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Curriculum Vitae

RICHARD A. SCHULTZ, Ph.D., P.G.
Grand Forks, North Dakota 58201 USA

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RICHARD A. SCHULTZ, Ph.D., P.G.
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Overview

A geologist by training, **Richard A. Schultz** works to advance underground energy storage and the energy transition toward a more secure, low-carbon future. Currently the Continental Resources Distinguished Professor and Chair of the Department of Energy and Petroleum Engineering at the University of North Dakota, he was Senior Research Scientist at The University of Texas at Austin, Principal Geomechanicist with ConocoPhillips, and Foundation Professor of Geological Engineering and Geomechanics (now Emeritus) with the University of Nevada, Reno.

- Published 1 book (*Geologic Fracture Mechanics*, Cambridge University Press), 124 research papers, 7 edited volumes, 19 chapters in books or edited volumes, and delivered more than 376 presentations to academia and industry worldwide including 108 invited.
- Total research funding received from external/academic sources is $5,580,589; total funding acquired including industrial sources is $14,563,642.
- Citations:
  - 9,572 (Google Scholar); 8,619 (ResearchGate); 5,567 (publons/Web of Science)
  - 50,275 reads (ResearchGate)
  - *h*-index: 54 (Google Scholar, as of 1/22/2026)
- Recent projects:
  - International Energy Agency (IEA) Hydrogen Technology Collaboration Programme (Hydrogen TCP), Task 42: Underground Hydrogen Storage (S. van Gessel, TNO, The Netherlands, Task Lead)
  - Subsurface Hydrogen Assessment, Storage, and Technology Acceleration (SHASTA; A. Goodman, NETL, PI; funded by US DOE)
  - IngeoExpert is an online training center that delivers specialized courses in Civil Engineering, Geology, Environmental Science, Mining, Architecture and Technical Software. My course "Fracture Mechanics of Rock for Geologists" has been taught to worldwide audiences since Fall 2023
- Member:
  - International Gas Union's Underground Gas Storage Committee
  - Fellow of the Geological Society of America
  - Licensed Professional Geologist in the State of Texas (P.G.)
- Certificates from:
  - UC Berkeley (ESG: Navigating the Board's Role)
  - Rice (Strategic Project Management)
  - UT Austin (Human Dimensions of Organizations—with concentration in Organizational Improvement)
- Board of Directors, American Rock Mechanics Association (ARMA); Founding Chair, Technical Committee on Underground Storage and Utilization, and Distinguished Service Award Committee

Education

Postdoctoral Research Fellow, U.S. National Academy of Sciences/National Research Council, at NASA Goddard Space Flight Center, Greenbelt, Maryland, 1988–1990;
Dr. Hebert V. Frey, Mentor

Purdue University, West Lafayette, Indiana; Ph.D., Geology, December 1987;
concentration and dissertation in Quantitative Structural Geology, Geomechanics, and Fault and Fracture Mechanics
Dr. Atilla Aydin, Dissertation advisor

Arizona State University, Tempe, Arizona; M.S., Geology, May 1982; concentration and thesis in Planetary Structural Geology (Mars)
Dr. Michael Malin, Thesis advisor

Rutgers University, New Brunswick, New Jersey; B.A., Geology, May 1979; concentration and thesis in Meteoritics (Petersburg howardite)
Dr. Roger Hewins, Senior thesis advisor

Professional Experience

University of North Dakota

Continental Resources Distinguished Professor (2024–present)
Chair, Department of Energy and Petroleum Engineering (2024–2025)

- Re-envisioned and reinvigorated the Department
- Expanded its focus into the global energy transition domain.
- Hired one tenure-track assistant professor and two teaching professors

Orion Geomechanics LLC

Geomechanicist and Owner

- Personal consulting business in underground gas storage integrity, petroleum geomechanics, structural geology, and rock mechanics providing expertise to various companies and industries. Located in Cypress (NW Houston), Texas (1990–present).
- Client companies have included international operating and service companies in oil-and-gas E&P, underground gas storage (natural gas and hydrogen), and precious-metals exploration.
- Instructor at The University of Texas at Austin with the TopCorp multi-university partnership (http://www.topenergytraining.com/topcorp) for state oil-and-gas regulators and well inspectors on subsurface integrity in underground gas storage and sequestration.
- Increased total academic support raised to about $5.5 million and combined total including industrial sources to about $14.5 million, individually or in collaboration with colleagues.
- In addition to my technical, project-management, and litigation consulting activities, I continue to be engaged in research including formal publications and participation at

academic or industry meetings and panels. Total research output as author and/or coauthor has increased to 120 papers in peer-reviewed journals and conference proceedings, 1 book, 6 edited volumes, 19 chapters in books and edited volumes, 269 abstracts and presentations, and 105 additional invited seminars or presentations to academia, trade groups, and industry. My work continues to be cited and favorably mentioned in the scientific and engineering literatures.

