



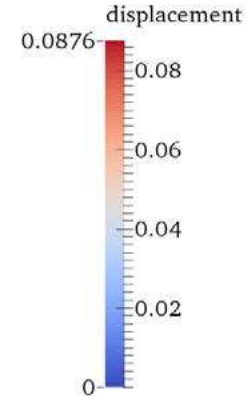
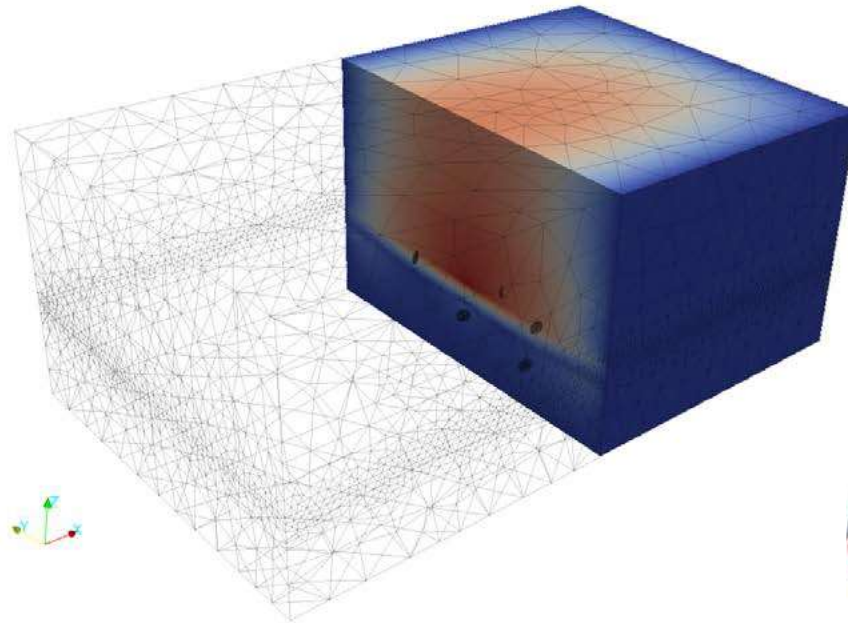
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Gateway to the Earth

CONTAIN

EPSRC

Pioneering research
and skills



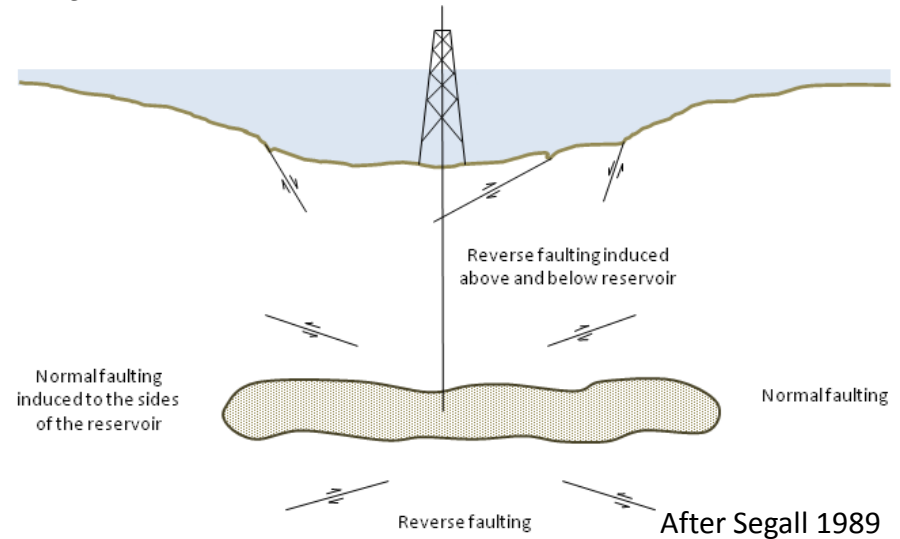
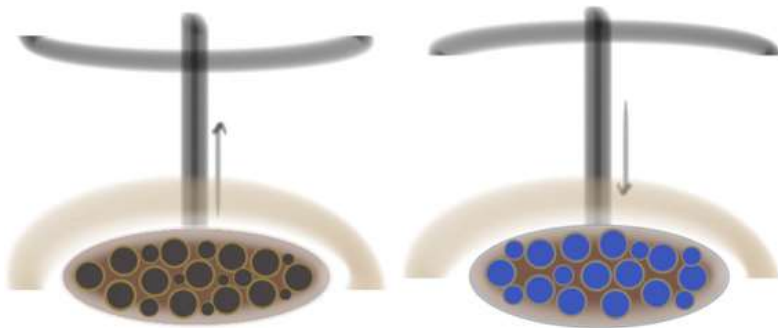
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CONTAIN: The impact of hydrocarbon depletion on the treatment of caprocks within performance assessment for CO₂ injection schemes

