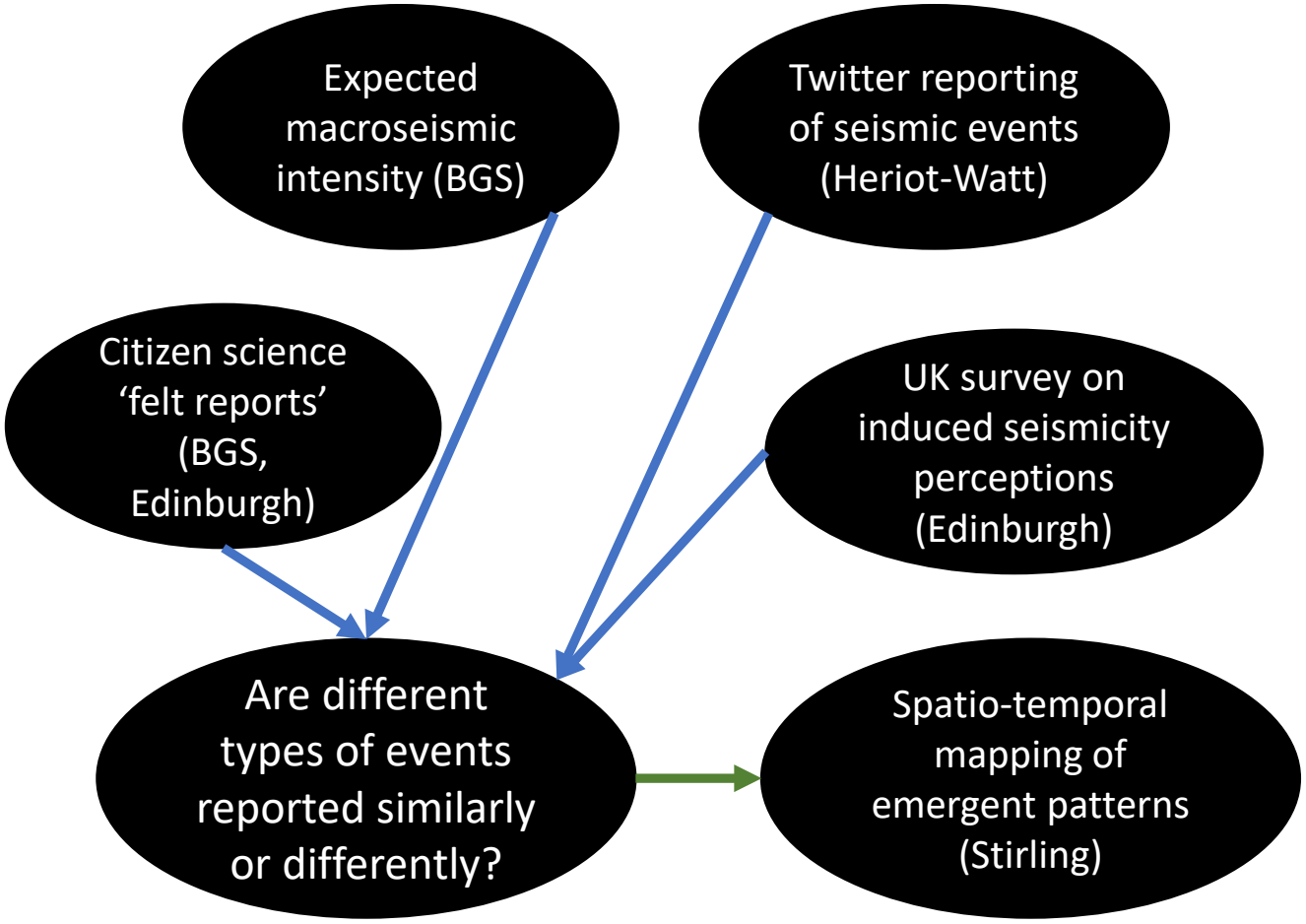
Shake, quake, or fake? Comparing BGS expected intensity modelling, felt reports, Tweets, and public perceptions

- *Research question*: To what extent, and why, are different types of seismic events in the UK (tectonic and induced by shale gas and other human activities) reported differently?
- *Hypothesis*: Seismic events with similar intensities will vary in how they are reported and perceived, based on whether they are tectonic, induced by shale gas operations, or induced by other human activities.
- *Aim*: Advance informed deliberation on novel technologies in the UK's energy landscape – NOT to *change* public opinions.