Consulting Expert (2016–present).

- Retained by national law firm as a consulting expert on cases involving subsurface integrity. I can opine on geology, geomechanics, and subsurface integrity related to oil-and-gas fields and underground natural gas storage. My practice has been listed on nationwide expert-witness directories including ExpertPages, SEAK, LegalDirectories, and ORC Experts (now Engine Group).

The University of Texas at Austin

Senior Research Scientist, Center for Petroleum and Geosystems Engineering[1] (2015–2017)

- Engaged in collaborative research and graduate education in petroleum-system geomechanics.
- Deepened the industry-funded research programs in UT's industry-sponsored Fracture Research and Application Consortium (FRAC) to emphasize reservoir geomechanics and engineering.
- Involved in research for the Texas Center for Integrated Seismicity Research (CISR) in wastewater injection geomechanics and induced seismicity.
- Instituted a focus on Subsurface Integrity in oil-and-gas fields and underground natural gas storage facilities.
- Instructor with the TopCorp multi-university partnership (http://www.topenergytraining.com/topcorp) for regulators and policymakers on subsurface integrity and geomechanics.
- Worked as a Member of the Natural Gas and Liquids Storage Work Group, sponsored by the Interstate Oil & Gas Compact Commission (IOGCC) and the Ground Water Protection Council through their joint States First initiative (now State Oil & Gas Regulatory Exchange), to produce a reference document to comprehensively review and evaluate the regulatory and technical environment for interstate and intrastate underground natural gas storage facilities as part of the US national energy infrastructure (published in May 2017).
- Mentored and/or served on advisory/examination committees for 2 postdoctoral scholars and 8 engineering Ph.D. and M.S. graduate students. PGE student-related research included geomechanics of wastewater disposal in faulted sedimentary basins, propagation and interaction of hydraulic fractures with natural fractures in unconventional reservoirs, vertical height containment of hydraulic fractures in stratified reservoir intervals, and laboratory simulations of perforation spacing along horizontal wellbores.
- Increased total research output as author and/or coauthor to approximately 108 papers in peer-reviewed journals and conference proceedings, 4 books and edited volumes, 15 chapters in books and edited volumes, 255 abstracts and presentations, and 80 invited seminars to academia and industry (cumulative output through August 2017).

[1] Now Center for Subsurface Energy and the Environment

- Increased total academic support raised to about $5.5 million and combined total including industrial sources to about $13.3 million individually or in collaboration with colleagues.
- Supervisor: Dr. Jon Olson, Chairman and Professor, Hildebrand Department of Petroleum and Geosystems Engineering (PGE; the Department's undergraduate and graduate degree programs have been ranked as among the top 5 in the nation by U.S. News & World Report; the Center was the research arm of the Department).

ConocoPhillips Company

Principal Geomechanicist (2011–2015), Houston, Texas

- Provided geomechanics expertise to projects involving geosciences, reservoir engineering, and drilling and wells across the company's exploration and production activities in onshore and offshore assets.
- Jointly framed and co-led the conceptualization, development, implementation, and global deployment of subsurface containment assurance methods, tools, and training programs; the team was credited with saving an estimated $100 million (2015 dollars) in wastewater pipeline costs in Indonesia alone.
- Recognized Subject Matter Expert in reservoir/overburden geomechanics, geodetic reservoir monitoring, knowledge sharing and capture, and subsurface containment assurance/subsurface integrity.
- Global technical project planning and/or management including onshore deformation monitoring program (Indonesia), subsurface containment assurance, and integration of geomechanics infrastructure for deepwater assets totaled approximately $7,762,500 as lead or co-lead.
- Technical project experience in fractured crystalline and chalk reservoirs, heavy oil (SAGD), and deepwater assets including Alaska, Canada, US (Lower 48), Gulf of Mexico, Norway/North Sea, Russia, Libya, Indonesia, and Malaysia.
- Monitored and engaged multiple university research-and-development groups and consortia for reservoir characterization.
- Designed and implemented global company-wide SharePoint and OneWiki knowledge sharing platforms across geosciences, reservoir engineering, operations, drilling and completions engineering individually or with colleagues.
- Recipient of multiple awards including Special Recognition Award for Subsurface Containment Analysis of Yuzhno Khilchuyu (YK) field, Russia (2012); SPIRIT Award for Innovation, with Indonesia Water Management Team (2015), for significant contributions to subsurface hydrocarbon containment integrity (this was the highest award in ConocoPhillips for teams that added value through sustained, large-scale integrated effort); and Certificate of Appreciation for development and deployment of company-wide knowledge sharing programs (2015).
- Co-inventor of 2 intellectual property patent applications.
- Mentor or co-mentor of 3 Ph.D. graduate summer interns on overburden characterization, fault stability in overburden sequences, and geodetic monitoring of fields located in North Sea and Indonesia.
- Authored or co-authored approximately 50 significant internal technical reports and presentations to technical workshops and senior management.

