

Peter H. Hennings

October 18, 2022

Overview

Peter Hennings' expertise is applied structural geology and geomechanics for which his interests are broad spanning structural systems analysis, subsurface interpretation, fault system characterization, fractured reservoir characterization, reservoir geomechanics, and subsurface fluid flow. Dr. Hennings is known as an integrator which is vital for the study of induced seismicity for which he is now known globally.

Hennings has had two career paths. From 1991 to 2015, after receiving his PhD in Geology from The University of Texas at Austin, he worked in the petroleum industry as a research structural geologist, where he achieved the position of Research Fellow. For fifteen of those years he served as a research manager within his area of expertise with teams of up to 25 geoscientists. During the majority of this period, Peter was active in the academic realm with adjunct professor appointments. He maintained a wide breadth of professional service and also gained a reputation for being an effective instructor. He gained a global reputation for his research in fractured reservoir characterization and geomechanics.

In 2016, Peter joined the Bureau of Economic Geology as Principal Investigator to form and build the Center for Integrated Seismicity Research (CISR). CISR has since become one of the Jackson School's largest industry-sponsored research programs. Peter is also a research leader in the BEG's TexNet Earthquake Monitoring Program where he heads its geological integration efforts and has been a principal in its development. In 2022 the TexNet-CISR collaboration will begin its 7th year and it has thus far collectively raised over \$20,000,000 in funding and published over 75 scientific papers. In Dr. Hennings capacity in CISR and TexNet, he has conducted a program of research with collaboration spanning 6 external universities and institutes; 7 research units at UT; and dozens of scientists, research staff, and students at the BEG. This broad collaboration has propelled CISR to become the leading group globally working to understand the geologically-integrated nature of induced seismicity. Hennings has also established a broad and effective stakeholder partnership spanning industry, regulators, academia, and the public to better understand induced seismicity and work to mitigate its occurrence. His peer-reviewed publication record that has recently become very strong and he has a highly successful track record of generating research funding. In 2022, Peter was promoted to the position of Senior Research Scientist, the Bureau's most senior science rank.

Dr. Hennings' CISR and TexNet research effort has revealed the mechanistic relationship between human activity and earthquakes in key regions of Texas and his basin-scale geologic characterizations now underpin new seismicity hazard assessments state-wide. The research products from he and his team are being directly used by the petroleum industry and its regulators to understand induced seismicity and put protocols in place for mitigation. This work has also led to an improved understanding of fault rupture in general which has significant scientific implications for natural and anthropogenically-altered systems globally.

Having taught over 100 classroom courses and field seminars within corporate and professional realms, Dr. Hennings is also an effective instructor. As a Lecturer in the Jackson School since 2016, Hennings also now teaches yearly at undergraduate and graduate levels on the topics of *Seismic Structural Analysis* and *Geological Field Methods*.

In 2022, Peter was appointed to the Board of Directors for the Big Bend Conservancy.

Dr. PETER H. HENNINGS, P.G.
Senior Research Scientist – Lecturer – Consulting Geologist

Bureau of Economic Geology
Jackson School of Geosciences
The University of Texas at Austin
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office: 512-471-0156

TECHNICAL and RESEARCH SPECIALTY:

Research program development and leadership, fund raising for research, analysis of induced and triggered seismicity, field and subsurface structural geology, seismic interpretation, characterization and hydraulic modeling of fractured and compartmentalized reservoirs, reservoir geomechanics, fault seal analysis, thrust belt kinematics.

Teaching field and classroom courses and workshops on seismic structural analysis, induced seismicity, reservoir geomechanics, geology of the Laramide Rockies, geology of West Texas.

PRESENT STATUS:

Principal Investigator – Center for Integrated Seismicity Research, Bureau of Economic Geology, The University of Texas at Austin: research program design and management, industrial associate program development (raised \$9+ million 2016-22), research in the areas of induced seismicity, structural geology, reservoir geomechanics, subsurface characterization and modeling.