Executive Group Meeting, BGS London, 20th April 2015



The impact of hydrocarbon depletion on the Treatment of caprocks within performance assessment, for CO₂ Injection schemes



- Potential UK storage capacity in depleted reservoirs ~ 9 billion tonnes (UKSAP)
- Focus on depletion and 're-inflation' response
- Paucity of data including: reservoir stress-path during inflation and long-term response of faults, well-bores and mechanical stability of caprock
- Improved understanding of effects on reservoir behaviour and seal integrity
- Explore controls on public and stakeholder understanding and acceptability



Partners and contributors



Transport
Properties
Research
Laboratory



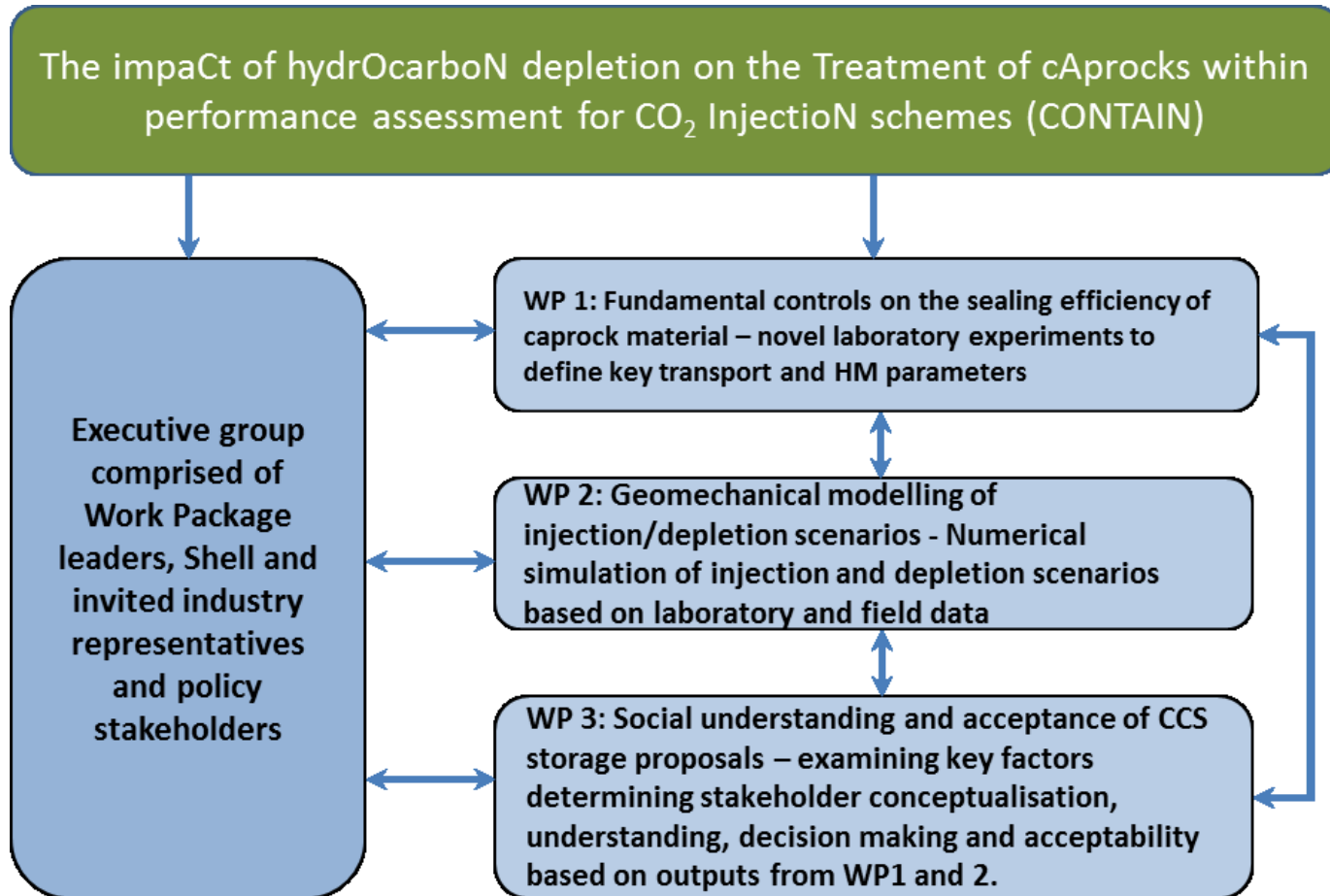
**Imperial College
London**



Tyndall Centre[®]
for Climate Change Research



Project Structure



Laboratory testing

Reservoir materials:

- stress path tests [simulating a range of production histories](#)
- simultaneously monitoring changes in σ , P_w , ϵ_v and k

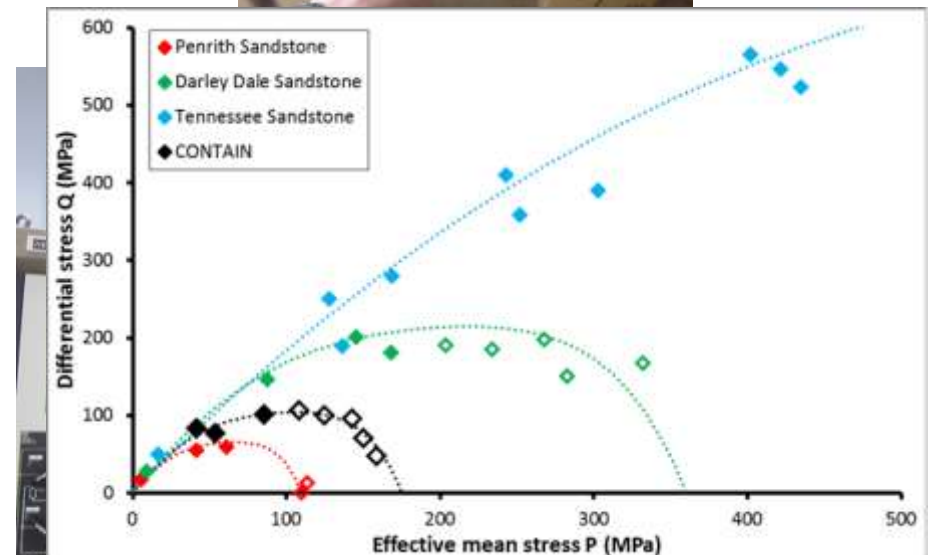
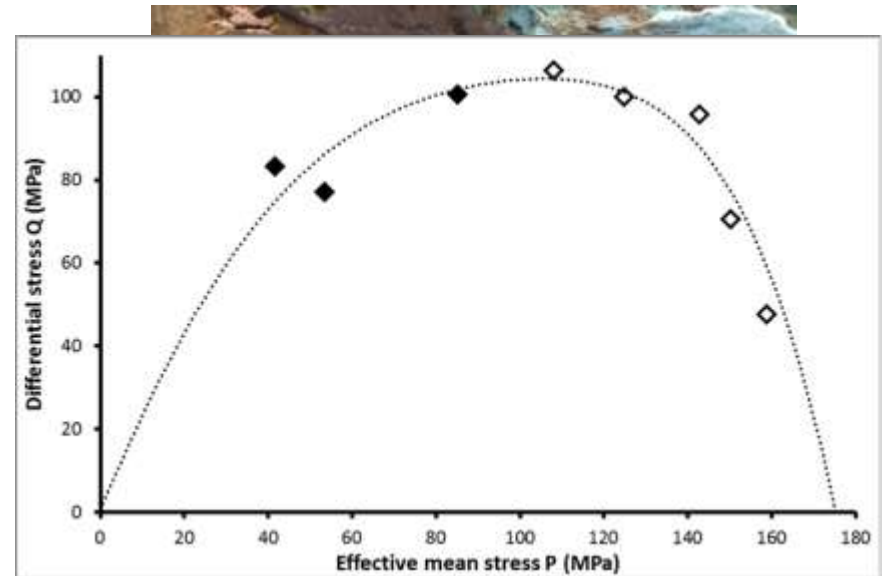
Caprock materials:

- simulate [impact](#) of reservoir depletion and re-inflation on [caprocks](#)
- Monitoring changes in σ , ϵ_v and k as a function of P_w

Critical state parameters:

- [define yield envelope](#) for various reservoir and caprock strata

Provides [operational limits](#), allows scenario analysis, provides parameterisation and [validation for modelling](#)



Numerical simulation

Initial poro-elastic simulations:

- **production period** of the reservoir calibrated using new experimental data

3-D simulations of post-depletion consolidation and re-injection:

- impact on **existing fracture networks and faults**
- focus on features at the **caprock/reservoir interface**

Temporal upscaling of geomechanics:

- system response during **post-operational phase** (<10,000 yrs)

Thermal effects incorporated:

- **fully coupled** thermo-hydro-mechanical (THM) model

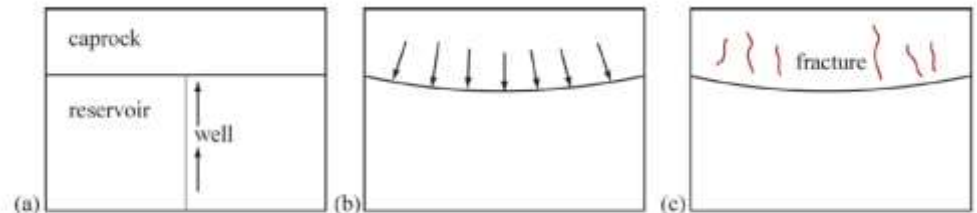


Figure 1- Deflation of the model (a) creates strains in the reservoir that create bending of the caprock (b) and generates fractures (d) in the caprock

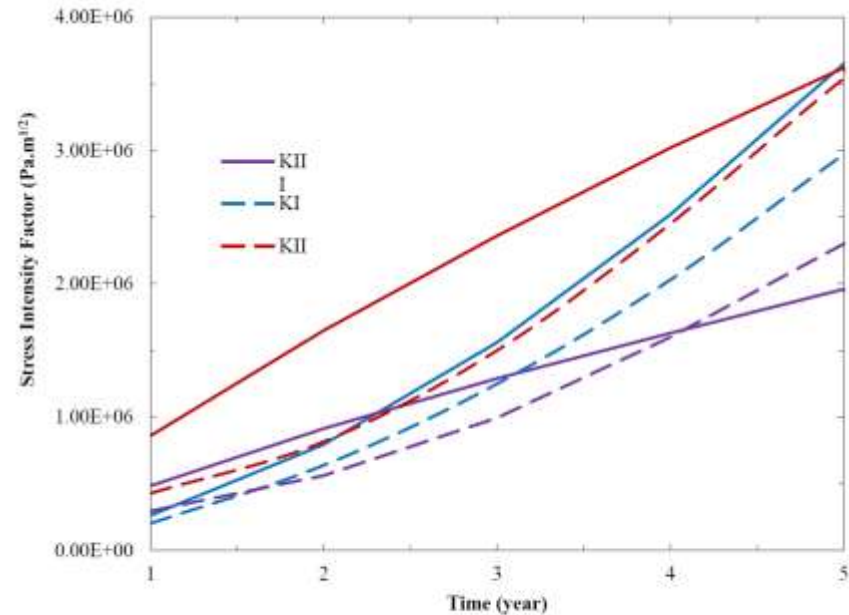


Figure 30- The evolution of maximum modal stress intensity factors during production, for the small-scale model with faults (solid lines) and with fractures (dashed lines)