Developing Deep Science Laboratories from the Shale Gas Legacy

PI – Mark Ireland (Newcastle University), Co-I - Jen Dickie (University of Stirling)

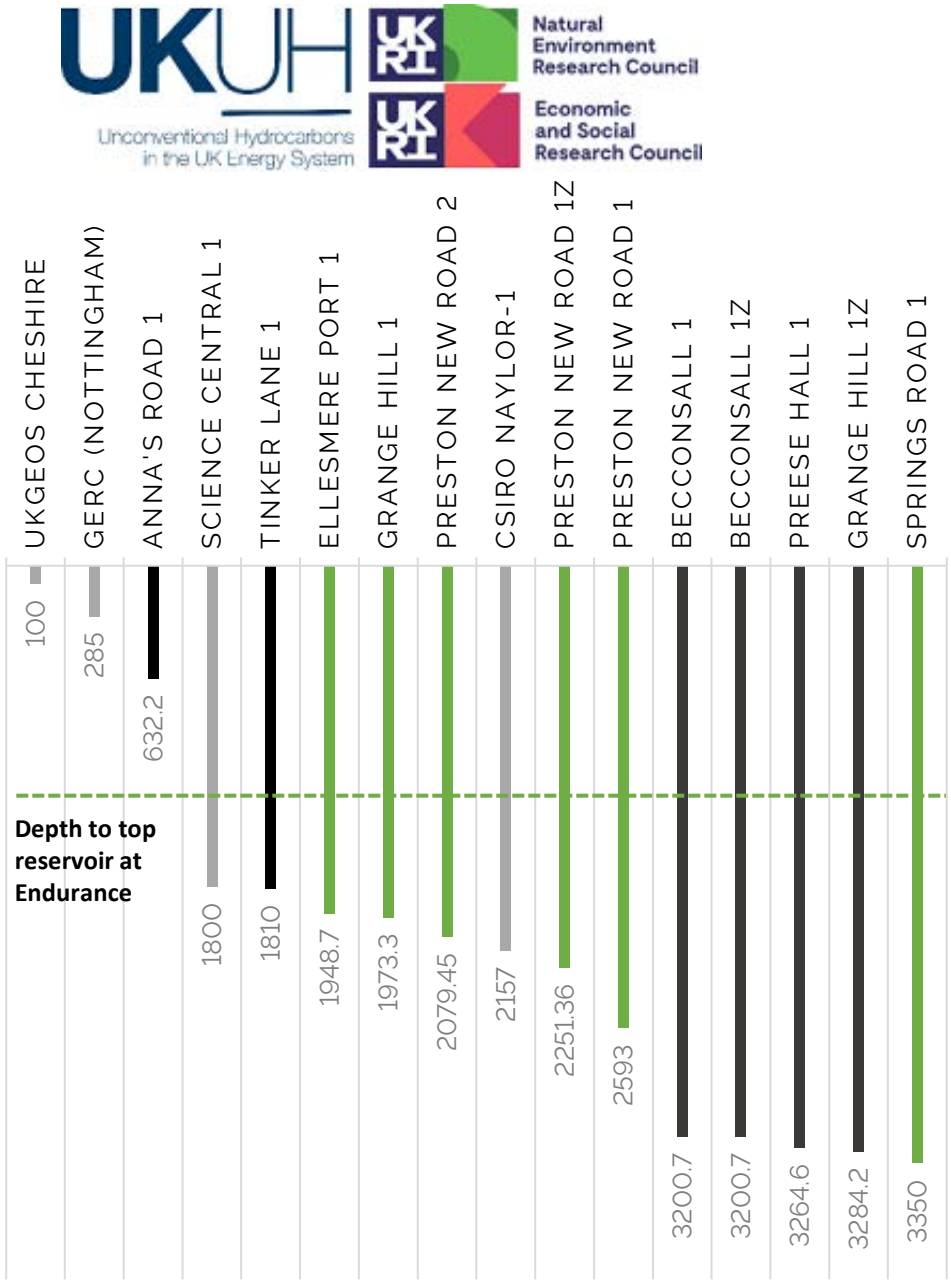
Since 2011 there have been 11 dedicated exploration wells constructed to evaluate the potential of shale gas in the UK.