- Supervisor: Dr. Peter Hennings[2], Manager, Structure and Geomechanics Group. Company mentor: Randy Nesvold, Global Chief Reservoir Engineer.

University of Nevada, Reno

Year	*Position*
2011–present	Emeritus
2010–2011	Foundation Professor Faculty Senator, College of Science Director of Graduate Programs (Department)
2000–2010	Professor of Geological Engineering and Geomechanics
1995–2000	Associate Professor of Geological Engineering (tenured 1995)
1990–1995	Assistant Professor of Geological Engineering

- Published as author or co-author 91 papers in peer-reviewed journals and conference proceedings, 4 books and edited volumes, 13 chapters in books and edited volumes, and 218 abstracts and presentations with 65 additional invited seminars to academia and industry (cumulative output through June 2011).
- Created 16 courses in geological engineering, rock mechanics, geomechanics, geology, structural geology, and planetary science; raised approximately $5 million in external research support individually or in collaboration with colleagues.
- Supervised and chaired advisory/examination committees for 5 Ph.D. students, 13 M.S. students, and 2 postdoctoral scholars (now working as university faculty) to solve problems in structural geology and geomechanics over a range of topics including growth and scaling of fractures, faults, and deformation bands; rock slope stability; deformation of layered sedimentary sequences; and planetary tectonics.
- Recognized as accomplished professor and researcher at University of Nevada for research on geological engineering, structural geology, geomechanics, and planetary geosciences.

[2] Now with Bureau of Economic Geology, The University of Texas at Austin

Visiting and Research Professor

Year	*Institution*
2023	Universität Wien, Vienna, Austria
2011	Université Montpellier II, Montpellier, France
2003, 2007	Université de Paris-Sud[3], Orsay, France
1998–1999	Université Pierre et Marie Curie[4], Paris, France
	MIT/Woods Hole Oceanographic Institution

- Taught short-course for graduate students on "Fracture Mechanics for Geologists" at the University of Vienna, Austria, as a Visiting Professor of Fracture Mechanics (Guest Professor; Bernhard Grasemann, sponsor).
- Authored or coauthored publications on mechanics of soft-rock deformation and rock fracture mechanics (with Jian Lin, Daniel Mége, Antonio Benedicto, Roger Soliva, Haakon Fossen).
- Co-taught graduate class in geologic fracture mechanics and research on faulted layered carbonate rocks (Université de Paris-Sud, OrsayTerre Tectonics Laboratory, France, with Antonio Benedicto).

University of Maryland

Research Fellow (1990)

- Quantitative studies of faulting and deformation on Earth and Mars, in collaboration with NASA Goddard's Geophysics and Geodynamics Branches (with Dr. Herbert Frey and colleagues).

NASA Goddard Space Flight Center

Postdoctoral Research Fellow, National Academy of Sciences/National Research Council, at Geodynamics Branch (1988–1990)

- Fault mechanics applied to Earth and planetary tectonic problems, resulting in multiple peer-reviewed publications as author or coauthor.
- Supervisor and mentor: Dr. Herbert Frey.

Purdue University

Instructor (1987)

- Taught graduate class on Mechanics of Joints and Faults and mentored students in structural geology, engineering geology, and geomechanics.

[3] Now Université Paris-Saclay
[4] Now Sorbonne Université Campus Pierre et Marie Curie

Freeport Exploration Company

Precious Metals Geologist, Tucson, Arizona and Denver, Colorado.

