

# Julia F W. Gale

## Professional Summary

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Business address: The University of Texas at Austin  
Bureau of Economic Geology  
University Station, Box X  
Austin, TX 78713-8924  
Telephone: (512) 232-7957  
E-mail address: julia.gale@beg.utexas.edu

## Professional Preparation

### Academic Background

Ph.D. Geology, The University of Exeter, 1987

B.Sc. Honors Geology, Imperial College, London, 1982

### Professional Appointments

Senior Research Scientist, Bureau of Economic Geology, The University of Texas at Austin (September 2016-Present)

Development of techniques for characterizing fracture architecture and attributes, with particular emphasis on fracture systems in shale and carbonate hydrocarbon reservoirs.

Research Scientist, Bureau of Economic Geology, The University of Texas at Austin (September 2008-August 2016)

Development of techniques for characterizing fracture architecture, with particular emphasis on fracture systems in shale and carbonate hydrocarbon reservoirs

Research Associate, Bureau of Economic Geology, The University of Texas at Austin (September 2000 - August 2008). Development of techniques for characterizing fracture architecture, with particular emphasis on fracture systems in carbonate and shale hydrocarbon reservoirs.

Research Associate, Department of Geological Sciences, The University of Texas at Austin (September 1998 - August 2000). Development of techniques for characterizing fracture architecture, with particular emphasis on fracture systems in carbonate hydrocarbon reservoirs.

Senior Lecturer, Division of Earth Sciences, University of Derby, UK (October 1986 - September 1998). Teaching of Undergraduate and Graduate courses in structural geology, tectonics, engineering geology and resource development. Supervision of PhD students.

Research Assistant, University of Exeter, UK / Greenland Geological Survey (June 1982 - July 1985). Ph.D. thesis work, contract mapping in SW Greenland and some undergraduate teaching.

### Theses

'Fault systems in the inner Godthabsfjord region of the Archaean Block, southern West Greenland' University of Exeter, UK. Ph.D. dissertation, 1987

### Continuing Education Courses Taken

Caney Shale Gas Workshop: Oklahoma Geological Survey and PTTC, Oklahoma City, OK, August 2006

PETRA overview: GeoPlus, Houston, Texas, December 2005

Well stimulation in deep gas reservoirs: PTTC, Houston, Texas, December 2004

Geology along the Wasatch Front: American Association of Petroleum Geologists/Utah Valley State College, Salt Lake City, Utah, May 2003

Using Core Data in Formation Evaluation: Core Lab Petroleum Services, Austin, Texas, March 2003

## Areas of Expertise

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Natural fracture / vein systems in sedimentary and metamorphic rocks

Structural geology

Tectonics

## Awards

### Awards and Honorary Societies

Bureau of Economic Geology Publication Award, for paper "Gale, J. F. W., Lander, R., Reed, R. M., and Laubach, S. E., 2010, Modeling fracture porosity evolution in dolostone: Journal of Structural Geology, v. 32, p. 1201-1211", 2011

President's Certificate for Excellence, Energy Minerals Division, American Association of Petroleum Geologists, for oral presentation titled "Natural Fractures in Shales: Timing, Sealing, Mechanisms of Formation and Relevance for Shale-Gas Reservoirs", 2011

President's Certificate for Excellence, Energy Minerals Division, American Association of Petroleum Geologists, for poster titled "Natural Fractures in the Barnett Shale: Why They Are Important", 2007

President's Certificate for Excellence, Energy Minerals Division, American Association of Petroleum Geologists, for poster titled "Synkinematic Carbonate Fracture Sealing Cements in Opening-Mode Fractures: Characteristics and Models", 2006

SEPM Honorable Mention, Oral Presentation Award, Understanding fractured carbonate reservoirs, AAPG/SEPM Annual Meeting, Denver, 2001

Recipient of the Clement le Nève Foster Memorial Prize, Imperial College, London, 1982

## Publications

### Peer Reviewed Journal Articles

Nicot, J.-P., Darvari, R., Eichhubl, P., Scanlon, B. R., Elliott, B. A., Bryndzia, T. L., Gale, J. F. W., and Fall, A., 2020, Origin of low salinity, high volume produced waters in the Wolfcamp Shale (Permian), Delaware Basin, USA: Applied Geochemistry, v. 122, no. 104771, 18 p., <http://doi.org/10.1016/j.apgeochem.2020.104771>.

McCay, A. T., Shipton, Z. K., Lunn, R. J., and Gale, J. F. W., 2019, Mini thief zones: subcentimeter sedimentary features enhance fracture connectivity in shales: AAPG Bulletin, v. 103, no. 4, p. 951-971, <http://doi.org/10.1306/0918181610617114>.

Wang, Q., Laubach, S. E., Gale, J. F. W., and Ramos, M. J., 2019, Quantified fracture (joint) clustering in Archean basement, Wyoming: application of normalized correlation count method: Petroleum Geoscience, v. 25, no. 4, p. 415-428, <http://doi.org/10.1144/petgeo2018-146>, [Supervised graduate student paper].

Li, J. Z., Laubach, S. E., Gale, J. F. W., and Marrett, R. A., 2018, Quantifying opening-mode fracture spatial organization in horizontal wellbore image logs, core and outcrop: application to Upper Cretaceous Frontier Formation tight gas sandstones, USA: Journal of Structural Geology, v. 108, p. 137-156, <http://doi.org/10.1016/j.jsg.2017.07.005>.

Marrett, R. A., Gale, J. F. W., Gomez, L., and Laubach, S. E., 2018, Correlation analysis of fracture arrangement in space: *Journal of Structural Geology*, v. 108, p. 16-33, <http://doi.org/10.1016/j.jsg.2017.06.012>.

Miranda, T. S., Santos, R. F., Barbosa, J. A., Gomes, I. F., Alencar, M. L., Correia, O. J., Falcao, T. C., Gale, J. F. W., and Neumann, V. H., 2018, Quantifying aperture, spacing and fracture intensity in a carbonate reservoir analogue: Crato Formation, NE Brazil: *Marine and Petroleum Geology*, v. 97, p. 556-567, <http://doi.org/10.1016/j.marpetgeo.2018.07.019>.

Ukar, E., Lopez, R. G., Gale, J. F. W., Laubach, S. E., and Manceda, R., 2017, New type of kinematic indicator in bed-parallel veins, Late Jurassic-Early Cretaceous Vaca Muerta Formation, Argentina: E-W shortening during Late Cretaceous vein opening: *Journal of Structural Geology*, v. 104, p. 31-47, <http://doi.org/10.1016/j.jsg.2017.09.014>.

Ukar, E., Lopez, R. G., Laubach, S. E., Gale, J. F. W., Manceda, R., and Marrett, R., 2017, Microfractures in bed-parallel veins (beef) as predictors of vertical macrofractures in shale: Vaca Muerta Formation, Agrio Fold-and-Thrust Belt, Argentina: *Journal of South American Earth Sciences*, v. 79, p. 152-169, <http://doi.org/10.1016/j.jsames.2017.07.015>.

Fan, Z., Eichhubl, P., and Gale, J. F. W., 2016, Geomechanical analysis of fluid injection and seismic fault slip for the Mw4.8 Timpson, Texas, earthquake sequence: *Journal of Geophysical Research: Solid Earth*, v. 121, p. 2798-2812, <http://doi.org/10.1002/2016JB012821>.

Walter, J. I., Dotray, P. J., Frohlich, C., and Gale, J. F. W., 2016, Earthquakes in Northwest Louisiana and the Texas-Louisiana Border Possibly Induced by Energy Resource Activities within the Haynesville Shale Play: *Seismological Research Letters*, v. 87, no. 2, p. 285-294, <http://doi.org/10.1785/0220150193>.

Frohlich, C., Walter, J. I., and Gale, J. F. W., 2015, Analysis of transportable array (USArray) data shows earthquakes are scarce near injection wells in the Williston Basin, 2008-2011: *Seismological Research Letters*, v. 86, no. 2A, p. 492-499, <http://doi.org/10.1785/0220140180>.

Lee, H. P., Olson, J. E., Holder, J., Gale, J. F. W., and Myers, R. D., 2015, The interaction of propagating opening mode fractures with preexisting discontinuities in shale: *Journal of Geophysical Research: Solid Earth*, v. 120, no. 1, p. 169-181, <http://doi.org/10.1002/2014JB011358>.