This project will investigate the feasibility of repurposing existing shale gas exploration wells onshore the UK as long term deep science facilities

Typically >2000m deep, they could provide a research infrastructure to investigate higher pressure and temperature subsurface systems than current research facilities in the UK

Project Aims:

- Characterise the shale gas wells that could be repurposed as research facilities.
- Explore the range of Earth science, geoenergy and low background science research possibilities for each well.
- Examine the community perspective of the changing usage, considering public attitudes and community responses to subsurface research



Relevant borehole by depth. Grey – research borehole; Black – permanently abandoned; green – suspended or partially abandoned

Underground energy on-the-ground: risk perception, community engagement and lessons learned for geothermal energy in a post-shale energy landscape

Dr Mel Rohse, Global Sustainability Institute, Anglia Ruskin University
Dr Corinna Abesser, BGS
Dr Stacia Ryder, University of Exeter
Hazel Napier, BGS

Project aims:
To compare shale gas governance and processes of community engagements as experienced by operators and communities with those of emerging geothermal energy developments

To draw lessons from the shale gas experience in order to develop an approach to governance and community engagement for geothermal energy developments for a just and sustainable energy future

Underground energy on-the-ground	Links/Data from current UKUH project
WP1 – Comparing the **governance** of subsurface interventions in the UK	**UKSGL**: insights on shale regulatory and legal framework
WP2 – Understanding operators' practices of **community engagement**	**ASSIST project**: Data on shale gas operators' engagement with local communities and on local communities' experience of this engagement
WP3 – Comparing **community experiences** with shale gas and geothermal developments	**ASSIST project**: Data on risk perceptions and community concerns on proposed shale gas developments
WP4 – Making **recommendations** on governance and community engagement for future geothermal energy developments	**'Fracking', framing and effective participation project**: data on policy shaping and formal processes of public participation and engagement

Perception spillover effects of fracking

Emily Cox (PI) and Steve Westlake
School of Psychology, Cardiff University

Public perceptions are vital for emerging technologies, as shown by fracking controversies. We aim to research whether fracking has impacted public perceptions of other technologies in the UK.

We will use mixed-methods (surveys and focus groups) to explore the impacts of fracking on perceptions of geothermal energy, and another emerging energy/climate technology without an underground component.

Our aims are:

1) Develop a transferrable methodology for learning about the impacts of one technology on another
2) Produce novel and robust empirical findings for journal publication
3) Deliver policy-relevant advice on public perceptions in an interconnected energy system

We are also interested in exploring collaborations and joint outputs with other UKUH projects!

Testing the limitations of empirical traffic light systems used to manage the hazard of fluid induced seismicity.

UKUH Unconventional Hydrocarbons in the UK Energy System

Natural Environment Research Council

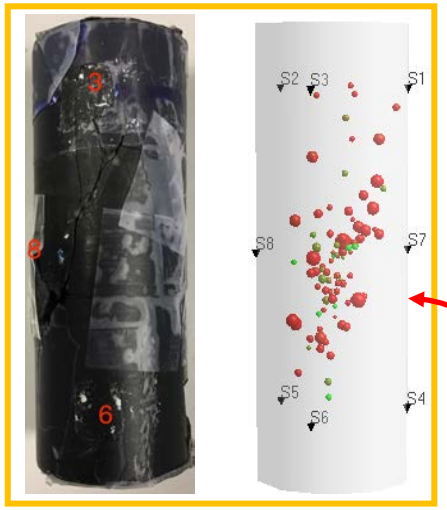
Economic and Social Research Council

Investigator Team: Dr Nicola De Paola (Durham University), ***Mr Fadul Dawood (ECR, Durham University)***, ***Dr Tom Kettlety (ECR, Oxford University)*** & Prof. Mike Kendall (Oxford University).