Topical Lead – TexNet Earthquake Monitoring Program, Bureau of Economic Geology, The University of Texas at Austin: research program design and management and participation for the topics of geological interpretation and subsurface integration; participation in program management and outreach. During my years of participation, the program has received funding of \$10+ million.

Teaching: organized and taught over 100 geologic field seminars and short courses.

2015-22 Teaching: Seismic Structural Analysis (UT Austin); Geological Field Camp (UT Austin); Geological Field Camp Structure Concentration (Univ Indiana); Application of Geomechanics to Reservoir Characterization, Management and Hydraulic Stimulation, Wyoming (RPS); Introduction to Petroleum Systems: Sources, Reservoirs, Traps, and Basins of the Laramide Rockies (AAPG, UWY); Thrust Belt Seismic Interpretation, Montana (RPS); Understanding Faults and Fault Rupture – Applications to Fluid Trapping, Pressure Containment, and Induced Seismicity for Hydrocarbons and CCS, Utah (RPS)

Professional Geoscientist, Texas, License Number 3887

Board of Directors – Big Bend Conservancy

EMPLOYMENT AND APPOINTMENT HISTORY:

2022- PI and Senior Research Scientist, Bureau of Economic Geology, UT Austin

- Principal Investigator for the Center for Integrated Seismicity Research (CISR, *my Lab*)
- Managed CISR industrial affiliate program and grew membership from 0 to 25 companies
- Subsurface integration leader for the TexNet Seismic Monitoring and Research Program
- Stakeholder liaison and management
- Research staff supervision

2016-22 PI and Research Scientist, Bureau of Economic Geology, UT Austin

- Same as above

2016- Lecturer, Jackson School of Geosciences, UT Austin

- Teach *GEO395S Seismic Structural Analysis* (2016, 2017, 2019, 2021)
- Teach 3 modules of *GEO660 Geological Field Camp* (2017-2022)
- Student supervision and service on graduate student committees, faculty search committees

2022- Board of Directors – Big Bend Conservancy

- 2021-** **Lecturer, Department of Earth and Atmospheric Sciences, University of Indiana**
- Teach *AESX498 Geologic Field Camp - Structure Concentration* (2021-22)
- 2006-** **Adjunct Professor, Dept. of Geology and Geophysics, University of Wyoming**
- Teach structural interpretation short courses and geological field trips
 - Service on graduate student committees
 - School of Energy Resources Enhanced Oil Recovery Institute Technical Advisory Board (2005-10)
- 2011-18** **Adjunct and Consulting Professor, Dept. of Geophysics, Stanford University**
- Collaborative research with the Zoback Stress and Crustal Mechanics Group
 - Service on graduate student committees
- 2005-15** **Manager Structure and Geomechanics Group, ConocoPhillips Technology & Projects**
- Design and management of a research, applications, and internal consultancy program
 - Supervision of a specialty group that I grew from 2 to 25 people, staff resource management, career development, budget administration, cross-functional integration, internal and external program communication and marketing
 - Coordination and participation in global technical service projects with personal emphasis in NW Shelf Australia, Sumatra, Vietnam, Eastern China, Nigeria, Kazakhstan, Norwegian North Sea, other areas
 - Research Fellow specializing in seismic structural analysis, geomechanics, fractured reservoirs
 - Developer and lead instructor for corporate structural geology training
- 2003-05** **Sr. Scientist/Team Lead, Reservoir Structure, ConocoPhillips Subsurface Technology**
- Same general responsibilities as the item above
- 2002-03** **Manager Structural Analysis Group, ConocoPhillips Upstream Technology**
- Same general responsibilities as the item above
- 1999-02** **Structural Geology Technology Leader, Phillips Petroleum Co., Bartlesville, OK.**
- Global Structural Geology Advisor
 - Research program management
 - Staff supervision
 - Technical service consultation and projects with personal emphasis in Venezuela, Norwegian North Sea, Nigeria, China, other areas
 - Research Scientist specializing in seismic structural analysis, geomechanics, fractured reservoirs
 - Developer and lead instructor for corporate structural geology training
- 1998-99** **Structural Geology Program Leader, Mobil Technology Co., Dallas, TX.**
- Design and management of a research, applications, and internal consultancy program
 - Coordination and participation in global technical service projects with personal emphasis in Sumatra, Vietnam, Nigeria, Kazakhstan, other areas
 - Researcher specializing in seismic structural analysis, geomechanics, fractured reservoirs
 - Conduct training in Seismic Structural Analysis and Compressional Structures Field Seminar
- 1991-98** **Research Structural Geologist, Mobil Technology Co., Dallas, TX.**
- Coordination and participation in global technical service projects with personal emphasis in Italy, Nigeria, US and Canadian Rocky Mountains, Sumatra, Vietnam, Western China, Peru, other areas
 - Researcher specializing in seismic structural analysis, complexly deformed reservoirs
 - Conduct training in Seismic Structural Analysis and Compressional Structures Field Seminar
- 1987-90 Texaco Fellow and Teaching Assistant, Dept. of Geological Sciences, UT Austin.
- 1988-90 Summer Intern, Mobil Research and Development Corp., Dallas, TX.
- 1987 Hydrogeologist Intern, Espey, Huston, and Assoc., Austin, TX.
- 1986 Research Assistant, Bureau of Economic Geology, UT Austin.
- 1984-86 Research and Teaching Assistant, Dept. of Geology, Texas A&M University