Santos, R. F. V. C., Miranda, T. S., Barbosa, J. A., Gomes, I. F., Matos, G. C., Gale, J. F. W., Neumann, V. H. L. M., and Guimaraes, L. J. N., 2015, Characterization of natural fracture systems: Analysis of uncertainty effects in linear scanline results: *AAPG Bulletin*, v. 99, no. 12, p. 2203-2219, <http://doi.org/10.1306/05211514104>.

Gale, J. F. W., Laubach, S. E., Olson, J. E., Eichhubl, P., and Fall, A., 2014, Natural fractures in shale: a review and new observations: *AAPG Bulletin*, v. 98, no. 11, p. 2165-2216, <http://doi.org/10.1306/08121413151>.

Gasparrini, M., Sassi, W., and Gale, J. F. W., 2014, Natural sealed fractures in mudrocks: A case study tied to burial history from the Barnett Shale, Fort Worth Basin, Texas, USA: *Marine and Petroleum Geology*, v. 55, p. 122-141, <http://doi.org/10.1016/j.marpetgeo.2013.12.006>.

Carty, J. P., Connelly, J. N., Hudson, N. F. C., and Gale, J. F. W., 2012, Constraints on the timing of deformation, magmatism and metamorphism in the Dalradian of NE Scotland: *Scottish Journal of Geology*, v. 48, no. 2, p. 103-117.

Hooker, J. N., Gomez, L. A., Laubach, S. E., Gale, J. F. W., and Marrett, R. A., 2012, Effects of diagenesis (cement precipitation) during fracture opening on fracture aperture-size scaling in carbonate rocks, in Garland, J., Neilson, J. E., Laubach, S. E., and Whidden, K. J., eds., *Advances in carbonate exploration and reservoir analysis*: Geological Society, London, Special Publication 370, p. 187-206.

Gale, J. F. W., and Holder, J., 2010, Natural fractures in some U.S. shales and their importance

for gas production: The Geological Society, London, Petroleum Geology Conference Series, v. 7, p. 1131-1140. doi: 10.1144/0070899

Gale, Julia F. W., Lander, R., Reed, R. M., and Laubach, S. E., 2010, Modeling fracture porosity evolution in dolostone: *Journal of Structural Geology*, v. 32, p. 1201-1211. doi:10.1016/j.jsg.2009.04.018.

Ortega, O. J., Gale, J. F. W., and Marrett, R. A., 2010, Quantifying diagenetic and stratigraphic controls on fracture intensity in platform carbonates: *Journal of Structural Geology*, v. 32, p. 1943-1959.

Hooker, J. N., Gale, J. F. W., Gomez, L. A., Laubach, S. E., Marrett, R. A., and Reed, R. M., 2009, Aperture-size scaling variations in a low-strain opening-mode fracture set, Cozzette Sandstone, Colorado: *Journal of Structural Geology*, v. 31, p. 707-718.

Gale, J. F. W., and Gomez, L. A., 2007, Late opening-mode fractures in karst-brecciated dolostones of the Lower Ordovician Ellenburger Group, West Texas: recognition, characterization, and implications for fluid flow: *AAPG Bulletin*, v. 91, p. 1005-1023.

Gale, J. F. W., Reed, R. M., and Holder, Jon, 2007, Natural fractures in the Barnett Shale and their importance for hydraulic fracture treatments: *AAPG Bulletin*, v. 91, no. 4, p. 603-622.

Laubach, S. E., and Gale, J. F. W., 2006, Obtaining fracture information for low-permeability (tight) gas sandstones from sidewall cores: *Journal of Petroleum Geology*, v. 29, no. 2, p. 147-158.

Gale, J. F. W., Laubach, S. E., Olson, Jon, and Marrett, Randall, 2005, Using the link between diagenesis and fracturing to accurately predict, characterize, and model fluid-flow in fractured carbonate rocks: *Society of Petroleum Engineers*, Paper No. 97382, 7 p.

Gale, J. F. W., Laubach, S. E., Marrett, R. A., Olson, J. E., Holder, Jon, and Reed, R. M., 2004, Predicting and characterizing fractures in dolostone reservoirs: using the link between diagenesis and fracturing, in Braithwaite, C. J. R., Rizzi, G., and Darke, G., eds., *The geometry and petrogenesis of dolomite hydrocarbon reservoirs*: London, Geological Society, Special Publications, 235, p. 177-192.

Laubach, S. E., Olson, J. E., and Gale, J. F. W., 2004, Are open fractures necessarily aligned with maximum horizontal stress?: *Earth and Planetary Science Letters*, v. 222, no. 1, p. 191-195.

Gale, J. F. W., 2002, Specifying lengths of horizontal wells in fractured reservoirs: *Society of Petroleum Engineers Reservoir Evaluation and Engineering*, v. 5, no. 3, p. 266-272.

Stowell, J. F. W., 2000, Specifying lengths of horizontal wells in fractured reservoirs: *Society of Petroleum Engineers/Petroleum Society of Canadian Institute of Mining, Metallurgy & Petroleum*, Paper No. SPE 65458, 8 p.

Stowell, J. F. W., Watson, A. P., and Hudson, N. F. C., 1999, Geometry and population systematics of a quartz vein set, Holy Island, Anglesey, North Wales, in McCaffrey, K, Lonegran, L., and Wilkinson, J., eds., *Fractures, fluid flow and mineralization*: Geological Society, London, Special Publications, 155, p. 17-33.

Hudson, N. F. C., and Stowell, J. F. W., 1997, On the deformation sequence in the New Harbour Group of Holy Island, Anglesey, North Wales: *Geological Journal*, v. 32, p. 119-129.

Nutman, A. P., Rivers, T., Longstaff, F., and Park, J. F. W., 1989, The Ataneq fault and mid-Proterozoic retrograde metamorphism of early Archaean tonalites of the Isukasia area, Southern West Greenland: reactions, fluid compositions and the implications for regional studies, in Bridgewater, D., ed., *Fluid movements, element transport and the composition of the deep crust*: Dordrecht, The Netherlands, Kluwer Academic Publishers.

Peer Reviewed Book Chapters

Ukar, E., López, R. G., Hryb, D., Gale, J. F. W., Manceda, R., Fall, A., Brisson, I., Hernandez-Bilbao, E., Weger, R. J., Marchal, D. A., Zanella, A., and Cobbold, P. R., 2020, Natural fractures: from core and outcrop observations to subsurface models, in Minisini, D., Fantín, M., Lanusse Noguera, I., and Leanza, H. A., eds., *Integrated geology of unconventional: the case of the Vaca Muerta play, Argentina*: Tulsa, Okla., American Association of Petroleum Geologists, AAPG Memoir, v. 121, p. 377-416, <http://doi.org/10.1306/13682234M1203837>.

Ukar, E., López, R. G., Hryb, D., Gale, J. F. W., Manceda, R., Fall, A., Brisson, I., Hernandez-Bilbao, E., Weger, R. J., Marchal, D. A., Zanella, A., and Cobbold, P. R., 2020, Natural fractures: from core and outcrop observations to subsurface models, in Minisini, D., Fantín, M., Lanusse Noguera, I., and Leanza, H. A., eds., *Integrated geology of unconventional: the case of the Vaca Muerta play, Argentina*: Tulsa, Okla., American Association of Petroleum Geologists, Memoir, v. 121, p. 377-416, <http://doi.org/10.1306/13682234M1203837>.

Gomez, L. A., Gale, J. F. W., Laubach, S. E., and Cumella, S. P., 2003, Chapter 6, Quantifying fracture intensity: an example from the Piceance Basin, in Peterson, K. M., Olson, T. M., and Anderson, D. S., eds., *Piceance Basin 2003 guidebook*: Rocky Mountain Association of Geologists, p. 96-113.

### Non Peer Reviewed Authored Books

Gale, J. F. W., compiler, 2008, *A compendium of influential papers: American Association of Petroleum Geologists, AAPG Getting Started Series No. 13, Product Code 182, ISBN: 978-1-58861-2287-8, CD-ROM.*

### Edited Books

Hammes, U., and Gale, J. F. W., 2013, *Geology of the Haynesville Gas Shale in East Texas and West Louisiana, USA: AAPG Memoir 105*

### Non Peer Reviewed Journal Articles

Elliott, S. J., and Gale, J. F. W., 2018, Study evaluates proppant distribution in HFTS Wolfcamp wells: American Oil & Gas Reporter, <https://www.aogr.com/magazine/frac-facts/frac-facts-december-2018>.