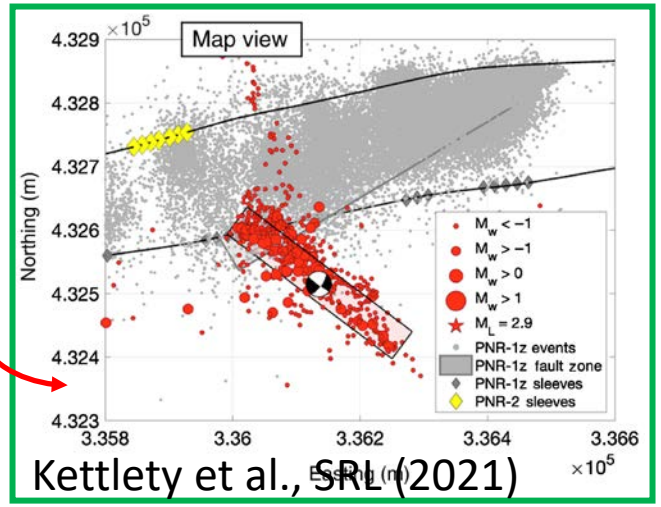
Aims: To find any diagnostic seismic signature produced by the spatiotemporal transition from operationally induced microseismicity to larger ruptures hosted on pre-existing faults.

Research Methods:

Laboratory Induced EQs



Field induced seismicity



Kettlety et al., SRL (2021)

Research Questions:

Q.1) How does the transition from distributed fracturing to slip along large faults affect the evolution of seismic parameters of laboratory earthquakes?

Q.2) Can laboratory-scale laws be upscaled to field-scale data to find the signature of precursory microseismic activity to large induced events.

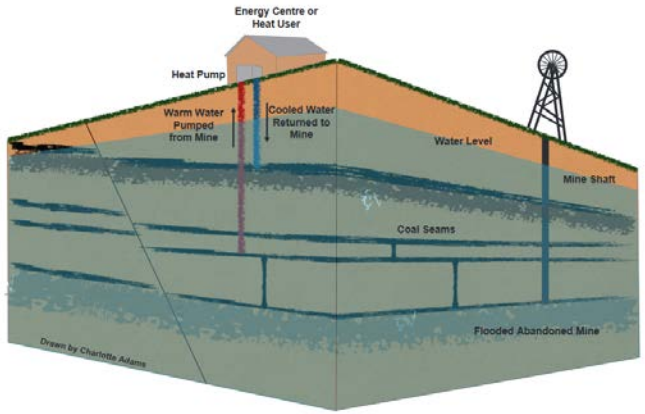
Baseline seismic monitoring survey for UKGEOS Glasgow geothermal production using Distributed Acoustic Sensing (DAS)

Joanna Holmgren[1] (PI), Max Werner[1], James Verdon[1], Mike Kendall[2], and Jonathan Chambers[3]

[1]University of Bristol, [2]University of Oxford, [3]British Geological Survey

Glasgow observatory

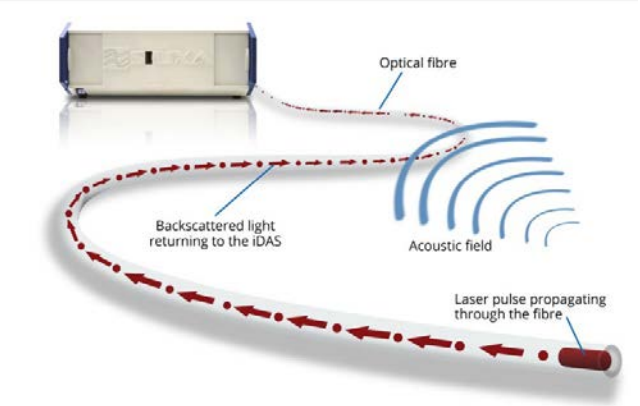
- Abandoned coal mines
- Geothermal heat source



Adams, Monaghan, & Gluyas (2019, Geoscientist)

DAS

- Measures ground deformation/ vibration



Aims

1) Initial state "baseline" characterisation of the site

2) Examine suitability of DAS for shallow geothermal sites

UKUH Unconventional Hydrocarbons in the UK Energy System

Natural Environment Research Council

Economic and Social Research Council

University of BRISTOL

UNIVERSITY OF OXFORD

BGS British Geological Survey

Owen King - Principal Investigator
owen.king1979@gmail.com

UKUH Unconventional Hydrocarbons in the UK Energy System

Natural Environment Research Council

Economic and Social Research Council

Public engagements with induced seismicity:

lessons for geothermal energy in the UK's *net-zero* transition

"Controversies around induced seismicity affirmed […] that regarding the public as misinformed and deficient of scientific understanding is ineffective in addressing such controversies. Rather, geoscience must actively engage with alternative forms of knowledge and first-hand experiences of subsurface events."