EDUCATION:

Ph.D. Geology (1991), The University of Texas, Austin; Adviser Dr. Bill Muehlberger

B.S. Geology (1983), M.S. Geology (1986), Texas A&M University, Center for Tectonophysics,
Advisor Dr. John Spang

HONORS and AWARDS:

2020 AAPG Division of Environmental Geology Best Paper Award

2019 Walter Award for Outstanding Research, The University of Texas Jackson School of Geosciences

2016 AAPG Distinguished Service Award

2015 AAPG George C. Matson Memorial Award for Best Paper

2013 AAPG Certificate of Merit (service to the association)

2007 ConocoPhillips Technology Achievement Award

2005 ConocoPhillips Outstanding Mentor Award

2001-02 AAPG Distinguished Lecturer

2001 GSA Honorary Fellow

2000 AAPG A. I. Levorsen Memorial Award for Best Paper

1986 AAPG A. I. Levorsen Award for Best Paper

PROFESSIONAL SERVICE:

2017- Advisory Trustee, Southwest Research Institute

2018-19 AAPG Annual Conference Technical Program Chair

2016-18 AAPG Annual Conference Organizing Committee

2013-17 Founder and President, AAPG Petroleum Structure and Geomechanics Division

2016- Associate Editor, Rocky Mountain Geology

2015-16 AAPG Annual Conference Organizing Committee Theme Chair

2002-06, 2013-16 AAPG Associate Editor

2001-2 AAPG Distinguished Lecturer

2011-13 AAPG Technical Advisory Committee

2010-12 Chair AAPG Research Committee

2001-07 AAPG Distinguished Lecture Committee

1997-14 AAPG Research Committee

2005-10 Univ WY School of Energy Resources Enhanced Oil Recovery Institute Technical Advisory Board

2008-9 Convener AAPG-SPE-SEG Fractured Reservoir Hedberg Conference & Special Volume Editor

2001-02 AAPG Distinguished Lecturer

PATENTS

Schultz, R.A., Soofi, K.A., and Hennings, P.H., Satellite Geodesy and Reservoir Performance, Patent #US20160238704 A1, Aug 18, 2016.

Amendt, D.V., Busetti, S., D'Onfro, P.S., and Hennings, P.H., Mechanical Characterization of Core Samples, Patent #US20140373616 A1, Dec 25, 2014.

