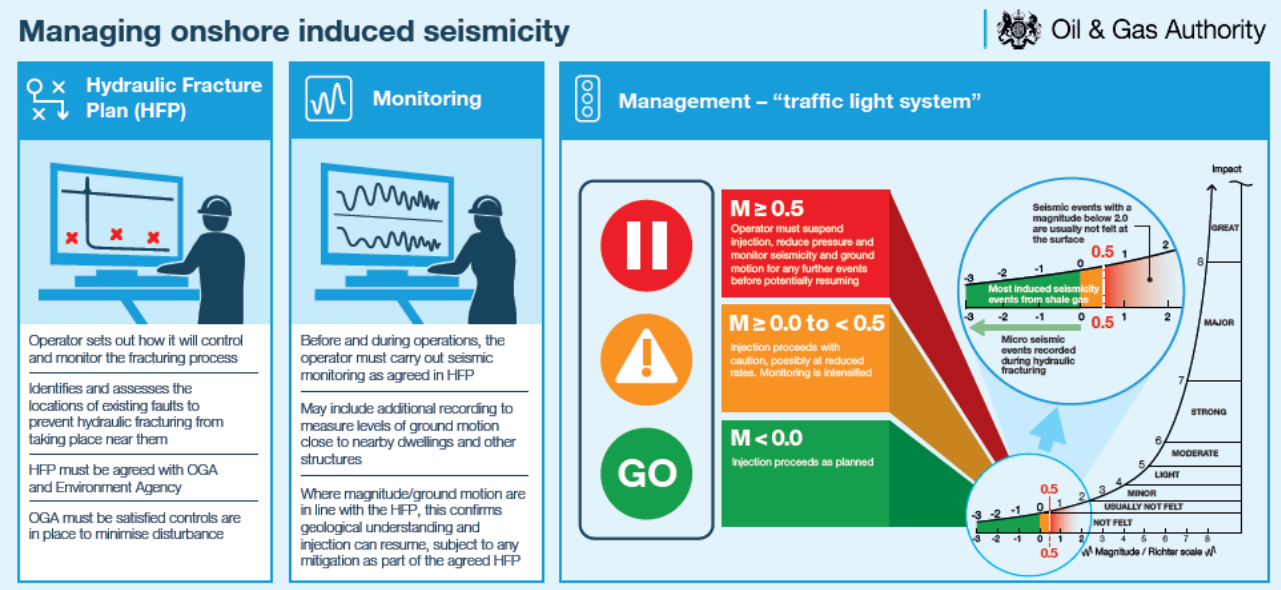
DR CORINNA ABESSER

Induced seismicity: why does it happen, how do we manage the risks … and ensure effective regulation ?

British Geological Survey

SGD Induced Seismicity regulations

A complex and detailed, **national regulatory framework** was put in place for shale gas fracking (including strict assessments and limits for induced seismicity) to reduce the risks to a level deemed acceptable by the regulators



Induced Seismicity & Social Licence to Operate (SLO)

- Induced seismicity contributed to **failure to obtain SLO** for shale gas development (SGD)
- **Public distrust** of shale gas/ seismicity regulations

Attitudes to shale gas fracking.

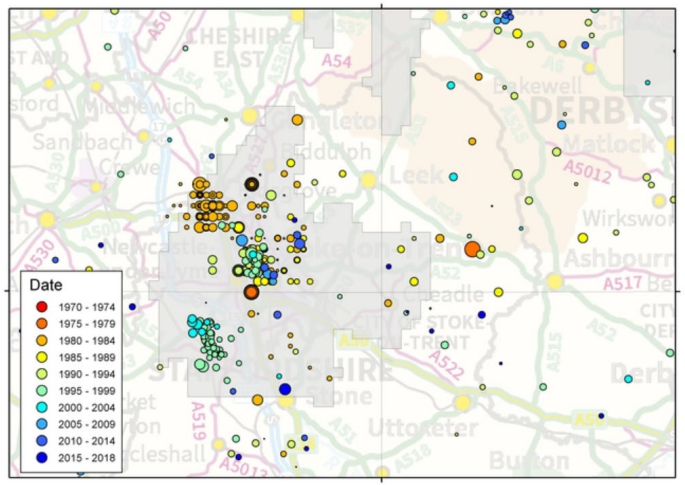
	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
Shale gas is a clean energy	3.1	14.8	54.2	18	10
I feel that current rules and regulations are sufficient to control any risks from shale gas fracking	3.7	16.2	42.5	21.5	16.1
I feel confident that the British Government will adequately regulate shale gas fracking	4.6	18.1	35.4	22.8	19.1
Knowing shale gas fracking is a possibility makes me feel less inclined to make changes in my own behaviour to tackle climate change	2.3	5.4	46.4	29.6	16.3

Whitmarsh et al. 2015

- "Government … presumption against issuing any further Hydraulic Fracturing Consents….an effective moratorium, will be maintained until compelling new evidence is provided which addresses the concerns around the **prediction and management of induced seismicity**" *(UK Government, 4 November 2019)*

Induced Seismicity is not new in the UK

"Tremors in the coalfields of Britain have been reported for at least the last hundred years, ... these events were related to ongoing mining activity …" (BGS, 2021)



Seismicity in the Staffordshire coal fields. Earthquake activity is coloured by time and correlates closely with areas of known mining. Grey shaded areas show the Mining Reporting Areas (Coal Authority data) *(BGS, 2021).*


302 Dr. C. Davison—The Stafford Earthquakes of 1916.

II.—On the Stafford Earthquakes of January 14–15, 1916, and on the Relations between the Twin-Earthquakes of the Midland Counties.