- Geochemical exploration for epithermal and bulk-tonnage gold and silver deposits, Arizona (1981), Colorado and New Mexico (1982).
- Supervisor: Mike Ward.

Lunar and Planetary Institute

Planetary Structural Geologist (1979–1980), Houston, Texas

- Mapping and structural development of multi-ring impact basins on Mars; results published as coauthor in peer-reviewed paper in 1982.
- Supervisor and Mentor: Dr. Peter Schultz (Brown University).

Undergraduate Summer Intern at NASA Johnson Space Center (1979), Houston, Texas

- Analyzed hypervelocity micrometeoroid impacts on Apollo/Skylab spacecraft windows with assessment of orbital debris hazards; results published as coauthor in peer-reviewed paper in 1980.
- Supervisors: Uel Clanton and Herbert Zook (JSC)

Boards of Directors

Organization	
American Rock Mechanics Association[5] (ARMA)	June 2021–June 2027 • Member, Bylaws Committee, Membership Committee, Finance Committee. • Chair, Communications Task Force.
Storagen, Inc.	Advisory Board, underground hydrogen storage start-up; 2026–present

Advisory Committees and Funding Agency Panels

Year or Agency	
2022–2025	International Energy Agency (IEA), Hydrogen Technology Collaboration Programme (Hydrogen TCP), Task 42: Underground Hydrogen Storage Workplan. • Task Coordination Team (TCT)

[5] ARMA is a 501(c)(6) nonprofit educational and charitable organization that promotes geomechanics in civil, environmental, geotechnical, petroleum, geothermal, and subsurface product storage and utilization to address strategic national needs including energy and infrastructure.

	• Co-Lead, Subtask F: "Planning, Regulation, Safety & Society" (2023 Technology Monitor Report, Chapter 8) • Participant, Subtask B: "Storage Integrity" • Contributor, Chapters 1 and 9 with Serge van Gessel, Hadi Hajibeygi.
2018–present	International Gas Union (IGU), Gas Storage Working Committee (WOC2; invited US delegate), Korean Triennium, Chinese Triennium, Italian Triennium.
2016–2025	Appointed to the Interstate Oil & Gas Compact Commission (IOGCC) and its Standing Committees on Energy Resources, Research, and Technology; and Environment & Safety; by David J. Porter, Chairman of the Texas Railroad Commission.
2015	Weatherford International Customer Advisory Board
NASA	Review Panel, Planetary Geology and Geophysics Program (1997–2000, 2010). Planetary Cartography and Geologic Mapping Working Group (PCGMWG) (1998–2000). Review Panel, Mars Data Analysis Program (1998–2000; 2009–2010). Mars '98 Surveyor Lander Instrument Science Review Panel, Washington, D.C. (1995). Working Group on Kinematics and Mechanics of Structural Landforms on Mars (1988–1989).
NSF	Invited participant, NeSS02, NSF-convened workshop on "Neutrinos and Subterranean Science," Washington, D.C., which set policy directions for U.S. underground laboratories for high-energy physics, geobiology, and geoscience (2002). Panel for CAREER Awards (national recognition of outstanding young scholars), Directorate for Engineering, Division of Civil and Mechanical Systems, Geomechanical, Geotechnical, and Geo-Environmental Systems Program (G3S), in Washington, D.C. (1997).

Certifications and Continuing Professional Development

Certifications

Registered and licensed as a Professional Geologist (P.G.), Texas Board of Professional Geoscientists, State of Texas, #11755 (since 2014).

Certificate, "Human Dimensions of Organizations—with concentration in Organizational Improvement," The University of Texas at Austin (March 2017). 'The Organizational Improvement Certificate Program from Human Dimensions of Organizations at UT Austin[6] prepared participants to build and lead better-functioning organizations. Participants were

[6] Description from https://hdo.utexas.edu/certificate-programs/, their option 2.

given the tools to (1) influence decision-making and productively manage change; (2) be more capable and ethical leaders during times of adversity and/or transition; (3) communicate effectively, especially in relation to project management; and (4) reduce instances of and minimize the impact of human error.'

Certificate, "Strategic Project Management," Rice University (May 2019). 'The need for strategic project management experience in business was shown in the widening talent gap between the requirements of employers and availability to fill roles[7]. Traditionally, project management focused on the application of tactics, but modern business required a defined strategy to make these tactics effective. Strategic project management has stepped in to this gap, transforming the value of project managers. This online short course moved beyond the basics of traditional project management: learners acquired knowledge of how to apply strategic thinking by aligning project, program, or portfolio goals with an organization's strategic goals.'