ADVISING AND COMMITTEE SERVICE

- Ph.D. Committee Member (2022-), The Univ. Texas at Austin, Zebker, M., Subsidence of Aquifers in Texas.
- Post Doctoral Supervisor (2020-present), The Univ. Texas at Austin, Calle, A., Interpretation of Geologic Models for Dynamic Assessment of Induced Earthquake Triggering, Permian Basin Region of West Texas and Southeast New Mexico.
- M.S. Supervisor (2020-22), The Univ. Texas at Austin, McKeighan, C., Relationship between hydraulic fracturing, earthquakes, and fault reactivation in the Eagle Ford, South Texas.
- Ph.D. Committee Member (2021-22), The Univ. Texas at Austin, Gutierrez, J., Flat slab subduction in the sedimentary record in the Colombian foreland.
- Ph.D. Committee Member (2020-22), The Univ. Texas at Austin, Staniewicz, S., Precision imaging and detection of surface deformation over the Permian Basin using radar interferometry.
- Ph.D. Committee Member (2021), The Univ. Texas at Austin, Shakiba, M., Multiscale Spatial Analysis and Modeling of Fracture Arrangements.
- Ph.D. Committee Member (2019-2021), Southern Methodist University, Quinones, L., Crustal shear wave splitting and pore fluid pressure in the central United States and modeling injection induced stress changes in the Fort Worth Basin, Texas using 3D coupled geomechanical models.
- Ph.D. Committee Member (2018-present), The Univ. Texas at Austin, Forstner, S., Reconstructing fracture pattern evolution.
- Ph.D. Committee Member (2018-20), The Univ. Texas at Austin, Mackaman-Lofland, C., Structural architecture and tectonic evolution of the southern Central Andes (31–33°S): implications for Cordilleran deformation modes and driving mechanisms.
- Ph.D. Committee Member (2017-20), Stanford University, Lund Snee, J.E., State of stress across the central and eastern USA and geologic controls.
- M.S. Committee Member (2017-18), The Univ. Texas at Austin, Gutierrez Tamayo, E.G., Provenance and geochronological insights into Late Cretaceous-Cenozoic foreland basin development in the Subandean Zone and Oriente Basin of Ecuador.
- Ph.D. Committee Member (2012-15), Stanford University, Johri, M., A scaling law to characterize fault-damage zones at reservoir depths.
- Ph.D. Committee Member (2008-11), Stanford University, Paul, P., Fluid flow in a fractured reservoir using a geomechanically-constrained fault zone damage model for reservoir simulation and a method to implement permeability anisotropy associated with fault damage zones in reservoir simulation.
- M.S. Committee Member (2004-06), Gilbertson, N., 3D geologic modeling and fracture interpretation of the Tensleep Sandstone, Alcova Anticline, Wyoming.
- M.S. Committee Member (2004-5), University of Wyoming, Ottomen, A., Structural analysis of a Laramide, basement-involved, foreland fault zone, Rawlins uplift, south-central Wyoming.
- Ph.D. Committee Member (2002-04), Stanford University, Bergbauer, S., Improving curvature analysis of deformed horizons using scale-dependent filtering techniques.
- Ph.D. Committee Member (2000-02), Colorado School of Mines, Zahm, C., Kinematics of tear faulting in structurally attenuated strata, Thermopolis Anticline, Wyoming.
- M.S. Committee Member (1997-8), Univ. Arizona, Karen Swanberg, Fracture analysis of the Circle Cliffs Uplift, Utah.
- M.S. Committee Member (1996-8), The Univ. Texas at Arlington, Bruce Prine, 3D Analysis of Thrust Fault Terminations, Kananaskis, Alberta.