Gale, J. F. W., Elliott, S. J., and Laubach, S. E., 2018, Hydraulic fractures in core from stimulated reservoirs: core fracture description of HFTS slant core, Midland Basin, West Texas: URTEC paper no. 2902624, 18 p., <http://doi.org/DOI 10.15530/urtec-2018-2902624>.

Pommer, L., Gale, J. F. W., Eichhubl, P., Fall, A., and Laubach, S. E., 2013, Using structural diagenesis to infer the timing of natural fractures in the Marcellus Shale: Proceedings of the Unconventional Resources Technology Conference (URTEC), Denver, Colorado, USA, no. SPE-168770-MS, 6 p., <http://doi.org/10.1190/URTEC2013-167>.

Pommer, L., Gale, Julia F. W., Eichhubl, Peter, Fall, A., and Laubach, S. E., 2013, Using structural diagenesis to infer the timing of natural fractures in the Marcellus Shale: Proceedings of the Unconventional Resources Technology Conference (URTEC) Denver, Colorado, USA, 12-14 August, URTEC Control ID Number: 1580135, 6 p.

Eichhubl, P., and Gale, J. F. W., 2011, Fractured mudrock reservoirs of the Monterey and Sisquoc formations of southern California: FRAC Research Meeting Santa Barbara, California, November 8-10, 134 p.

Gale, J. F. W., 2009, Greenland, in Laubach, S. E., and Tinker, S. W., eds., 2009, *Earth's art: celebrating the Centennial of the Bureau of Economic Geology, 1909-2009: The University of Texas at Austin, Bureau of Economic Geology*, p. 84-85.

Gale, J. F. W., 2009, Natural fractures in carbonates and shales in the Texas Hill Country: FRAC Research Meeting, Austin, Texas, Fall 2009 and 2010, 37 p.

Gale, J. F. W., and Laubach, S. E., 2009, Natural fractures in the New Albany Shale and their importance for shale-gas production, in 2009 International Coalbed & Shale Gas Symposium.

Wang, F. P., and Gale, J. F. W., 2009, Screening criteria for shale gas systems, in Proceedings of GCAGS Annual Meeting, Shreveport, Louisiana, 19 p.

Wang, F. P., and Gale, J. F. W., 2009, Screening criteria for shale-gas systems: Gulf Coast Association of Geological Societies Transactions, v. 59, p. 779-794.

Gale, J. F. W., and Holder, J., 2008, Natural fractures in the Barnett Shale: constraints on spatial organization and tensile strength with implications for hydraulic fracture treatment in shale-gas reservoirs, in 42nd U.S. Rock Mechanics Symposium and U.S.-Canada Rock Mechanics Symposium, San Francisco, June 29-July 2: ARMA, American Rock Mechanics Association, paper ARMA 08-96, 9 p.

Neumann, V. H., Gale, Julia F. W., Reed, R. M., Barbosa, J. A., 2008, Padrão de fraturamento nos calcários laminados Aptianos da região de Nova Olinda-Santana do Cariri, Bacia do Araripe: Uma aplicação da técnica de escalas: Estudos Geológicos, v. 18, no. 2, 15 p., p. 101-115.

Ruppel, S. C., Gale, J. F. W., Loucks, R. G., and Wright, W. R., 2007, Stop 3: Chappel type section and quarry, San Saba, TX: Mississippian Barnett Fm mudrocks: stratigraphy, facies, mineralogy, and chemistry, in Outcrop analogs for Paleozoic reservoir systems: examples from the Texas Hill Country: a fieldtrip for the Annual Meeting of the Permian Basin Geological Synthesis Program: The University of Texas at Austin, Bureau of Economic Geology, Guidebook, p. 45-64.

Ruppel, S. C., Gale, J., Loucks, R. G., and Wright, W. R., 2007, Stop 2: Chappel type section and quarry, San Saba, Texas: Mississippian Barnett Formation mudrocks: stratigraphy, facies, mineralogy, and chemistry, in Wright, Wayne, Loucks, Bob, Gale, Julia, Kane, Jeff, and McDonnell, Angela, field-trip leaders, Paleozoic reservoir systems: Texas Hill Country--stratigraphy to petrophysics: a field trip for the Annual Meeting of the Petrophysicists and Well Log Analysts, p. 37-58.

Treviño, R. H., Loucks, R. G., Gale, Julia F. W., and Abdelmoniem, A. K., 2007, Extending facies interpretations by integrating core, image-log, and wireline-log data in the Upper Cretaceous Olmos Formation of South Texas: Gulf Coast Association of Geological Societies Transactions, v. 57, p. 729-736.

Wright, W. R., Gale, J. F. W., Ruppel, S. C., and Loucks, R. G., 2007, Stop 1: Bend Section, Colorado River, San Saba, TX: Lower Pennsylvanian (Atokan) Upper Marble Falls Fm carbonates and Smithwick Fm mudrocks: stratigraphy, ecology, facies structure, and mineralogy; their influence on lateral and vertical variations in reservoir quality, in Outcrop analogs for Paleozoic reservoir systems: examples from the Texas Hill Country: a fieldtrip for the Annual Meeting of the Permian Basin Geological Synthesis Program: The University of Texas at Austin, Bureau of Economic Geology, Guidebook, p. 5-30.

Wright, W. R., Gale, J., Ruppel, S. C., and Loucks, R. G., 2007, Stop 1: Bend section, Colorado River, San Saba, Texas: Lower Pennsylvanian (Atokan) Upper Marble Falls Formation carbonates and Smithwick Formation mudrocks: stratigraphy, ecology, facies, structure, and mineralogy: their influence on lateral and vertical variations in reservoir quality, in Wright, Wayne, Loucks, Bob, Gale, Julia, Kane, Jeff, and McDonnell, Angela, field-trip leaders, Paleozoic reservoir systems: Texas Hill Country--stratigraphy to petrophysics: a field trip for the Annual Meeting of the Petrophysicists and Well Log Analysts, p. 5-36.

Gale, Julia, 2004, Self-organization of natural mode-1 fracture apertures into power-law distributions, in 6th North America Rock Mechanics Symposium, Rock mechanics across borders and disciplines, June 5-9, Houston: ARMA/NARMS 04-488, CD-ROM [13 p].

Mackenzie, D. M., Hudson, N. F. C., Watson, A. P., Gale, J. F. W., Jones, P. F., Regan, P. F.,

Wilkins, H., and Johnson, T., 2003, The use of C&IT to support fieldwork teaching and assessment at the University of Derby: Planet, no. 5, p. 11-14.

Gale, Julia F. W., Laubach, S. E., Reed, R. M., Moros Otero, J. G., and Gomez, L. A., 2002, Fracture analysis of Clear Fork outcrops in Apache Canyon and cores from South Wasson Clear Fork field, in Integrated outcrop and subsurface studies of the interwell environment of carbonate reservoirs: Clear Fork (Leonardian-age) reservoirs, West Texas and New Mexico: The University of Texas at Austin, Bureau of Economic Geology, final technical report prepared for U.S. Department of Energy under contract no. DE-AC26-98BC15105, p. 191-226.

Laubach, S. E., Reed, R. M., Gale, J. F. W., Ortega, Orlando, and Doherty, Eloise, 2002, Fracture characterization based on microfracture surrogates, Pottsville Sandstone, Black Warrior Basin, Alabama: Gulf Coast Association of Geological Societies Transactions, v. 52, p. 585-596.

Smith, Mike, Hudson, N. F. C., Watson, A. P., Mackenzie, D. M., and Gale, J. F. W., 2002, A CD-based courseware package for the teaching and consolidating of geological field skills: Planet, no. 4, p. 10-12.

Smith, Mike, Hudson, Neil, Watson, Adrian, Mackenzie, Don, and Gale, Julia, 2002, A CD-based courseware package for the teaching and consolidating of geological field skills, in Fernandez, Anne, Sorenson, Stacey, Richardson, Simone, Bishop, Pam, and Sauders, Mike, eds., CAL-laborate: United Kingdom, University of Surrey, Physical Sciences Learning and Teaching Support Network, p. 23-26.

Gomez, L. A., Gale, J. F. W., Ruppel, S. C., and Laubach, S. E., 2001, Fracture characterization using rotary-drilled sidewall cores: an example from the Ellenburger Formation, West Texas, in Proceedings, West Texas Geological Society Fall Meeting, WTGS Publication 01-110, p. 81-89.