Certificate, "ESG: Navigating the Board's Role," University of California Berkeley School of Law Executive Education (July 2021). The course was 'geared towards current and aspiring directors who are building their foundational knowledge of the role of corporate boards in ESG oversight.'

Continuing Professional Development

Year	
2026	
2025	"Unlocking the Potential: Underground Hydrogen Storage and Global Momentum." Webinar sponsored by SPE Hydrogen Technical Section, October 9, 2025. Vector Solutions Online Training: • Multiple training courses including "Conflicts of Interest" • "Sexual Harassment: Policy and Prevention" • "The Aftermath of Trauma" • "Preventing Harassment & Discrimination: Supervisors + Clery Act and Title IX" UND Courses: • "Best Practices in Blackboard (Ultra) Course Design"
2024	"Fueling the Future: Petroleum Engineering Industry/ Education in a New Era." Workshop sponsored by SPE/PEDHA, August 8–9, 2024. University of Houston, Texas. (1.5 PDH) "Implementing UHS in depleted gas reservoirs (Hychico's Underground Hydrogen Storage project)." Webinar sponsored by International Energy Agency, March 21, 2024.

[7] Description of course materials and expectations from https://glasscockcatalog.rice.edu/search/publicCourseSearchDetails.do?method=load&courseId=29181.

	"Exploring International Hydrogen Drivers and Developments." Webinar sponsored by Environmental Analyst, March 14, 2024.
2023	"Technical Challenges of CO_2 Regulatory Approval Procedures." Webinar sponsored by SPE/IOGCC, October 4, 2023. "Navigating the Hydrogen Horizon: Regulatory Update." Webinar series sponsored by Greenberg Traurig, LLP, September 26, 2023. "Underground Hydrogen Storage: Enabling a Hydrogen Economy at Scale." Webinar sponsored by InterPore, Karin de Borst (Shell), May 9, 2023. "An Overview of Underground Hydrogen Storage." Webinar sponsored by SPE, Shadi Salahshoor (GTI Energy), February 13, 2023. "Chatting About Risk. With a Computer." Webinar on using OpenAI's ChatGPT with risk analysis, Jack Whitsitt, Society of Information Risk Analysts, January 27, 2023.
2022	"Development and Deployment of Low-Carbon-Intensity Hydrogen at Scale," Webinar series sponsored by SPE/IOGCC, December 15, 2022. "DEI Workshop." ARMA, December 5, 2022. "TBPG Ethics." AEG Texas section webinar, July 17, 2022. "SPE Workshop: Well Integrity in a Changing World (preview)." Webinar series sponsored by SPE, April 28, 2022. "Live from 2022 World Hydrogen North America Congress: A Conversation with Conference Participants." Webinar series sponsored by Greenberg Traurig, LLP, April 5, 2022. US Department of Energy virtual workshop on "Bulk Storage of Gaseous Hydrogen." Washington, DC, February 10–11, 2022.
2021	"CCS – CO_2 Storage Management and Key Technical Challenges Regulators Face – Monitoring, Modeling, Sampling & Containment." Webinar series sponsored by SPE/IOGCC, December 7, 2021. "Geomechanical Challenges Associated with Massive Storage of CO_2." Mark Zoback, Webinar series sponsored by SPE, December 3, 2021. "Oil & Gas Majors in Hydrogen," Reuters, September 22, 2021. "Enabling your Transition – Can you Decarbonize with Hydrogen?" Wood webinar, September 2, 2021. "Future of Energy in Focus: The Path Towards a Net-Zero Carbon Circular Economy." Webcast series sponsored by S&P Global Platts, Energy Transition Webinar, September 1, 2021. "Seven Sins of the Classic Wellbore Stability Models." Hamed Soroush, PetroLern, October 26, 2021.