PAPERS

⁺denotes paper from my CISR lab for which I generated the funding and supervised the research as PI

^{*}denotes papers or abstracts where, in my former corporate role, I sponsored the research and served as thesis committee member

- ⁺Smye, K.M., Ge, J., Morris, A., Horne, E.A., Calle, A., Eastwood, R.L., Nicot, J.-P., Hennings, P., (in review) Role of Deep Fluid Injection in Induced Seismicity in the Delaware Basin, West Texas and Southeast New Mexico, G-Cubed.
- ⁺Hennings, P., and Young, M., (accepted) The TexNet-CISR collaboration and steps toward understanding induced seismicity in Texas, Geological Society of America Special Volume on Induced Seismicity.
- ⁺Horne, E., Smye, K., Hennings, P., (in press) Structure and characteristics of the basement in the Fort Worth Basin, , in Callahan, O. A., Eichhubl, P., eds., The Geologic Basement of Texas: a volume in honor of Peter Flawn, Texas Bureau of Economic Geology.
- ⁺McKeighan, C., Hennings, P., Horne, E.A., Smye, K., Morris, A.P., 2022, Understanding anthropogenic fault rupture in the Eagle Ford Region, south-central Texas, Bulletin of the Seismological Society of America, doi: [10.1785/0120220074](https://doi.org/10.1785/0120220074).
- ⁺Horne, E., Hennings, P., Smye, K., Staniewicz, S., Chen, J., Savvaidis, A., (2022) Structural characteristics of shallow-normal Faults in the Delaware Basin, Texas and New Mexico, Interpretation, DOI:10.1190/int-2022-0005.1.
- ⁺Ge, J., Nicot, J.-P., Hennings, P.H., Smye, K.M., Hosseini, S.A., Gao, R.S., and Breton, C.L., 2022, Recent Water Disposal and Pore Pressure Evolution in the Delaware Mountain Group, Delaware Basin, Southeast New Mexico and West Texas, Journal of Hydrology - Regional Studies, <https://doi.org/10.1016/j.ejrh.2022.101041>
- ⁺Hennings, P.H., Dvory, N., Horne, E.A., LI, P., Savvaidis, A., Zoback, M., 2021, Stability of the Fault Systems that Host Induced Earthquakes in the Delaware Basin of West Texas and Southeast New Mexico, The Seismic Record, <https://doi.org/10.1785/0320210020>
- ⁺Hennings, P.H., J.P. Nicot, R.S. Gao, H.R. DeShon, J-E. Lund Snee, A.P. Morris, M.R. Brudzinski, E.A. Horne, and C. Breton, 2021, Pore Pressure Threshold and Fault Slip Potential for Induced Earthquakes in the Dallas-Fort Worth Area of North Central Texas, Geophysical Research Letters, <https://doi.org/10.1029/2021GL093564>
- ⁺Smye, K.M., Banerji, D.A., Eastwood, R., McDaid, G. and Hennings, P.H., 2021, Lithology and Reservoir Properties of the Delaware Mountain Group of the Delaware Basin and Implications for Saltwater Disposal and Induced Seismicity, Journal of Sedimentary Research, <https://doi.org/10.2110/jsr.2020.134>
- ⁺Morris, A.P., Hennings, P.H., Horne, E.A., Smye, K.M., 2021 Stability of Basement-Rooted Faults in the Delaware Basin of Texas and New Mexico, USA, Journal of Structural Geology, <https://doi.org/10.1016/j.jsg.2021.104360>
- ⁺Gao, R., Nicot, J.-P., Hennings, P. H., La Pointe, P., Smye, K., Horne, E. A., Dommissive, R., 2021, Low pressure build-up with large disposal volumes of oilfield water A comprehensive hydrogeologic model of pore pressure change in the Ellenburger Group, Fort Worth Basin, North-Central Texas: AAPG Bulletin, <https://doi.org/10.1306/03252120159>
- ⁺Smye, K.M., Hennings, P.H., Horne, E.A., 2021, Variations in Vertical Stress in the Permian Basin Region, AAPG Bulletin, <https://doi.org/10.1306/10092019189>
- ⁺Horne, E.A., Hennings, P.H., and Zahm, C. K., 2021, Basement-rooted faults of the Delaware Basin and Central Basin Platform, Permian Basin, West Texas and Southeastern New Mexico, in Callahan, O. A., Eichhubl, P., eds., The Geologic Basement of Texas: a volume in honor of Peter Flawn, Texas Bureau of Economic Geology, [10.23867/RI0286C6](https://doi.org/10.23867/RI0286C6).
- Staniewicz, S., Chen, J. Lee, H., Olson, J., Savvaidis, A., Reedy, R., Breton, C., Rathje, E., Hennings, P.,