UNIVERSITY OF BIRMINGHAM

Project partners

BGS British Geological Survey

Durham University Durham Energy Institute

UKUH Unconventional Hydrocarbons in the UK Energy System

Natural Environment Research Council

Economic and Social Research Council

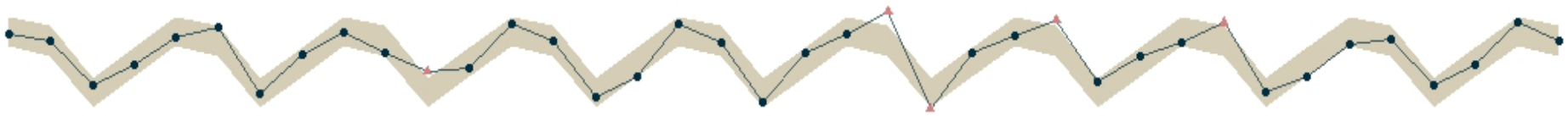
Effective monitoring of the environment before, during and after sub-surface activities

Kathryn Leeming, Ben Marchant, Pauline Smedley

British Geological Survey

with partners

Environment Agency



Statistical methodology to assess *relevant* changes in environmental monitoring data

Numerical geomechanics study of the influence of injection scenarios to quantify seismic hazard at Preston New Road

UKUH Integration Event 3

15th January 2021

Small project

Investigators:

Robin N. Thomas, Imperial College (Lead)
Adriana Paluszny, Imperial College
Robert W. Zimmerman, Imperial College

Tom Kettley, University of Oxford

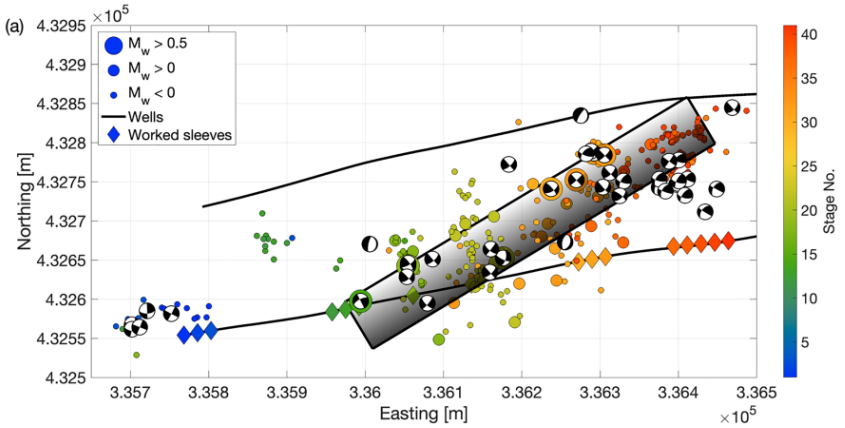
James Verdon, University of Bristol

Kieran Blacker, University of Leicester
Tayyaba Khurram, University of Leicester
Tim Pritchard, University of Leicester
Sarah Davies, University of Leicester

Project background

Seismicity at Preston New Road was a key factor influencing the current mortarium on fracking in the UK

New hydraulic fracture and fault analysis can help quantitatively determine how seismic events are linked to fracking operations



Seismic events and inferred fault structure at Preston New Road. Kettley, Verdon, Werner & Kendall 2020. JGR: Solid Earth

Project objectives

1. Construct a geomechanical fracture and fault model of Preston New Road (PNR) based on microseismic, seismic, and well data, in the Imperial College Geomechanics Toolkit
2. Simulate different injection scenarios and quantify the resulting fracture and fault interaction behaviour, including fault slip and event magnitude
3. Quantify the risk associated with different injection approaches and subsurface properties (fracturing fluid properties, injection rate, injection volume, hydraulic fracture spacing)
4. Produce recommendations for the implementation of hydraulic fracturing to minimise seismic hazard from undiscovered faults

Embedding EDI in working practices

Dr Mel Rohse and Dr Stacia Ryder

2 complementary activities:

1/ An **ECR workshop** including:

- Structured writing retreat, with places funded by stipend but application required and selection based on inclusive eligibility criteria)
- Facilitated discussion on barriers experienced by ECRs in everyday work

2/ **Web-based training session** for UKUH affiliated on developing more inclusive working environments

- Building on workshop findings and on previous work
- Panel of speakers and interactive workshop elements