	"Hydrogen Infrastructure and Storage Projects." DEEP.KBB and REBEL, Webinar series sponsored by Greenberg Traurig, LLP, June 10, 2021. "Hydrogen Infrastructure Challenges and Case Studies: Bumpy Road or Expressway to a Clean Fuel Future?" Webinar series sponsored by Greenberg Traurig, LLP, DEEP.KBB and Rebel Group, March 11, 2021. "Geomechanical Assessment of Caprock Integrity for Carbon Capture, Utilization and Storage Operations (CCUS)." SPE, March 20, 2021. "Post-Election Impact on U.S. and Mexico Energy and Environmental Matters." Webinar series sponsored by Greenberg Traurig, LLP, January 26, 2021. "Environmental, Social, and Governance (ESG) Webinar for Regulators." Interstate Oil and Gas Compact Commission, June 29, 2021. "2021 Proxy Season: Trends and Insights." Webinar series sponsored by NACD, June 17, 2021.
2020	"The Coming Hydrogen Revolution in Europe: Opportunities and Challenges." Webinar series sponsored by Greenberg Traurig, LLP, DEEP.KBB and REBEL, November 12, 2020. "Green Shoots: A Growing Hydrogen Economy." Webcast series sponsored by S&P Global Platts, March 18, 2020.
2019	SPE Gulf Coast Section *Geomechanics Congress on Recent Advancements in Petroleum Geomechanics*, Houston, Texas, May 17, 2019.
2018	Technical classes sponsored by SPE: • "Storage: The New Frontier of Integrity – What's in it for Oil and Gas?" SPE technical class led by Nicolas Bonnier, October 2018. • "When Rocks Stop Leaks: Geological Barriers in Well Integrity." SPE technical class led by Matteo Loizzo, January 2018.
2017	"How to Be an Effective Expert Witness." Workshop led by James J. Mangraviti, Jr. Esq., SEAK, Inc., Naples, Florida, December 2017. "Embracing Uncertainty: Probability in Risk Management." Workshop led by Douglas Hubbard and Sam Savage, hosted by Chevron, Houston, November 2017. "Well Integrity Management for Salt Caverns." Technical class taken at Solution Mining Research Institute, Albuquerque, New Mexico, April 2017.
2011–2015	Various technical classes in structural and seismic interpretation, petrophysics, pore pressure prediction, logging methods, ConocoPhillips.

Awards, Honors, and Evidence of National and International Recognition

Year or Agency	
2024	Continental Resources Distinguished Professorship (Endowed), University of North Dakota.
2023	Presidential Citation in recognition of the American Rock Mechanics Association (ARMA)'s Monthly News Crew, shared with Wencheng Jin, Wenzhuo Cao, Jerjes Porlles, Hui Wu, and Teeratorn Kadeethum.
2021	Elected to the Board of Directors, American Rock Mechanics Association (ARMA) for a 6-year term.
2018	Presidential Citation for dedicated service in managing the technical program for the 52nd US Rock Mechanics/Geomechanics Symposium, American Rock Mechanics Association (ARMA).
2016	Fellow, Geological Society of America (2016). Recipient of the 2016 Completions Optimization and Technology Region Award, Society of Petroleum Engineers (SPE) Gulf Coast North America Region. Member, Interstate Oil and Gas Compact Commission (IOGCC).
2015	SPIRIT Award for Innovation, with Indonesia Water Management Team, for significant contributions to subsurface hydrocarbon containment integrity, ConocoPhillips.
2010	Selected as Foundation Professor, one of the highest honors given to faculty at the University of Nevada to recognize outstanding and sustained excellence in teaching, research, and service.
2009	Co-Recipient of Outstanding Researcher of the Year Award, Mackay School of Earth Sciences and Engineering, UNR.
1992	Recipient of the Editor's Citation for Excellence in Refereeing, *Journal of Geophysical Research.*
1988–1990	U.S. National Academy of Sciences/National Research Council, Postdoctoral Fellow; selected following a nationwide competition.
1983–1985	David Ross Fellow, Purdue University; selected following a university-wide competition.
NASA	Principal Investigator, NASA Mars Geologic Mapping Program (1988–1992). Principal Investigator, NASA Planetary Geology and Geophysics Program (1994–2011).