Laubach, S. E., Reed, R. M., Olson, J., Ortega, Orlando, and Gale, J. F. W., 2001, Fracture-surrogate analysis methods applied to Spraberry, Bone Spring, and "Canyon" cores: preliminary results, in The Permian Basin: microns to satellites, looking for oil and gas at all scales: West Texas Geological Society Fall Symposium, West Texas Geological Society Publication 01-110, p. 75-79.

Stowell, J. F. W., 2001, Characterization of opening-mode fracture systems in the Austin Chalk: Gulf Coast Association of Geological Societies Transactions, v. 51, p. 313-319.

Stowell, J. F. W., Laubach, S. E., and Olson, J., 2001, Effect of modern state of stress on flow-controlling fractures: a misleading paradigm in need of revision, in Elsworth, D., Tinucci, J. P., and Heasley, K. A., eds., Rock mechanics in the national interest: Proceedings, 38th Annual U.S. Rock Mechanics Symposium - Balkema, v. 1, p. 691-698.

Mackenzie, D. M., and Stowell, J. F. W., 1998, TRIADS applications: computer-based assessment of recent field experience, in Proceedings of the UK Geosciences Fieldwork Consortium Symposium: ISBN (085432 669 3), p. 53-54.

Brewer, M., Chadwick, B., Coe, K., and Park, J. F. W., 1984, Further field observations in the Ivisartoq region of southern West Greenland, in Rapport Grønlands Geologiske Undersøgelse 12, p. 55-67.

Chadwick, B., Crewe, M. A., and Park, J. F. W., 1983, Fieldwork in the north of the Ivisartoq region, inner Godthabsfjord, southern West Greenland, in Rapport Grønlands Geologiske Undersøgelse 115, p. 49-56.

## Guidebooks

Gale, J. F. W., Marrett, R., and Ukar, E., 2014, Fracture spatial organization field workshop, Pedernales Falls State Park.

Ruppel, S. C., Loucks, R. G., and Gale, J. F. W., 2008, Barnett, Woodford, and related mudrock successions in Texas cores and outcrops: a core workshop prepared for the 2008 AAPG/SEPM

Annual Convention: The University of Texas at Austin, Bureau of Economic Geology 82 p.

Ruppel, Stephen, Wright, Wayne, Loucks, Robert, and Gale, Julia, 2007, Outcrop analogs for Paleozoic reservoir systems: examples from the Texas Hill Country: a fieldtrip for the Annual Meeting of the Permian Basin Geological Synthesis Program: The University of Texas at Austin, Bureau of Economic Geology Guidebook , 83 p.

Wright, Wayne, Loucks, Bob, Gale, Julia, Kane, Jeff, and McDonnell, Angela, 2007, Paleozoic reservoir systems: Texas Hill Country--stratigraphy to petrophysics: a field trip for the Annual Meeting of the Petrophysicists and Well Log Analysts: The University of Texas at Austin, Bureau of Economic Geology Field-Trip Guidebook, 77 p.

## Conference Proceedings

Wang, L., Gale, J. F. W., and Sun, A. Y., 2020, Development of a machine-learning-based workflow for well completion optimization in Permian Basin, Unconventional Resources Technology Conference (URTeC), Annual Meeting, 13 p.

Ukar, E., Lopez, R. G., Gale, J. F. W., and Manceda, R., 2019, Outcrop to core comparison of natural fractures in the Vaca Muerta Formation, Argentina., Sixth European Association of Geoscientists and Engineers Shale Workshop, Bordeaux, France, 5 p.

Gale, J. F. W., Ukar, E., and Laubach, S. E., 2018, Gaps in DFN models and how to fill them, 2nd International Discrete Fracture Network Engineering Conference, American Rock Mechanics Association, no. DFNE 18-857, Seattle, Wash., 9 p.

Ukar, E., Lopez, R. G., Fall, A., Manceda, R., Gale, J. F. W., and Laubach, S. E., 2017, Vertical fractures and a new type of kinematic indicator in bed-parallel veins (beef) at Arroyo Mulichinco, Neuquen Basin, XX Congreso Geologico Argentino, 3 p.

## Contract Reports

Gale, J. F. W., and Elliott, S. J., 2019, Fracture description and proppant analysis in the Laredo Sugg E 197 5TW slant well cores: final report prepared for GTI-NETL Project No. DE-FE0024292: Hydraulic Fracture Test Site (HFTS) EOR, under contract no. S592 (subcontract), 45 p.

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Gale, J. F. W., Gomez, Leonel, Laubach, S. E., Marrett, Randall, Olson, J. E., Holder, Jon, and



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Gomez, Leonel, Gale, J. F. W., Reed, R. M., Loucks, R. G., Ruppel, S. C., and Laubach, S. E., 2003, New techniques in fracture imaging and quantification: applications in the Ellenburger Group, West Texas (abs.): American Association of Petroleum Geologists Annual Convention Official Program, v. 12, p. A64.

Carty, J. P., Connelly, Jim, Gale, J. F. W., and Hudson, N. F. C., 2002, Kinematics and timing of deformation in the Portsoy Shear Zone, NE Scotland (abs.), in Proceedings, Tectonics Studies Group Meeting, The University of Leicester, UK, January, unpaginated.

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Lander, R., Gale, J. F. W., Laubach, S. E., and Bonnell, L., 2002, Interaction between quartz cementation and fracturing in sandstones (abs.): American Association of Petroleum Geologists Annual Convention Official Program, v. 11, p. A98-A99.

Laubach, S. E., Gale, J. F. W., and Olson, J., 2002, Are open fractures necessarily aligned with maximum horizontal stress? (abs.): American Association of Petroleum Geologists Annual Convention Official Program, v. 11, p. A100.

Laubach, Stephen, Gale, Julia, Olson, Jon, Bonnell, Linda, and Lander, Rob, 2002, Cement patterns control fracture porosity preservation in tight gas sandstones (abs.), in American Association of Petroleum Geologists International Meeting: Cairo, Egypt, October 27-30, p. 254.

Stowell, J. F. W., Laubach, S. E., Marrett, Randall, Olson, J., and Holder, Jon, 2001, Understanding fractured carbonate reservoirs (abs.): American Association of Petroleum Geologists Annual Convention, Extended Abstracts, CD-ROM.

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Stowell, J. F. W., and Marrett, Randall, 2000, Fracture spatial organization: empirical analysis and scaling (abs.), in Proceedings, Tectonic Studies Group AGM, University of Manchester: unpaginated.

Laubach, S. E., Marrett, Randall, and Stowell, J. F. W., 1999, Controls on fracture permeability (abs.), in Proceedings, Fractures and in situ stress characterization: The Geological Society, Burlington House, Petroleum Group, unpaginated.

Mackenzie, D. M., and Stowell, J. F. W., 1997, Computer-based assessment of recent field experience. A use of the TRIADS system (abs.), in Programme, UK Geosciences Fieldwork Symposium: University of Leicester, unpaginated.

Watson, A. P., Stowell, J. F. W., and Hudson, N. F. C., 1997, Quartz vein emplacement on Holy Island, Anglesey (abs.), in Proceedings, Structural controls and genesis of economic resources: The Dave Johnston Memorial meeting: Trinity College, Dublin, Ireland, unpaginated.

Stowell, J. F. W., 1996, Evolution of the Portsoy Shear Zone - magmatism, deformation and metamorphism along a lithospheric weakness (abs.), in Proceedings, Tectonic Studies Group Reactivation Conference, Burlington House, London, unpaginated.

Watson, A. P., Hudson, N. F. C., and Stowell, J. F. W., 1995, Fluid incisions from quartz veins in the New Harbour Group, Anglesey (abs.) Proceedings, Metamorphic Studies Group, University of Bristol, unpaginated.

Hudson, N. F. C., and Stowell, J. F. W., 1993, The deformation sequence in the New Harbour Beds of Holy Island, Anglesey (abs.), in Proceedings, Tectonic Studies Group AGM, Trinity College, Dublin, unpaginated.

Stowell, J. F. W., 1993, A natural, lineation-parallel quartz c-axis fabric: prism  $\langle c \rangle$  slip or dynamic recrystallization? (abs.), in Proceedings, Metamorphic Studies Group, University of Leeds, unpaginated.

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Stowell, J. F. W., 1989, The geometry of basement strike-slip faulting and its influence over patterns of faulting in cover sequences (abs.), in Proceedings, Tectonic Studies Group AGM, Imperial College, London, unpaginated.