- 2020, InSAR reveals complex surface deformation patterns over an 80,000 square kilometer oil-producing region in the Permian Basin, Geophysical Research Letters, <https://doi.org/10.1029/2020GL090151>
- ⁺Horne, E.A., Hennings, P.H., Osmond, J.L., DeShon, H., 2020, Structural characterization of potentially seismogenic faults in the greater Fort Worth Basin: Interpretation, v. 8, no. 2, 74 p., <https://doi.org/10.1190/int-2019-0188.1>
- Frohlich, C., Hayward, C., Rosenblit, J., Aiken, C., Hennings, P., Savvaadis, A., Lemons, C., Horne, E., Walter, J.L., DeShon, H.R., 2020, Onset and cause of increased seismic activity near Pecos, West Texas, USA from observations at the Lajitas TXAR Seismic Array, JGR Solid Earth, <https://doi.org/10.1029/2019JB017737>
- ⁺Hennings, P.H., Lund Snee, J-E., Osmond, J.L., DeShon, H.R., Dommissie, R., Horne, E.A., Lemons, C. and Zoback, M.D., 2019, Injection-Induced Seismicity and Fault Slip Potential in the Fort Worth Basin, Texas, Bulletin of the Seismological Society of America, <https://doi.org/10.1785/0120190017>
- ⁺Lemons, C., McDaid, G., Scanlon, B., Hennings, P.H., and Acevedo, J., 2019, Geographic, Stratigraphic, and Temporal Variation in Saltwater Disposal Practices of the Permian Region, Texas and New Mexico, USA, Environmental Geosciences, <https://doi.org/10.1306/eg.06201919002>
- ⁺Smye, K.M., Lemons, C. R., Eastwood, R., McDaid, G., and Hennings, P.H., 2019, Stratigraphic Architecture and Petrophysical Characterization of Formations for Deep Disposal in the Fort Worth Basin, TX., Interpretation, <https://doi.org/10.1190/INT-2018-0195.1>
- ⁺Chen, R., Xue, X. Yao, C., Datta-Gupta, A., King, M., Hennings, P., & Dommissie, R., 2018, Coupled Fluid Flow and Geomechanical Modeling of Seismicity in the Azle Area North Texas, SPE, <https://doi.org/10.2118/191623-MS>
- *Johri, M., Zoback, M., and Hennings, P., 2014, A scaling law to characterize fault-damage zones at reservoir depths: AAPG Bulletin, <https://doi.org/10.1306/05061413173>
- Schultz, R., Soofi, K., Hennings, P., Tong, X., and Sandwell, T., 2014, Using InSAR to detect active deformation associated with faults in Suban field, South Sumatra Basin, Indonesia, The Leading Edge, <https://doi.org/10.1190/tle33080882.1>
- Flottman, T., Brooke-Barnett, S., Trubshaw, R., Naidu S., Kirk-Burnnand, E., Paul, P., Busetti, S., Hennings, P., 2013, Influence of In-Situ Stresses on Fracture Stimulations in the Surat Basin, Southeast Queensland, SPE Res Eval & Eng, <https://doi.org/10.2118/167064-MS>
- *Busetti, S., Mish, K., Hennings, P., and Reches, Z, 2012 Damage and plastic deformation of reservoir rocks: Part 2. Propagation of a hydraulic fracture, AAPG Bulletin, <https://doi.org/10.1306/02011211011>
- Hennings, P., Allwardt, P., Paul, P., and others, 2012, Relationship between fractures, fault zones, stress and reservoir productivity in the Suban gas field, Sumatra, Indonesia, AAPG Bulletin, v. 96, p. 753-772, <https://doi.org/10.1306/08161109084>
- *Paul, P., Zoback, M., and Hennings, P., 2011, A method to implement permeability anisotropy associated with fault damage zones in reservoir simulation, SPE Res Eval & Eng <https://doi.org/10.2118/143305-PA>
- Hennings, P., 2009, AAPG-SPE-SEG Hedberg research conference on "The Geologic Occurrence and Hydraulic Significance of Fractures in Reservoirs", AAPG Bulletin, <https://doi.org/10.1306/intro931109>
- McLennan, J., Allwardt, P., Hennings, P., and Farrell, H, 2009, Multivariate fracture intensity prediction: Application to Oil Mountain anticline, Wyoming, AAPG Bulletin, <https://doi.org/10.1306/07220909081>
- Zahm, C. and Hennings, P., 2009, Complex fracture development related to stratigraphic architecture: Challenges for structural deformation prediction, Tensleep Sandstone at the Alcova anticline, Wyoming, AAPG Bulletin, <https://doi.org/10.1306/08040909110>
- *Paul, P., Zoback, M., and Hennings, P., 2009, Fluid flow in a fractured reservoir using a geomechanically-constrained fault zone damage model for reservoir simulation, SPE, <https://doi.org/10.2118/110542-MS>
- *Bergbauer, S., Mukerji, T., and Hennings, P., 2003, Improving curvature analysis of deformed horizons using scale-dependent filtering techniques: AAPG Bulletin, <https://doi.org/10.1306/0319032001101>
- Hennings, P., Olson, J.E., and Thompson, L.E., 2000, Combining outcrop data and 3-d structural models

