



JAMES VERDON

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PERSONAL STATEMENT

I am an applied geophysicist with a strong, multi-disciplinary background in the Earth Sciences. I am an expert in the use of microseismic monitoring and geomechanical modelling to improve our understanding of deformation, stress changes and fluid movement in porous, often fractured (or faulted) rocks.

Particular applications of this knowledge include: mitigating induced seismicity from industrial activities; the extraction of conventional hydrocarbon resources as well as unconventional techniques such as hydraulic fracturing for shale gas; the subsurface storage of waste materials such as CO₂, oilfield brines, and nuclear waste; and in accessing novel energy resources such as geothermal energy.

I am comfortable applying my expertise in both an academic and a commercial setting. I hold a research fellowship at the University of Bristol, while I regularly provide data processing, project management and consultancy services for Outer Limits Geophysics.

CURRENT POSITIONS

Lecturer in Applied Geophysics, School of Earth Sciences, University of Bristol.

Founding Partner, Lead Geophysicist, Outer Limits Geophysics.

PREVIOUS EMPLOYMENT

- **BGS Research Fellow**, School of Earth Sciences, University of Bristol. 2014 – 2017.
- **NERC Early Career Research Fellow**, School of Earth Sciences, University of Bristol. 2011 – 2014.
- **Post-Doctoral Research Assistant**, School of Earth Sciences, University of Bristol. 2010 – 2011.
- **Internship, Shell International**. 2009. Assessing the feasibility of detecting CO₂ using 4D seismics at the CO2SINK project, Ketzin.

EDUCATION

- **Ph.D., University of Bristol**. 2006 – 2010. Microseismic monitoring and geomechanical modelling of CO₂ storage in subsurface reservoirs.
- **M.Sci, Cambridge University**. 2002 – 2006. Natural Sciences (Geology). 1st class honours.

OUTER LIMITS GEOPHYSICS

In response to a growing demand from the industry, in 2014 I founded Outer Limits Geophysics LLP. Outer Limits is a bespoke consultancy and processing house for microseismic and induced seismicity applications. It offers: project design and feasibility studies, field monitoring, data processing and interpretation services, and induced seismicity impact assessments. Our position on the leading edge of technological developments means that we tend to work on difficult or unusual projects that are beyond the capacity of the larger but more traditional oilfield service providers. Primary clients have included shale gas and CCS operators across 3 continents.

RECENT PROFESSIONAL ROLES

- **Chair, UKOOG Working Group on Microseismic Monitoring and Hydraulic Fracture Mapping.** 2015 – present. Chairing a group established to discuss and determine best practice in microseismic monitoring for the UK Onshore Operators Group (the trade body representing shale gas operators in the UK).
- **Member, EAGE Working Group on Microseismic Data.** 2016 – present. Panel member on the working group set up by the European Association of Geoscience and Engineering to establish industry standards and best practice in the use of microseismic data.
- **Workshop Convener, WS02 Induced Seismicity and Human Activities: Monitoring, Mechanisms, Risk Assessment and Regulation, EAGE Annual Meeting, Paris 2017.**
- **Steering Committee Member, EAGE/SPE Workshop on Integrated Geomechanics in E&P, Abu Dhabi, October 2016.**

ACADEMIC AWARDS

- **Royal Astronomical Society Keith Runcorn Prize, 2010,** for best doctoral thesis in geophysics.
- **University of Bristol Faculty of Science Commendation** for exceptional achievement in a Ph.D. thesis, 2010.
- BGA Postgraduate Conference, **Best Oral Presentation, 2010.**
- **Springer Thesis Prize** recognizing outstanding Ph.D. research, 2011.

RESEARCH GRANT INVOLVEMENT

- Co-Investigator: **Bristol University Microseismicity ProjectS (BUMPS) Phase IV.** 2016 – Present. A consortium jointly sponsored by 6 industrial and governmental partners.
- Co-Investigator: **Bristol University Microseismicity ProjectS (BUMPS) Phase III.** 2013 – 2015. A consortium jointly sponsored by 10 industrial partners.
- **NERC Early Career Fellowship.** 2011 – 2014. An integrated geophysical, geodetic geomechanical and geochemical study of CO₂ storage in subsurface reservoirs.
- **Named PDRA: NERC Partnership Grant.** 2011-2014. Still or Sparkling: Microseismic monitoring of CO₂ injection at In Salah.
- **Research Provider, Petroleum Technology Research Center (Canada).** 2010 – 2012. Passive seismic monitoring of CO₂ injection at Weyburn: Phase II.
- **Research Provider, Petroleum Technology Research Center (Canada).** 2008 – 2010. Passive seismic monitoring of CO₂ injection at Weyburn: Phase I.