Stowell, J. F. W., 1987, Tungsten mineralisation of Early Proterozoic shear zones within the Archaean Block, southern West Greenland (abs.), in Proceedings, Joint Meeting of the Tectonic Studies Group and Mineral Deposits Group, Southampton, unpaginated.

## Funding

### Research Support

Principal Investigator: Hydraulic Fracture Test Site (HFTS2) Slant Core Description, NETL, Subcontract to GTI (October 7, 2019-March 8, 2020; \$200K).

PI: SUTUR2 Wolfcamp, Shell (January 1, 2016-December 31, 2018; \$2.4 million over 3 years).

Researcher: Center for Integrated Seismicity Research, State of Texas (June 21, 2015-June 20, 2017; \$4.47 million).

PI: GTI/NETL Hydraulic Fracture Test Site, NETL (October 15, 2015-December 31, 2016; \$205K).

Principal Investigator: Natural Fracture Characterization in the Vaca Muerta Formation, Neuquen Basin, Argentina., YPF S.A. Argentina (January 1, 2015-December 31, 2016; \$322,203).

Co-PI, Relationships between induced seismicity and fluid injection: development of strategies

to manage fluid disposal in shale hydrocarbon plays, RPSEA, March 2013-March 2015, 963,664  
PI: Fracture Characterization in the Marcellus Shale, RPSEA (2010 - 2012, \$264,405).

Co-PI: New Albany Shale; 2-year project during 3 fiscal years 2007-8, 2008-9 and 2009-10,  
RPSEA--Outside (non-BEG) Research Support (July 25, 2008 - July 31, 2010, \$344,018).

Principal Investigator: Acquisition of an electron backscatter detector, Geocosm LLC and  
Chevron (2006 - 2007, \$10,000).

Principal Investigator: Acquisition of electron backscatter diffraction system, Jackson School  
match (2005 - 2006, \$58,575).

Co-Principal Investigator: Predicting fracture porosity evolution in sandstone, DOE basic energy  
sciences, DOE (2003 - 2006, \$600,000).

Principal Investigator: Acquisition of electron backscatter diffraction system, Funding approved  
by Jackson School (2005, \$58,575).

Principal Investigator: Fracture characterization in Cupiagua field, Ecopetrol (2005, \$22,000).

Principal Investigator: Fracture characterization in Gaviota field, Repsol YPF (2004 - 2005,  
\$9,414).

Principal Investigator: Radical questioning of carbonate diagenesis paradigms: predicting  
fracture and porosity evolution in dolostone, Jackson School of Geosciences (2004 - 2005,  
\$29,594).

Researcher: Fracture Research And Application Consortium, Industrial Associates Program  
(\$50,000 per company (14 companies to date)).

## Service

### External Committees Participation

Chair, Endowment Committee, Jackson School of Geosciences, 2011 - present

Associate Editor, Bulletin, AAPG, 2008 - present

Session Chair, 2007, 2008 Tectonic Studies Group Annual Meetings, Geological Society of  
London

Session Chair, 2008, 2009, 2010 Annual Meetings, American Association of Petroleum  
Geologists

Member, Endowment Committee, Jackson School of Geosciences, 2010

Member, Publications Board, Bureau of Economic Geology, 2004 - 2009

Session Chair, GSA Annual Meeting, Geological Society of America, 2008

Chair, Oral Session, AAPG 2008 San Antonio Organizing Committee, American Association of  
Petroleum Geologists, 2006 - 2008

Member, Student Support Committee, Jackson School of Geosciences, The University of Texas  
at Austin, 2005 - 2008

Technical program Co-Chair, Annual Meeting, Austin, TX, October 30-November 1, Gulf Coast  
Association of Geological Societies, 2002

Session Chair, Behavior of Shales, Washington D.C., July 7-12, 38th Annual U.S. Rock  
Mechanics Symposium, 2001

Agent for the University of Derby, Geological Society of London, 1990 - 1998

Member, Promotions Committee, Geological Society of London, 1990 - 1993

### Outreach Activities

Careers in Geological Sciences: presented to Lago Vista High School, Lago Vista, Tex., November 28, 2018.

Panelist at public "Hydraulic Fracturing" town-hall-style meeting at University of Texas during UT Energy Week. February 16, 2015.

## Proposal Review Panels Participation

AAPG Bulletin (Analysis of joints in shale reservoir based on borehole data: modifications to conventional fracture analysis methods), 58 p., 2019

Elsevier Marine and Petroleum Geology (Influence of Nodules on Fracturing in Fine-Grained Rocks: Discrete), 2019

Geological Society of America Geosphere (Computed tomography X-ray scanning reveals the transition from planar to sigmoidal en echelon morphology in a single vein), 41 p., 2019

Journal of Geophysical Research: Solid Earth (Fracture properties of Nash Point shale as a function of orientation to bedding), 2019

Journal of Structural Geology (Mechanical Controls on Horizontal Stresses and Fracture Behaviour in Layered Rocks: A Numerical Sensitivity Analysis), 2019

AAPG Bulletin (editorial reviews of six papers), 2018

AAPG Bulletin (Editorial handling of 4 manuscripts in 2016-17), 2017

Journal of Structural Geology (Sheath folds as a strain gauge in simple shear), 44 p., 2017

Marine and Petroleum Geology (Bedding-parallel veins of fibrous calcite [beef] in petroleum source rocks from compressional basins), 35 p., 2017

Natural Environment Research Council (UK agency) (Research Fellowship proposal: Modelling the effect of geological inhomogeneities on fracture development in shales), 40 p., 2017

Geological Society of London Special Publications (Article), 39 p., 2016

Geological Society of London Special Publications (Simulation of Geomechanical History: 1 Contributions to Petroleum Geoscience), 29 p., 2016

Journal of Structural Geology (Article), 69 p., 2016

AAPG Article (Interpretation), 49 p., 2015

AAPG Bulletin (Article), 56 p., 2015

AAPG Bulletin (editorial handling of 6 papers), 2015

Elsevier (Journal of Structural Geology), 2015

Elsevier (Journal of Unconventional Oil and Gas Resources), 2015

AAPG Bulletin Special Issue on fractures in shale reservoirs (Article), 2014

American Association of Petroleum Geologists, AAPG Bulletin pre-review, editorial (Numerical simulation study of shale gas reservoir with fracture stress-sensitivity using multiscale discrete fracture network model), 2014

Bulletin of Engineering Geology and the Environment (Article), 2014

SPE Reservoir Evaluation & Engineering-Formation Evaluation (Article), 2014

American Chemical Society (Proposal), 2013

Bulletin of Engineering Geology and the Environment (Article), 2013

American Chemical Society (Proposal), 2012

International Journal of Rock Mechanics and Mining Sciences (Article), 2012

AAPG Bulletin (Article), 2011  
AAPG Bulletin (Article), 2011  
AAPG Bulletin (Editorial comment on article review), 2011  
American Chemical Society (Proposal), 2011  
Geological Society of London (Article), 2011  
Geological Society of London (Article), 2011  
Geology (Article), 2011  
AAPG Bulletin (Article), 2010  
AAPG Bulletin (Article), 2010  
AAPG Bulletin (Article), 2010  
Journal of Structural Geology (Article), 2010  
AAPG Bulletin (Article), 2009  
Journal of Structural Geology (Article), 2009  
Journal of Structural Geology (Article), 2009  
Marine and Petroleum Geology (Article), 2009  
Petroleum Geoscience (Article), 2009  
AAPG Bulletin (Article), 2008  
Bureau of Economic Geology Report of Investigations (Ruppel et al.), 2007  
Bureau of Economic Geology Report of Investigations (Hammes et al.), 2006  
Bureau of Economic Geology Report of Investigations ( D. Schultz-Ela), 2005  
Chemical Geology (Article), 2005  
Gulf Coast Association of Geological Societies Transactions (Article), 2002  
Journal of Structural Geology (Article), 2002  
Journal of the Geological Society of London (Article), 2002  
Terra Antarctica (Article), 2000  
2014, Article: AAPG Bulletin.  
2014, Article: Bulletin of Engineering Geology and the Environment.  
2014, Article: AAPG Bulletin.  
2014, Article: AAPG Bulletin.  
2014, Editorial handling of 4 manuscripts: AAPG Bulletin.  
2013, Editorial handling of 3 manuscripts: AAPG Bulletin.