- to characterize fractured reservoirs with outcrop fracture and fault data for reservoir characterization, AAPG Bulletin, <http://dx.doi.org/10.1306/A967340A-1738-11D7-8645000102C1865D>
- Hennings, P., 1999, Structural Geology in Reservoir Characterization [Book Review]: Journal of Structural Geology, v. 21, p. 246-7.
- Hennings, P. and Hager, R., 1996, Basement backthrusts and thin-skinned detachments in Gooseberry Field, Western Bighorn Basin, Wyoming: Wyoming Geol. Assoc. Guidebook, Resources of the Bighorn Basin, https://archives.datapages.com/data/wga/data/060/060001/221_wga0600221.htm
- Hennings, P., 1994, Structural transect of the southern Chihuahua tectonic belt: Tectonics, <https://doi.org/10.1029/94TC00800>
- Hennings, P., Dyer, R., and Muehlberger, W.R., 1989, Laramide development of the eastern Chihuahua tectonic belt in Structure and Stratigraphy of Trans-Pecos Texas: 28th Inter. Geol. Congress Fieldtrip Guidebook T317: AGU, <https://doi.org/10.1029/FT317p0071>
- Hennings, P. and Spang, J.H., 1987, Sequential development of Dry Fork Ridge anticline, northeastern Bighorn Mountains, Wyoming and Montana: Contributions to Geology, Univ. of Wyoming Press, v. 25, p. 73-93, <https://geobookstore.uwyo.edu/contributions-fall-1987-25-2>
- Hennings, P. and Spang, J.H., 1987, A method for determining fault geometry from rotated basement blocks using slip lines: The Mtn. Geol., Rocky Mtn Assoc. of Geol., v. 24, p. 30-32.

