjected to changes in pore pressure and temperature. A distinction is made between depletion and injection. The added value of numerical models compared to analytical models is discussed. The principles are illustrated by several practical real-life examples and case studies.

- Adriana Paluszny is a Reader in Computational Geomechanics and Royal Society University Research Fellow at Imperial College London. Her research focuses on advanced numerical modelling of fracture growth and fluid–rock interactions in subsurface systems, with applications in CCS, hydrogen storage, geothermal energy, and radioactive waste disposal. She leads the SeisGreen project on induced seismicity in green energy technologies and WP7 of the GeoSafe project on geological disposal safety. Adriana is the lead developer of the Imperial College Geomechanics Toolkit and serves as Director of Research in the Department of Earth Science and Engineering. She is an Associate Editor for JGR: Solid Earth and IJRMMS, and recipient of the Chin-Fu Tsang Coupled Processes Award. Adriana also leads STEM outreach initiatives including the Watson Forum and Curio.

Abstracts: *The role of subsurface geomechanics in the green energy transition*

- The global energy landscape is currently experiencing a significant shift towards non-hydrocarbon, sustainable energy sources, often referred to as ‘green energy’. This transition is being driven by the urgent need to address the problem of global warming caused by greenhouse gases, most of which are generated by the burning of fossil fuels. This article provides an overview of the role that subsurface geomechanics will play in this transition, focusing on green energy technologies such as carbon sequestration, geothermal energy production, hydrogen storage and nuclear waste disposal. The article starts with a review of geomechanical properties and structures that will be relevant to the green energy transition, such as in situ stresses, elastic moduli, strength properties, permeability, faults and fractures. This is followed by introductions to the four green energy technologies mentioned above. The next section focuses on the specific geomechanical challenges associated with each of these technologies, such as surface subsidence, induced seismicity and fluid and contaminant leakage. Gaps in existing knowledge, and potential pitfalls to be avoided, are highlighted. The article concludes with a brief discussion of public perception of environmental risks associated with subsurface energy technologies. It is concluded that geomechanics will play a key role in each of these emerging subsurface energy technologies, and the knowledge and tools that have mainly been developed in the context of fossil fuel exploitation will be key to these developments.

[The role of subsurface geomechanics in the green energy transition | Royal Society Open Science]

- Tim has 33 years of wide-ranging experience in the geological and geomechanical aspects of the energy business focussed on reservoir characterisation & development. This includes projects on nuclear waste stores, hydrocarbon reservoirs, Carbon Capture & Storage (CCS) projects, subsurface gas storage and geothermal reservoirs.

Development Geology & Fractured Reservoir Characterisation.
Geomodelling consultancy and training for appraisal and development planning. Wide range of geological concept definition and geomodelling experience in most reservoir types in the UKCS plus most major hydrocarbon provinces around the world. Extensive experience in fractured reservoir characterisation and modelling including geothermal reservoirs. This includes fractured reservoir data analysis and concept generation and the construction of implicit and explicit fractured reservoir models in sandstones, carbonates and basement reservoirs. Software used includes SLB Petrel, Emerson RMS, RFD Geology Designer and FracMan.

Geomechanics
Evaluation of geomechanical issues in reservoirs including input to wellbore stability and stimulation jobs, specifying in-situ stress and core testing programs, analysing stress and rock property data and assessing impact of geomechanics on production / injection performance. Includes over ten year's experience of using Petrel Geomechanics and VISAGE to model the effects of reservoir depletion, gas storage pressure cycling and CCS injection into saline aquifers and depleted gas stores. Creation and delivery of training courses in reservoir geomechanics.

Abstract: *Geomechanics considerations for UKCS CCS projects*

Carbon Capture and Storage (CCS) is a key aspect of the UK government Carbon Net Zero Strategy. In the United Kingdom Continental Shelf (UKCS), saline aquifers and depleted gas fields are being considered as CCS stores. Key geomechanical processes relevant to both types as a result of pressure increases and cooling are failure of intact rocks e.g. caprock, reactivation of faults and fractures creating leak pathways and/or seismicity and uplift of the sea bed that may affect surface infrastructure. For depleted gas reservoirs, the depleted pressure prior to injection provides significant capacity before the reservoir pressures reach initial conditions. There may be geomechanical changes during depletion including stress arches and hysteresis in the injection-related stress path. Joule–Thomson cooling can occur during gas-phase injection that could cause thermal fracturing. Halite is important in many UKCS stores for providing an effective seal owing to extremely low poroperms and a lithostatic stress state. Halite below stores can also affect the overlying sequence response due to stress changes from halite creep. Geomechanical analysis and modelling are an important aspect of understanding CCS store behaviour and can provide guidance for planned activities such as injector locations, injection rates, overall injected CO2 mass and the measurement, monitoring and verification plans.

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