## Presentations

### Invited Presentations

Core Fracture Description of the Hydraulic Fracture Test Site (HFTS1) Slant Core, Reagan Co., Midland Basin, Texas: presented to The University of Texas at Austin, Hildebrand Department of Petroleum and Geosystems Engineering, presented at Graduate Student Seminar Series, September 9, 2019.  
Core Fracture Description of the Hydraulic Fracture Test Site (HFTS1) Slant Core, Reagan Co.,

Midland Basin, Texas: presented to Texas A&M Petroleum Engineering Graduate Student Seminar Series, presented at Texas A&M University, College Station, September 3, 2019.

Hydraulic Fractures in Core from Stimulated Reservoirs: Core Fracture Description of HFTS Slant Core, Midland Basin, West Texas: presented to SPE Gulf Coast Section Houston Reservoir Study Group, luncheon guest speaker, Houston, Tex., February 21, 2019.

Natural Fractures in Shale Hydrocarbon Reservoirs: presented to Tectonic Studies Group, presented at annual meeting, Edinburgh, UK, January 7, 2015.

Bedding-parallel natural fractures: their occurrence in shale plays and possible effects on hydraulic fracture treatments: presented to AAPG/SEG/SPWLA, presented at Hedberg Conference, Austin, Texas, December 8, 2014.

## Presentations

Deformation bands as fluid pathways in outcrops of Lajas Formation tight-gas sandstone, Neuquén Basin, Argentina: presented to Fracture Research and Application Consortium (FRAC), presented at Annual Sponsors' Meeting, Austin, Tex., November 2019.

HFTS 1 EOR: 5TW Core Proppant Results: presented to HFTS 1 Consortium, presented at Core Laboratories, Houston, Tex., July 18, 2019.

Update on Fracture Description Work for the HFTS1 EOR Project: presented to HFTS1 Consortium by WebEx, January 23, 2019.

Analysis and Distribution of Proppant Recovered from Fracture Faces in the HFTS Slant Core Drilled through a Stimulated Reservoir: presented to Fracture Research and Application Consortium Annual Sponsors' Meeting, Casper, Wyo., September 17-19, 2018.

The University of Texas at Austin Center for Integrated Seismicity Research: presented to Bureau of Economic Geology Visiting Committee, presented at annual meeting, Austin, Texas, August 18, 2015.

Regional Assessment of Induced and Natural Earthquake Potential and Occurrence: presented to industry representatives, presented at Center for Integrated Seismicity scoping meeting, Houston, Texas, May 12, 2015.

TexNet: A Plan to Monitor Seismicity in Texas: presented to Jackson School Advisory Council, presented at Fall meeting, Austin, Texas, November 7, 2014.

Bedding-parallel fractures in shales: How widespread are they? Can they be predicted? Are they important?: presented to Fracture Research and Applications Consortium, presented at Annual Sponsors' meeting, Balcones Springs, Texas, September 16, 2014.

Introduction to Seismicity project: presented to Fracture Research and Application Consortium, presented at Annual Sponsors' Meeting, Balcones Springs, Texas, September 16, 2014.

Overview of Shale Fracture Research Program: presented to Fracture Research and Application Consortium, presented at Annual Sponsors' Meeting, Balcones Springs, Texas, September 16, 2014.

Fracture Spatial Organization Example Applications: presented to Fracture Research and Application Consortium, presented at Annual Sponsors' meeting, Balcones Springs, Texas, September 15, 2014.

AAPG Distinguished Lecturer Series: Natural fractures in shale hydrocarbon reservoirs: presented to Canadian Society of Petroleum Geologists, Calgary, Alberta, March 25, 2014.

AAPG Distinguished Lecturer Series: Natural fractures in shale hydrocarbon reservoirs: presented to Wyoming Geological Society, Casper, Wyoming, March 14, 2014.

AAPG Distinguished Lecturer Series: Natural fractures in shale hydrocarbon reservoirs: presented to Montana Geological Society, Billings, Montana, March 13, 2014.

AAPG Distinguished Lecturer Series: Fractures across a range of scales: presented at University of Colorado at Boulder, Boulder, Colorado, March 11, 2014.

AAPG Distinguished Lecturer Series: Natural fractures in shale hydrocarbon reservoirs: presented to Saskatchewan Geological Society, Regina, Saskatchewan, March 10, 2014.

AAPG Distinguished Lecturer Series: Natural fractures in shale hydrocarbon reservoirs: presented to San Joaquin Geological Society, Bakersfield, California, March 7, 2014.

AAPG Distinguished Lecturer Series: Natural fractures in shale hydrocarbon reservoirs: presented to Fort Worth Geological Society, Fort Worth, Texas, March 6, 2014.

AAPG Distinguished Lecturer Series: Natural fractures in shale hydrocarbon reservoirs: presented to Oklahoma Geological Society, Oklahoma City, Oklahoma, March 5, 2014.

AAPG Distinguished Lecturer Series: Natural fractures in shale hydrocarbon reservoirs: presented at Colorado School of Mines, Golden, Colorado, March 4, 2014.

Natural Fractures in Shales: presented at Unconventional Energy Research Meeting, Austin, Texas, February 11, 2014.

Fractures across a range of scales (AAPG Distinguished Lecturer Series, 2013-14): presented to Illinois Geological Survey, Champaign, Illinois, October 2013.

Fractures across a range of scales (AAPG Distinguished Lecturer Series, 2013-14): presented to Pittsburgh Association of Petroleum Geologists, Pittsburgh, Pennsylvania, October 2013.

Fractures across a range of scales (AAPG Distinguished Lecturer Series, 2013-14): presented to Pittsburgh Association of Petroleum Geologists, Pittsburgh, Pennsylvania, October 2013.

Natural fractures in shale hydrocarbon reservoirs: presented at Bureau of Economic Geology, The University of Texas, Austin, Texas, October 2013.

Natural fractures in shale hydrocarbon reservoirs: presented at Missouri University of Science and Technology, Rolla, Missouri, October 2013.

Natural fractures in shale hydrocarbon reservoirs: presented at University of Kentucky, Lexington, Kentucky, October 2013.

Natural fractures in shale hydrocarbon reservoirs: presented at Western Michigan University, Kalamazoo, Michigan, October 2013.

Natural fracture occurrence in domestic unconventional plays: frequency and prediction: presented to Houston Geological Society Applied Geoscience Meeting, Houston, Texas, 2013.

Report of activities presented to FRAC members: presented to Nexen, Austin, Texas, July 6, 2012.

Report of activities presented to FRAC members: presented to YPF, Buenos Aires, Argentina, June 24-30, 2012.

Report of activities presented to FRAC members: presented to Pace Oil and Gas, Houston, Texas, June 21, 2012.

ExxonMobil project on fracture plane strength: presented at ExxonMobil, Houston, Texas, June 20, 2012.

Report of activities presented to FRAC members: presented to Shell, Houston, Texas, June 14, 2012.

Natural fractures in the Marcellus Shale: presented at MSRL Annual Sponsors' Group Meeting, Austin, Texas, March 6-7, 2012.

Talk presented at potential research funding meeting with BP: presented at Bureau of Economic Geology, Austin, Texas, February 6, 2012.

Report of activities presented to FRAC members: presented to Devon, Austin, Texas, January 24, 2012.

ExxonMobil project on fracture plane strength: presented at Bureau of Economic Geology, Austin, Texas, December 15, 2011.

Natural fractures in the Marcellus Shale: presented at FRAC Annual Sponsors' Group Meeting, Santa Barbara, California, November 7-11, 2011.

Natural fractures in the New Albany Shale: presented at RPSEA Unconventional Gas Conference: Technological Keys to Unlocking Additional Reserves, Denver, Colorado, April 19, 2011.

Natural fractures in shale-gas reservoirs and their importance for gas production: presented at UT AAPG Student Chapter Unconventional Reservoir Workshop, Austin, Texas, March 28, 2011.

Natural fractures in shale-gas reservoirs and their importance for gas production: presented at Unconventional Workshop sponsored by UT AAPG Student Chapter, Houston, Texas, April 10-13, 2011.

Natural fractures in shales and their importance for gas production: presented to the Department of Petroleum and Geosystems Engineering, The University of Texas at Austin, Austin, Texas, August 2010.

Natural fractures in gas shales and their importance for gas production: presented at Global Unconventional Gas Meeting, Amsterdam, Netherlands, June 2010.

Natural fracture studies in the New Albany Shale: presented at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, Colorado, April 2010.