Social understanding and acceptance

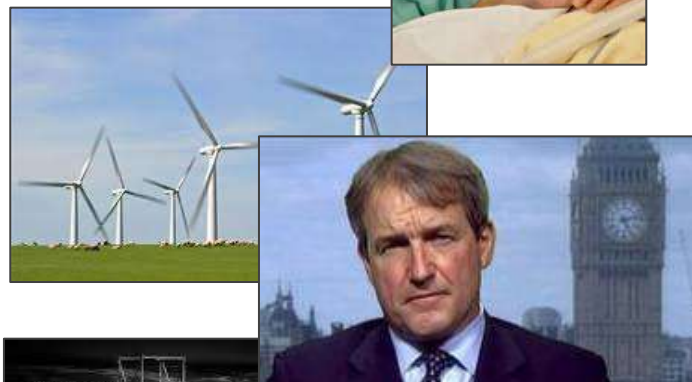
Explore controls on public and stakeholder understanding and acceptability of CCS

Develop and test novel information materials and engagement methods


- Mental model **interviews with stakeholders and publics** (understand conceptualisation of CCS and perceived risks and benefits)
- Deliberative **survey** to examine **influences on acceptability** (e.g, framing, audience and communication characteristics)
- Deliberative **workshops** to explore effective **engagement methods** for encouraging societal involvement/acceptance of CCS proposals

Lessons and knowledge derived from this work will be summarised in an **outreach and engagement toolkit**

Work begins this summer



Dissemination



CO₂ CONTAIN

What is CCS?

- What do you think?

Who are we?

- Investigators
- Partners

Work packages

- Work package 1
- Work package 2
- Work package 3


Dissemination

- EPSRC press release

The impact of hydrocarbon depletion on the Treatment of caprocks within performance assessment for CO₂ injection schemes - CONTAIN

CCS and depletion sites

The UK is committed to meeting stringent carbon dioxide (CO₂) emission targets over the next 35 years. One potentially valuable technology in achieving this target is the development of carbon capture and storage (CCS) technologies, where CO₂ is captured during power generation and, instead of being released into the atmosphere, is injected into porous rocks underground. Porous rocks such as sandstone can act as a reservoir for CO₂, which can potentially be stored at depth over long periods of time and kept isolated from the rocks above by a much less porous caprock. The UK has a large 'porosity resource', currently estimated to be of sufficient capacity to store the necessary 2-5 billion tonnes of CO₂ to meet 2050 CO₂ emission targets. It has been estimated that up to 9 billion tonnes of UK storage capacity comes from reservoirs that previously contained hydrocarbons that have been extracted by the oil and gas industry. This form of CO₂ storage has a number of benefits, as the rocks are generally well characterised and there may be pre-existing infrastructure (such as pipelines) suitable for adaptation to CO₂ injection.



Why does depletion matter?

The process of hydrocarbon extraction, or depletion, can significantly impact both the reservoir involved and the surrounding rocks. These activities can potentially cause deformation, movement on faults and/or damage to infrastructure. The long term impacts of these activities, particularly when the reservoir is 're-inflated' during injection of CO₂, are not well understood and there is limited physical data for specific rock types and scenarios. In order for depleted reservoirs to become a viable national resource, these uncertainties must be addressed. As such, this project is focussed on providing a better understanding of the impact of depletion and re-inflation on reservoir and caprock material. It will involve a combined approach, using both laboratory experiments and computer simulation, to improve our understanding of this aspect of storage site behaviour. The project seeks to address this key area with a focussed programme of work that will generate a much needed and unique dataset, new modeling tools and a fuller understanding of the processes involved. The findings will inform regulators and oil operators in reducing the financial and environmental risks of CCS for depleted storage sites, making the technology more likely to happen.

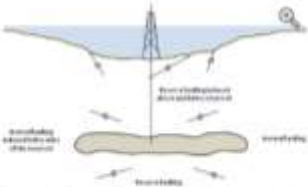


Diagram illustrating deformation of the surroundings of a depleted reservoir (after Seale, 1999)

Funding

- EPSRC

Partners

- Cardiff University
- Imperial College London
- Tyndal Centre for Climate Change Research
- Transport Properties Research Laboratory

Linked with

- UNCCSRC

www.co2contain.org/ 1st project reports due to go live shortly

Public dissemination event at the British Science Festival, September 2016

Questions? Caro5@bgs.ac.uk