OUTREACH

My expertise is in topics about which there is substantial and ongoing public debate. While passions are often raised, the public do not in general have a good understanding of what these industrial processes entail. It is therefore vital that those with expertise engage with the public to provide impartial and factually accurate information. I believe that public outreach is part of the job description for any scientist, and to that end I have:

- Taken part in 3 TV interviews on these subjects (BBC Sunday Politics; BBC Points West; BBC News 24) and numerous radio interviews (including: BBC 5Live Drive; BBC R4 You and Yours; BBC 5Live Question Time Extra; BBC Radio London Breakfast Show).
- Set up a blog (www.frackland.blogspot.co.uk) that receives an average of 5,000 “hits” per month.
- Set up a twitter account (@TheFracDoctor), which currently has nearly 1,000 followers.
- Attended numerous local community meetings in town and village halls around the south-west and beyond, particularly in areas where licenses for shale gas exploration have been granted, to give presentations or take part in panel discussions and debates.

PEER-REVIEWED ACADEMIC PUBLICATIONS

Listed chronologically. Citation numbers for each paper (as of 30.1.2017) are listed for [GoogleScholar](#) and [Scopus](#).

- Verdon J.P.**, J-M. Kendall, S.P. Hicks, P. Hill (2017), Using beamforming to maximise the detection capability of seismometer arrays deployed to monitor oilfield activities: *Geophysical Prospecting*, in press. [NA](#) [NA](#).
- Butcher A., R. Luckett, **J.P. Verdon**, J-M. Kendall, B. Baptie, J. Wookey (2017), Local magnitude discrepancies for near-event receivers; implications for the UK traffic light scheme: *Bulletin of the Seismological Society of America* 107, in press. [NA](#) [NA](#).
- Verdon J.P.** (2016), Using microseismic data recorded at the Weyburn CCS-EOR site to assess the likelihood of induced seismic activity: *International Journal of Greenhouse Gas Control* 54, 421-428. [4](#) [1](#).
- Verdon J.P.**, J-M. Kendall, A.C. Horleston, A.L. Stork (2016), Subsurface fluid injection and induced seismicity in southeast Saskatchewan: *International Journal of Greenhouse Gas Control* 54, 429-440. [3](#) [2](#).
- Verdon J.P.** and A.L. Stork (2016), Carbon capture and storage, geomechanics and induced seismic activity: *Journal of Rock Mechanics and Geotechnical Engineering* 8, 928-935. [1](#) [0](#).
- Angus D.A., Q.J. Fisher, J.M. Segura, **J.P. Verdon**, J-M. Kendall, M. Dutko, A.J.L. Crook (2016), Reservoir stress path and induced seismic anisotropy: results from linking coupled fluid-flow/geomechanical simulation with seismic modelling: *Petroleum Science* 13, 669-684. [0](#) [0](#).
- Schlaphorst D., J-M. Kendall, J. Collier, **J.P. Verdon**, J. Blundy, B.J. Baptie, J. Latchman, F. Massin, M-P. Bouin (2016), Water, oceanic fracture zones and the lubrication of subducting plate boundaries - insights from seismicity: *Geophysical Journal International* 204, 1405-1420. [2](#) [1](#).
- Verdon J.P.**, A.L. Stork, R.C. Bissell, C.E. Bond, M.J. Werner (2015), Simulation of seismic events induced by CO₂ injection at In Salah, Algeria: *Earth and Planetary Science Letters* 426, 118-129. [10](#) [5](#).
- Foord G., **J.P. Verdon**, J-M. Kendall (2015), Seismic characterisation of fracture compliance in the field using P-wave and S-wave sources: *Geophysical Journal International* 203, 1726-1737. [1](#) [1](#).
- Whitmarsh L., N. Nash, P. Upham, A. Lloyd, **J.P. Verdon**, 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. [17](#) [11](#).
- Angus D.A., M. Dutko, T.G. Kristiansen, Q.J. Fisher J-M. Kendall, A.F. Baird, **J.P. Verdon**, O.I. Barkved, J. Yu, S. Zhao (2015), Integrated hydro-mechanical and seismic modelling of the Valhall reservoir: A case study of predicting subsidence, AVOA and microseismicity: *Geomechanics for Energy and the Environment* 2, 32-44. [8](#) [5](#).