Discussion of shale fracture program & plans: presented at Annual Sponsors' Group Meeting of the Fracture Research and Application Consortium, Austin, Texas, November 2009.

Fracture characterization in the New Albany Shale: presented at Annual Sponsors' Group Meeting of the Fracture Research and Application Consortium, Austin, Texas, November 2009.

Origins and mechanisms of fracturing in the Barnett Shale in the Delaware Basin: a fluid inclusion study: presented at Annual Sponsors' Group Meeting of the Fracture Research and Application Consortium, Austin, Texas, November 2009.

Natural fractures in shales: origins, characteristics and relevance for hydraulic fracture treatments: presented at Houston Geological Society Luncheon Meeting, Houston, Texas, October 21, 13, 2009.

Applications of Cores to Permian Basin Reservoir Characterization: presented at Southwest Section, American Association of Petroleum Geologists, Annual Meeting, Midland, Texas, April 25, 2009.

Natural fractures in the Barnett Shale in the Delaware Basin, Pecos Co., West Texas: comparison with the Barnett Shale in the Fort Worth Basin: presented at North Texas Geological Society Luncheon Meeting, Irvine, Texas, January 15, 2009.

Natural Fractures in the Barnett Shale: workshop presented at Unconventional Gas Technical Forum, Victoria, British Columbia, April 3-4 2008.

Fracture enhanced permeability within a crystalline porous dolostone matrix: a reservoir model in the Knox Formation, Maben gas field, Mississippi: presented at the AAPG Annual Convention, San Antonio, Texas, April 2008.

Natural fractures in shales: origins, characteristics, and relevance for hydraulic fracture treatments: presented at the AAPG Annual Convention, San Antonio, Texas, April 2008.



Natural fractures in the Barnett Shale and their importance for hydraulic fracture treatments: presented at Unconventional Gas Technical Forum, Victoria, British Columbia, Canada, April 2008.

Natural fractures in the Barnett Shale: presented to Society of Petrophysicists and Well Log Analysts, Austin, Texas, June 3, 2007.

Natural fractures in the Barnett Shale: presented at STARR/PTTC Seminar, Houston, Texas, November 14, 2006.

Natural fractures in the Barnett Shale: presented at STARR/PTTC Seminar, Midland, Texas, November 8, 2006.

RMAG and PTTC shale gas core workshop: presented to U.S. Geological Survey, Lakewood, Colorado, September 26, 2006.

Natural fractures in the Barnett: presented at Rocky Mountain Association of Geologists and Rocky Mountain PTTC 2006 Fall Symposium: Shale gas: from grass roots exploration to production, Denver, Colorado, September 25, 2006.

Carbonate structural diagenesis initiative: presented at FRAC IA program sponsors' annual research meeting, Austin, Texas, July 22, 2005.

Testing fracture intensity measures: presented at FRAC IA sponsors' annual research meeting, Austin, Texas, July 22, 2005.

Fractures in dolostones workshop 2: presented to carbonate diagenesis and fracture specialists at the Bureau of Economic Geology, Austin, Texas, July 12, 2005.

Modeling fracture sealing in dolostones: presented to carbonate diagenesis specialists at the Bureau of Economic Geology, Austin, Texas, January 28, 2005.

Fracture size scaling results and interpretation of patterns: presented at Fracture Research and Application Consortium Annual Research Meeting, Park City, Utah, July 19, 2004.

Predicting and characterizing fractures in hydrocarbon reservoirs: using the link between diagenesis and fracturing: presented at Houston Structural Geology Group Meeting, Bureau of Economic Geology Houston Core Facility, January 16, 2003.

Predicting and characterizing fractures in dolomite reservoirs: using the link between diagenesis and fracturing: presented at Geological Society Meeting, Burlington House, London, England, December 2002.

Structural diagenesis: establishing P-T-t-d paths for opening mode fractures: presented at Research Seminar Series, School of Environmental and Applied Sciences, The University of Derby, UK, September 27, 2001.

Fracture Research and Application Consortium research update: presented at review meeting, BG Group, Reading, UK, September 25, 2001.

Are open fractures aligned with maximum horizontal stress in the Rockies?: presented at Rocky Mountain Association of Geologists luncheon meeting, July 20, 2001.

Demonstration on geological mapping: presented to school visitors, Bureau of Economic Geology, The University of Texas at Austin, Austin, TX, April 2001.

Permeability prediction and horizontal well design and Stress sensitivity of natural fractures: presented at Fracture Research and Application Consortium: Technical Review Meeting, The Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, February 2001.

Stress sensitivity of natural fractures: presented at technical review meeting, Fracture Research and Application Consortium, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, February 2001.

Spatial organization of natural opening mode fracture systems: poster presented at 2000 SPE Forum Series in Europe, Forum II Fractured Reservoirs: Challenges and Opportunities for Their Integrated Characterization and Exploitation, Sainte Maxime, France, September 10-15, 2000.

Fracture spatial distribution: research update: presented to Fracture Research and Application Consortium, Spring Applications Workshop, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, May 2000.

Characterization of fracture systems in the subsurface: from microfractures to macrofractures: presented at Schlumberger-Doll Research, Ridgefield, Connecticut, April 2000.

Scaling analysis of fractures in the Austin Chalk: presented to Chevron USA Production Company, Wilcrest, Houston, TX, March 2000.

Fracture spatial organization: empirical analysis and scaling: presented at Department of Geological Sciences, Hard Rock Seminar Series, The University of Texas at Austin, Austin, Texas, January 2000.

Fracture spatial organization: empirical analysis and scaling: presented at School of Environmental and Applied Sciences Seminar Series, The University of Derby, Derbyshire, UK, January 2000.

Structural analysis of slant and horizontal curves, Austin Chalk deep gas play: presented to Chevron USA Production Company, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, December 1999.

Fracture characterization in the Apon Formation: outcrop studies at Carrasquero Quarry: presented to PDVSA-Maracaibo and FLSTP-Maracaibo, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, September 1999.

Fracture Spatial Organization I: Empirical analysis and scaling: presented at the Fracture Research and Application Consortium, Technical Review Meeting, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, September 1999.

Status of fractured carbonate reservoir studies: presented to the Fracture Research and Application Consortium, Technical Review Meeting, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, September 1999.

Scaling analysis of core and outcrop analogues, Austin Chalk: presented to Chevron USA Production Company, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas, May 1999.

Natural fractures in shale hydrocarbon reservoirs: presented to BHP Billiton, Houston, Texas, May 2014

## Activities of a Professional Nature

### Professional Societies

American Association of Petroleum Geologists

American Rock Mechanics Association

Geological Society of London (Fellow)

### Major Field Campaigns

Joint fracture characterization project with YPF; included 2 weeks of field work examining Vaca Muerta outcrops in Neuquén Province, Argentina. March 7-22, 2015.

### Program and Project Management

SUTUR 2 Wolfcamp Principal Investigator, project proposal development. Funding will be ~ \$600,000 per year for 4 years, commencing Fall 2015

## Activities of a Professional Nature

Core demonstration for teachers, Bureau of Economic Geology, March 11, 2003

Earth Science Week Career Fair presentation, Field Geologist: The Earth Is My Office, October 16, 2006

Earth Science Week Career Fair presentation, Field Geologist: The Earth Is My Office, October 2007

Earth Science Week Career Fair presentation, Field Geologist: The Earth Is My Office, October 2008

Research supervision of Visiting Scientist Dr. Virginio Neumann from the University of Pernambuco, Brazil. Dr. Neumann is working on fracture systems in carbonates. August 2005-January 2007

Science Fair Judge, Blackwood Elementary School, Round Rock, January 2006

Supervision of David Freire, Master's student from University Simon Bolivar, Venezuela, as part of Repsol YPF fracture analysis program in Tropical field, 3-semester visit, 2004-2005.

Volunteer at Earth Science Week Summer Science Festival, Zilker Park, June 17, 2006

## Teaching and Advising

### University Courses Taught

Natural fractures in shale gas systems: presented to Advances in Unconventional Shale Gas Resources Graduate Student class, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas, 2010.

Natural fractures in shale-gas reservoirs: why they are important: presented at BEG Seminar, Bureau of Economic Geology, Austin, Texas, 2008.

Geological fieldwork in Greenland: presented at Bureau of Economic Geology Research Seminar, The University of Texas at Austin, Austin, Texas, August 11, 2006.

Predicting fracture and porosity evolution in dolostone: presented at Bureau of Economic Geology research seminar, The University of Texas at Austin, Austin, Texas, March 2006.