CONFERENCE PAPERS

⁺denotes paper from my CISR lab for which I generated the funding and supervised the research as PI

- ⁺Horne, E., Hennings, P., Smye, K., Calle, A., Huang, D., Savvaidis, A., 2022, Structural characterization and rupture hazard assessment of faults in the Midland Basin, West Texas, Conference Paper, AAPG-SEG IMAGE, <https://doi.org/10.1190/image2022-3745325.1>.
- Jin, L., Curry, W., Zoback, M., Hussenoeder, S., Savvaidis, A., Nicot, J-P., Hennings, P., and Bhargava, P., 2022, Rapid geomechanical analysis of injection-related earthquakes, Conference Paper, AAPG-SEG IMAGE, <https://doi.org/10.1190/image2022-3740083.1>.
- Olson, J.E., Hennings, P.H., and S.E. Laubach. "Integrating Wellbore Data and Geomechanical Modeling for Effective Characterization of Naturally Fractured Reservoirs." Paper presented at the SPE/ISRM Rock Mechanics in Petroleum Engineering, Trondheim, Norway, July 1998. doi: <https://doi.org/10.2118/47352-MS>

INVITED PRESENTATIONS – not specifically tracked estimated at 5 per year from 2000-2022

CONFERENCE ABSTRACTS including INVITED (presenter underlined)

- ⁺denotes paper from my CISR lab for which I generated the funding and supervised or co-supervised the research as PI
- ⁺Ge, J., Nicot, J-P., Smye, K.M., Calle, A., Horne, E.A., Hennings, P., 2022, Wastewater Injection, Surface Deformation and Induced Earthquakes in Delaware Basin, West Texas, AGU Annual Convention, Chicago, IL.
- ⁺Smye, K.M., Hennings, P., Nicot, J-P., 2022, Role of Geology in Induced Seismicity Associated with Shallow and Deep Wastewater Injection, AGU Annual Convention, Chicago, IL.
- ⁺Hennings, P., Staniewicz, S.J., Chen, J., Smye, K.M., Horne, E.A., Nicot, J-P., Reedy, R.C., Scanlon, B.R., 2022, Combining InSAR and Comprehensive Subsurface Data to Understand Regional Anthropogenic Uplift, Subsidence, Faulting and Earthquakes in the Delaware Basin, West Texas, AGU Annual Convention, Chicago, IL.
- Lee, J-C., Khorrami, M., Shirzaei, M., Teatini, P., Franceschini, A., Zoccarato, C., Ge, J, Nicot, J-P., Smye, K.M., Hennings, P., 2022, Wastewater Injection, Surface Deformation and Induced Earthquakes in Delaware Basin, West Texas, AGU Annual Convention, Chicago, IL.
- ⁺Hennings, P., 2022, The Geology and Mechanics of Injection-Induced Earthquakes in the Permian Basin: SPE Permian Basin Energy Conference, 2022, Midland, Texas, USA.
- ⁺Hennings, P., 2022, Role of Deep Injection in Induced Seismicity in the Delaware Basin of West Texas and Southeast New Mexico: Injection Induced Seismicity – A Decade of Learnings, 2022, Austin, Texas, USA.
- ⁺Smye, K., and Hennings, P., 2022, Understanding Induced Seismicity in Texas and Nearby – An Update on the TexNet-CISR Collaboration, SPE/SEG Workshop: Injection Induced Seismicity – A Decade of Learnings, Austin, Texas, USA.
- Xiao, Y., Zigler, C., Savvaidis, A., Hennings, P., 2021, Spatial causal inference on induced seismicity, AGU Annual Meeting, <https://doi.org/10.1002/essoar.10509199.1>.
- Staniewicz, S., Chen, J., Lee, H., Olson, J., Savvaidis, A., Hennings, P., 2021, Cumulative and transient surface deformation signals in the Permian Basin, AGU Annual Meeting, <https://doi.org/10.1002/essoar.10505979.1>.
- Xiao, Y., Zigler, C., Savvaidis, A., Hennings, P., Pycrz, M., 2021, Causal Inference In Geoscience: An Application to Induced Seismicity, GeoGulf 2021 Conference.
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