By Charles Davison, Sc.D., F.G.S.

THE strong shock … which … for several … fact … ary 14, 1919, originated in a region from … e been absent for many years, perhaps … interest is therefore increased by the … ake, that is, one produced by a single … l foci. … of any fore-shock, and, so far as … hock.

(Davison, 1919)

Engineering Geology

Volume 16, Issues 3–4, November 1980, Pages 225-241

ELSEVIER

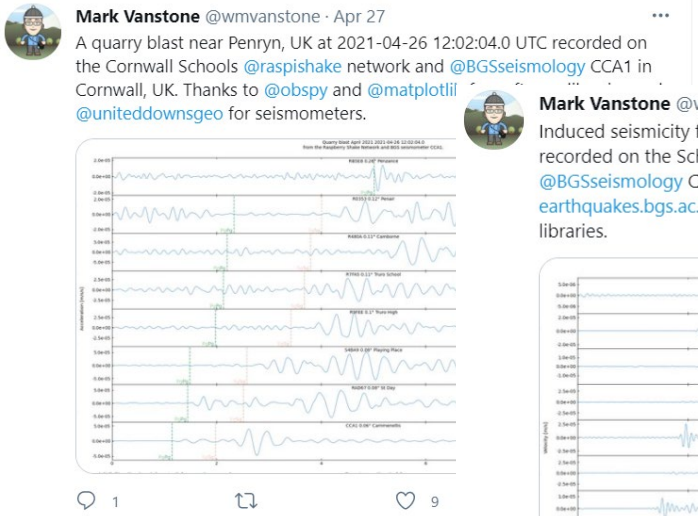
Seismicity induced by coal mining in Stoke-on-Trent (U.K.)

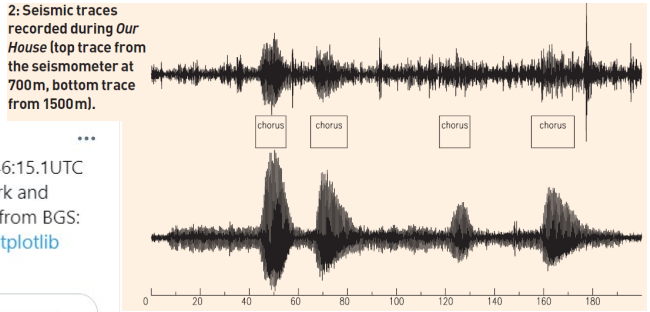
G.K. Westbrook [1], N.J. Kusznir [2], C.W.A. Browitt [3], B.K. Holdsworth [2]

(Westbrook et al. 1980)

Induced Seismicity is commonplace in the UK

"During the … period 1988-99, there was an induced earthquake >0.5ML almost every working day, on average, in the UK" (Browitt & Walker, 2019)





"The maximum amplitude signal recorded during this [Madness] song [Baggy trousers] … was…equivalent to…an earthquake of ML = 0.4" (Denton, 2014)

Source: Mark Vanstone (@wmvanstone) | Twitter

Non-SG sources of Induced Seismicity

- underground mining
- impoundment of reservoirs
- conventional oil and gas extraction
- geothermal energy production
- waste water disposal in deep wells
- groundwater abstraction/ injection
- blasting during mining / quarry operations

Regulations

- No national regulation
- **Planning process** may impose conditions that require vibration monitoring and restrict blast-induced vibration levels
- British Standards (BS) provide guidelines on the assessment and **threshold values for vibration-induced damage** in buildings based on measured ground vibrations (commonly measured as peak particle velocity – PPV)
- UDDGP operates combined monitoring of ML and PPV

Learning from SGD and other activities

How to develop **effective** and **trusted** regulations for induced seismicity for net zero technologies in the UK ?

WHO	National regulator vs Local Planning Authorities ? Public role in risk governance / monitoring/ mitigation ?
HOW	National regulatory framework versus local planning framework ? Consistency (*same rules for all*) versus flexibility (*geological/ local settings*) ?
WHAT	What to measure? Peak particle velocity (PPV) versus local magnitude (ML) ? What risks to include? Technical ('factual') versus non-technical ('emotive') risks ?

References

BGS (2021): http://www.earthquakes.bgs.ac.uk/research/PrestonNewRoadFAQ.html

Browitt, C. W. A. and A. Walker (2019). Induced Seismicity is commonplace in the UK!, 2019 SECED conference: Earthquake risk and engineering towards a resilient world, 9-10 September 2019, London, UK.

Davison, C. (1919), The Stafford earthquakes of January 14-15, 1916 and the relations between twin earthquakes of the Midland counties, Geological Magazine, Decade VI, 6, 302-312

Denton, P. (2014). One step beyond. Astronomy & Geophysics 55(5): 5.30-35.31.

Westbrook, G.K., Kusznir, N.J., Browitt, C.W.A. and Holdsworth, B.K. (1980), Seismicity induced by coal mining in Stoke-on-Trent (U.K.), Engineering Geology, 16, 225-241

Whitmarsh, L., N. Nash, P. Upham, A. Lloyd, J. P. Verdon and J. M. Kendall (2015). UK public perceptions of shale gas hydraulic fracturing: The role of audience, message and contextual factors on risk perceptions and policy support. Applied Energy 160: 419-430.

Thank you!

Dr Corinna Abesser
BGS Geothermal Energy lead

p +44 (0)1491 692296
m +44 (0)7864 943010
e cabe@bgs.ac.uk
w www.bgs.ac.uk