- Stork A.L., **J.P. Verdon**, J-M. Kendall (2015), The microseismic response at the In Salah Carbon Capture and Storage (CCS) site: *International Journal of Greenhouse Gas Control* 32, 159-171. [22](#) [15](#).
- Verdon J.P.** (2014), Significance for secure CO₂ storage of earthquakes induced by fluid injection: *Environmental Research Letters* 9, 064022. [25](#) [15](#).
- Stork A.L., **J.P. Verdon**, J-M. Kendall (2014), Assessing the effect of velocity model accuracy on microseismic interpretation at the In Salah carbon capture and storage site: *Energy Procedia* 63, 4385-4393. [3](#) [1](#).
- Angus D.A., A. Aljaafari, P. Usher, **J.P. Verdon** (2014), Seismic waveforms and velocity model heterogeneity: Towards a full-waveform microseismic location algorithm: *Journal of Applied Geophysics* 111, 228-233. [1](#) [1](#).
- Stork A.L., **J.P. Verdon**, J-M. Kendall (2014), The robustness of seismic moment and magnitudes estimated using spectral analysis: *Geophysical Prospecting* 62, 862-878. [7](#) [5](#).
- Verdon J.P.**, J-M. Kendall, A.L. Stork, R.A. Chadwick, D.J. White, R.C. Bissell (2013), A comparison of geomechanical deformation induced by 'megatonne' scale CO₂ storage at Sleipner, Weyburn and In Salah: *Proceedings of the National Academy of Sciences* 110, E2762-E2771. [79](#) [50](#).
- Verdon J.P.** and A. Wuestefeld (2013), Measurement of the normal/tangential compliance ratio (Z_N/Z_T) during hydraulic fracture stimulation using shear wave splitting data: *Geophysical Prospecting* 61, 461-475. [25](#) [12](#).
- Baird A.F., J-M. Kendall, **J.P. Verdon**, A. Wuestefeld, T.E. Noble, Y. Li, M. Dutko, Q.J. Fisher (2013), Monitoring increases in fracture connectivity during hydraulic stimulations from temporal variations in shear-wave splitting polarization: *Geophysical Journal International* 195, 1120-1131. [16](#) [9](#).
- Angus D.A. and **J.P. Verdon** (2013), Using microseismicity to estimate formation permeability for geological storage of CO₂: *ISRN Geophysics*, 2013, ID160758. [6](#) [NA](#).
- Usher P., D.A. Angus, **J.P. Verdon** (2013), Influence of velocity model and source frequency on microseismic waveforms: some implications for microseismic locations: *Geophysical Prospecting* 61, 334-345. [16](#) [9](#).
- Verdon J.P.**, J-M. Kendall, D.J. White (2012), Monitoring CO₂ storage using passive seismic techniques: *Proceedings of the Institute of Civil Engineers - Energy* 165, 85-96. [4](#) [4](#).
- Angus D.A., Q.J. Fisher, **J.P. Verdon** (2012), Exploring trends in microcrack properties of sedimentary rocks: An audit of dry and water saturated sandstone core velocity-stress measurements: *International Journal of Geosciences* 3, 822-833. [10](#) [NA](#).
- Kendall J-M., **J.P. Verdon**, A. Baird, A. Wuestefeld, J.T. Rutledge (2012), Microseismic Monitoring of Fracture Networks During Hydraulic Stimulation: Beyond Event Locations: *SPE Paper* 152594. [0](#) [0](#).
- Verdon J.P.**, J-M. Kendall, D.J. White, D.A. Angus (2011), Linking microseismic event observations with geomechanical models to minimise the risks of storing CO₂ in geological formations: *Earth and Planetary Science Letters* 305, 143-152. [93](#) [59](#).
- Verdon J.P.** and J-M. Kendall (2011), Detection of multiple fracture sets using observations of shear-wave splitting in microseismic data: *Geophysical Prospecting* 59, 593-608. [43](#) [27](#).
- Wuestefeld A., **J.P. Verdon**, J-M. Kendall, J. Rutledge, H. Clarke, J. Wookey (2011), Inferring rock fracture evolution during reservoir stimulation from seismic anisotropy: *Geophysics* 76, WC159-WC168. [23](#) [18](#).
- Wuestefeld A., J-M. Kendall, **J.P. Verdon**, A. van Aas (2011), In-situ monitoring of rock fracturing using shear-wave splitting analysis: An example from a mining setting: *Geophysical Journal International* 187, 848-860. [13](#) [7](#).
- Segura J.M., Q.J. Fisher, A.J.L. Crook, M. Dutko, J. Yu, S. Skachkov, D.A. Angus, **J.P. Verdon**, J-M. Kendall (2011), Reservoir stress path characterization and its implications for fluid-flow production simulations: *Petroleum Geosciences* 17, 335-344. [36](#) [23](#).
- Angus D.A., **J.P. Verdon**, Q.J. Fisher, J-M. Kendall, J.M. Segura, T.G. Kristiansen, A.J.L. Crook, S. Skachkov, M. Dutko (2011), Integrated fluid-flow, geomechanic and seismic modelling for reservoir characterization: *Canadian Society of Exploration Geophysicists, Recorder* 36, 26-35. [8](#) [NA](#).
- White D.J., M. Meadows, S. Cole, A. Ramirez, Y. Hao, S. Carle, A. Duxbury, C. Samson, J-M. Kendall, J.P. Verdon, B. Dietker, T. Urbancic, J. Johnson, I. Morozov (2011), Geophysical monitoring of the Weyburn CO₂ flood: Results during 10 years of injection: *Energy Procedia* 4, 3628-3635. [28](#) [19](#).
- Verdon J.P.**, J-M. Kendall, S.C. Maxwell (2010), A comparison of passive seismic monitoring of fracture stimulation due to water versus CO₂ injection: *Geophysics* 75, MA1-MA7. [26](#) [20](#).
- Verdon J.P.**, D.J. White, J-M. Kendall, D. Angus, Q. Fisher, T. Urbancic (2010), Passive seismic monitoring of carbon dioxide storage at Weyburn: *The Leading Edge* 29, 200-206. [45](#) [32](#).