Description of natural fractures in core: presented to Geology for Engineers graduate student class, Department of Petroleum and Geosystems Engineering, The University of Texas at Austin, Austin, Texas, November 18, 2004.

The scaling of natural fracture systems: presented to Geology for Engineers graduate student class, Department of Petroleum and Geosystems Engineering, The University of Texas at Austin, Austin, Texas, September 23, 2004.

Effect of modern state of stress on flow-controlling fractures: a misleading paradigm in need of revision: presented at Bureau of Economic Geology research seminar, The University of Texas at Austin, Austin, TX, February 23, 2001.

Specifying lengths of horizontal wells: presented at Bureau of Economic Geology research seminar, The University of Texas at Austin, Austin, TX, January 2000.

### Continuing Education Courses Taught

Discussion of shale fracture program and plans: presented at the Annual Sponsors' Group Meeting of the Fracture Research and Application Consortium, Austin, Texas, September 2010.

Fracture characterization in the New Albany Shale: presented at the Annual Sponsors' Group Meeting of the Fracture Research and Application Consortium, Austin, Texas, September 2010.

Natural fractures in shales: timing, sealing, mechanisms of formation, and relevance for shale-gas reservoirs: presented at the Petrology Geochemistry Structure and Tectonics seminar

series, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas, September 2010.

Fracture characterization in the New Albany Shale: presented at Annual Sponsors' Group Meeting of the Mudrocks Systems Research Laboratory, Austin, Texas, January 2010.

Natural fractures in shales: origins, characteristics and relevance for hydraulic fracture treatments: presented at SPE Meeting, Irving, Texas, November 2008.

Natural fractures, stress, and induced fractures in the Barnett Shale: presented at Schlumberger, Houston, Texas, April 13, 2007.

Natural fractures, stress, and induced fractures in the Barnett Shale: presented at Shell, Houston, Texas, December 4, 2006.

Natural fractures in the Barnett Shale: presented at Fracture Research Consortium, Annual Sponsors' Meeting, Teton Village, Wyoming, October 2006.

Barnett Shale fracture overview: presented at Permian Basin Geological Synthesis Project Annual Meeting, Austin, Texas, February 27, 2006.

Olmos Formation fracture study, Gold River field, S. Texas: progress report: presented at Huber Energy at Huber Offices, Houston, Texas, August 11, 2005.

Understanding, predicting, characterizing, and simulating reservoir-scale fracture systems: presented at the Marathon Oil Company Technology Fair, Houston, Texas, May 4, 2005.

Fracture Research and Application Consortium Short Course: presented to Ecopetrol and Instituto Colombiano del Petroleo, Bucaramanga, Colombia, March 15-16, 2005.

Fracture Research and Application Consortium Short Course: presented to Devon Canada, Calgary, Canada, January 11-12, 2005.

Fracture Research and Application Consortium: research update: ConocoPhillips, Houston, Texas, December 15, 2004.

## Field Trips Leadership

Leader, Fracture Spatial Organization Field Workshop, Fracture Research and Application Consortium, The University of Texas at Austin, Pedernales Falls State Park, September 15, 2014.

Leader, Fractures in Devonian Shales and Limestones in the Finger Lakes District, New York State: Fracture Research and Application Consortium Annual Sponsors' Meeting, Rochester, New York, 2012.

Leader, Natural Fractures in Carbonates and Shales in the Texas Hill Country: Fracture Research and Application Consortium Annual Sponsors' Meeting, Austin, Texas, 2010.

Leader, Natural Fractures in Carbonates and Shales in the Texas Hill Country: Fracture Research and Application Consortium Annual Sponsors' Meeting, Austin, Texas, 2009.

Co-Leader, Paleozoic reservoir systems: Texas Hill Country--stratigraphy to petrophysics: sponsored by SPWLA, Austin, Texas, June 2007.

Leader, Fractures in Central Texas: OGCI, Austin, Texas, May 2007.

Leader, Fractures in Central Texas: OGCI, Austin, Texas, April 2006.

Leader, Fractures in Central Texas: OGCI, Austin, Texas, November 2005.

Leader, Fractures in Central Texas: OGCI Course (run by Robert Skopec), Austin, Texas, November 2004.

Leader, Fractures in Central Texas: Oil & Gas Consultants International, Inc., Austin, Texas, October 2003.

Leader, Fractures in Central Texas: OGCI Applied Rock Mechanics Course, , Central Texas, December 2002.

Leader, Fractures in Central Texas: Oil & Gas Consultants International, Inc., December 2002.

Leader, Fractures in Central Texas: OGCI Applied Rock Mechanics Course, , Central Texas, September 2002.

Leader, Fractures in Central Texas: Oil & Gas Consultants International, Inc., September 2002.

Co-Leader, Fractures in Central Texas: issues in fracture characterization: Schlumberger, June 2001.

Reservoir and Modeling School, Fractures in Central Texas: Issues in Fracture Characterization: AAPG, November 1999.

Annual Meeting, Fracture Spatial Organization: Analysis Using an Indicator Semivariogram, Pedernales Falls State Park: North American Council on Geostatistics, Austin, Texas, October 1999.

Fractures in Central Texas: Issues in Fracture Characterization: BP-Amoco, October 1999.

### Student Committee Supervision

Co-Advisor, M.S., Project Supervision Committee, John Z. Li, Spatial organization of opening-mode fractures using image log and drilling data, The University of Texas at Austin, 2015

MS, Co-advisor, Qiqi Wang, Bedding-parallel fractures in shale, The University of Texas at Austin, Austin, 2014

Co-Supervisor, M.S. Thesis Committee, Laura Pommer, Fracture Characterization in the Marcellus Shale: The University of Texas at Austin, 2010

Co-Supervisor, M.A. Thesis Committee, Walaa Awaad AliF, Lithofacies, Depositional Environment, Burial History and Calculation of Organic Richness from the Wireline Logs: A Study of Barnett Shale in the Delaware Basin, Pecos Co., West Texas, and Comparison with the Barnett Shale in the Fort Worth Basin: The University of Texas at Austin, Austin, Texas, Completed, 2009

Co-Supervisor, M.S. Thesis Committee, Luke Fidler, Fracture Characterization in the New Albany Shale: The University of Texas at Austin, 2009

Co-supervisor, Ph.D. dissertation committee, Carty, J. P., Deformation, magmatism, metamorphism and fluid movement in the Portsoy Shear Zone, NE Scotland, University of Derby, Derby, Derbyshire, United Kingdom, 2001

Co-supervisor, Ph.D. dissertation committee, Watson, A. P., The timing and significance of veins in Greenschist facies metamorphic rocks with particular reference to the Precambrian of N. Anglesey, Wales, University of Derby, Derby, Derbyshire, United Kingdom, 1999

### Student Committee Participation

Ph.D. Proposal, Kaimin Yue, Height Containment of Hydraulic Fractures in Layered Reservoirs, Dept. of Petroleum and Geosystems Engineering, The University of Texas at Austin, 2016

Member, Ph.D., Dissertation Committee, Weiwei Wu, Acid fracturing shales: behavior of propped and unpropped fractures, The University of Texas at Austin, 2015

Member, Ph.D. Dissertation Committee, Ming Gu, Improvement of Fracturing Fluid for Hydraulic Fracturing in Gas Shales: The University of Texas at Austin, 2010

Member, Ph.D. Dissertation Committee, Faustino Santiago Monroy, The University of Texas at Austin, 2005

Member, Ph.D. Dissertation Committee, Leonel Gomez, Characterization and Prediction of the Spatial Distribution of Opening Mode Fractures: The University of Texas at Austin, Austin, Texas, 2003

Ph.D. Dissertation Committee, James P. Carty, Deformation, Magmatism, Metamorphism and Fluid Movement in the Portsoy Shear Zone, NE Scotland: University of Derby, Derbyshire, UK, March, 2001

Co-supervisor, Ph.D. dissertation committee, Watson, A. P., The timing and significance of veins in Greenschist facies metamorphic rocks with particular reference to the Precambrian of N. Anglesey, Wales, University of Derby, Derby, Derbyshire, United Kingdom, 1999

Ph.D. Dissertation Committee, Adrian P. Watson, The Timing and Significance of Veins in Greenschist Facies Metamorphic Rocks with Particular Reference to the Precambrian of N. Anglesey, Wales: University of Derby, Derbyshire, UK, July, 1999