- Wuestefeld A., O. Al Harrasi, **J.P. Verdon**, J. Wookey, J-M. Kendall (2010), A strategy for automated analysis of passive microseismic data to image seismic anisotropy and fracture characteristics: *Geophysical Prospecting* 58, 755-773. [56](#) [44](#).
- Verdon J.P.**, J-M. Kendall, A. Wuestefeld (2009), Imaging fractures and sedimentary fabrics using shear wave splitting measurements made on passive seismic data: *Geophysical Journal International* 179, 1245-1254. [44](#) [34](#).
- Angus D.A., **J.P. Verdon**, Q.J. Fisher, J-M. Kendall (2009), Exploring trends in microcrack properties of sedimentary rocks: An audit of dry core velocity-stress measurements: *Geophysics* 74, E193-E203. [32](#) [25](#).
- Verdon J.P.**, D.A. Angus, J-M. Kendall, S.A. Hall (2008), The effects of microstructure and nonlinear stress on anisotropic seismic velocities: *Geophysics* 73, D41-D51. [49](#) [39](#).
- Verdon J.P.** and A.W. Woods (2007), Gravity-driven reacting flows in a confined porous aquifer: *Journal of Fluid Mechanics* 588, 29-41. [19](#) [16](#).

H-Factor: [Google Scholar = 17](#); [Scopus = 15](#).

OTHER PUBLICATIONS

- Verdon J.P.** and J-M. Kendall (2015), Response to Call for Evidence on the Environmental Risks of Fracking: The House of Commons Select Environmental Audit Committee, FRA0022.
- Verdon J.P.**, J-M. Kendall, A.L. Stork (2013), Response to Call for Evidence on Carbon Capture and Storage: The House of Commons Select Committee on Energy and Climate Change, CCS02.

INVITED TALKS (SELECTED)

- Geomechanical Deformation and Microseismic Monitoring at CCS Sites: **IRSM International Forum on CO2 Geological Storage Geomechanics, Wuhan**. 05/2016.
- Injection Induced Seismicity: **Stanford University, Dept. of Geophysics**. 05/2015.
- Carbon Dioxide Storage: Induced Seismicity and Microseismic Monitoring: **Taiwan International CCS Conference**. 05/2015.
- Shale gas extraction and 'fracking': **Glastonbury Town Council Public Meeting discussing the potential impacts of unconventional gas development in the area**. 03/2013.
- Microseismic monitoring: Beyond the dots in the box: **British Geophysical Association New Advances in Geophysics: Geophysics in Future Energy Challenges**. 02/2013.
- Linking geomechanical models with observations of microseismicity during CCS operations: **AGU Fall Meeting, T14C: How well do we predict fractures and their patterns?** 12/2012.
- Microseismic monitoring and geomechanical modelling of CO2 storage in subsurface reservoirs: **Royal Astronomical Society Ordinary Meeting, London**. 12/2011.