	Principal Investigator, NASA Mars Data Analysis Program (1999–2011). Co-Principal Investigator, NASA Planetary Geology and Geophysics Program, Department of Energy, and NSF projects (1987–2011).
MIT/Woods Hole; France	Granted one-year sabbatical leave from UNR to work on fault mechanics at Woods Hole Oceanographic Institution and at the Université Pierre et Marie Curie (Paris VI); awarded three-month Fellowship through CNRS, France (1998–1999).
Austria	University Professor of Fracture Mechanics at the Institut für Geologie, Arbeitsgruppe Geodynamik (Structural Processes Group), Universität Wien, Vienna, Austria, May 2023. Taught short-course for graduate students on "Fracture Mechanics for Geologists." Supported by a two-month visiting faculty appointment through the Universität Wien.
France	Visiting (Invited) Professor at the Université Montpellier II, France (2011). Visiting (Invited) Professor at OrsayTerre (Tectonics Laboratory), Université de Paris-Sud[3], Orsay, France, in March and June–July 2007, to teach a compulsory graduate class in rock fracture and to work on faulting in layered carbonate rocks from the French Alps and from Italy. Supported by a one-month Fellowship from France. Visiting (Invited) Professor at OrsayTerre (Tectonics Laboratory), Université de Paris-Sud[3], Orsay, France, in June–July 2003, to work on fault segmentation and growth in carbonate rocks in the Spanish Pyrenees. Supported by a one-month research fellowship from CNRS France.
1992	Recipient of the Editor's Citation for Excellence in Refereeing, *Journal of Geophysical Research*.
Various	Invited lecturer and participant, Computational Geodynamics Modeling (12.521), upper division graduate course taught at MIT by Prof. Maria Zuber and Dr. Jian Lin. Material included high-level treatments of finite element, finite difference, and boundary element methods and their application to representative problems in geodynamics (1998). Invited member of the Ph.D. juries (evaluation committees) for: • Zhaoliang Hou, dissertation entitled "Fault zone microstructures and the associated fluid-rock interactions in highly porous rocks," Universität Wien, Vienna, Austria (June 2023) • Anita Torabi, dissertation entitled "Deformation bands in porous sandstones: Their microstructure and petrophysical properties," University of Bergen, Norway (December 2007) • Roger Soliva, dissertation entitled "Normal fault growth in layered rocks: The role of vertical restriction and linkage on scaling laws and fault spatial distribution," both at the Université Paris-Sud, Orsay, France (November 2004)

	• Daniel Mége, dissertation entitled "Aspects structuraux du complexe magmato-tectonique de Tharsis sur Mars," (November 1996) Multiply recognized as Most Cited Author by Elsevier, including papers in *Tectonophysics* (2005–2010) and *Journal of Structural Geology* (2006–2011); multiple additional papers were top downloads following their publication. Have been a regular peer reviewer in rock fracture and geomechanics for the *Journal of Energy Storage*, *Journal of Natural Gas Science and Engineering*, *AAPG Bulletin*, various *SPE* journals, *Journal of Geophysical Research*, *Science*, *Nature*, *International Journal of Fracture*, *Pure and Applied Geophysics*, *Tectonics*, *Bulletin of the Association of Engineering Geologists*, *Geophysical Research Letters*, *Reviews of Planetary and Space Sciences*, *Icarus*, *Tectonophysics*, *Journal of Geotechnical Engineering*, *Geological Society of America Bulletin*, *Geology*, and *Journal of Structural Geology*. Have been a regular peer reviewer for research proposals to U.S. Geological Survey, American Chemical Society's Petroleum Research Fund, NSF, DOE, and NASA as well as international funding agencies.

Patents

Some of my work at ConocoPhillips led to patent applications for proprietary intellectual property inventions. Both have been filed with the U.S. Patent Office.

1) Amendt, D.V., P.K. Paul, S. Busetti, and R.A. Schultz (2012). Integrating rock ductility with fracture propagation mechanics for hydraulic fracture design: Intellectual property invention record (IR) patent application, Docket No. IR–41681–USPRO, initiated November 30, 2010, approved by ConocoPhillips for filing for U.S. Patent on November 21, 2011, on file at the U.S. Patent Office, application number 61/828368.
2) Schultz, R.A., K.A. Soofi, and P.H. Hennings (2013). Satellite geodesy and reservoir performance: Intellectual property invention record (IR–42277) patent application, initiated December 18, 2013; approved by ConocoPhillips for filing for U.S. Patent on February 25, 2014; filed for Provisional U.S. Patent number 62/081,945 on November 19, 2014; US Utility Patent Application Serial Number 14/945,933 filed on November 19, 2014; International (PCT) Patent Application Serial Number PCT/US2015/061565 filed November 19, 2015.

Professional and Editorial Service

Professional Societies and Organizations

Agency	
American Rock Mechanics Association (ARMA)	Board of Directors (2021–2027). • Member, Bylaws Committee; Membership Committee; Finance Committee. • Chair, Communications Task Force. Founder and Charter Member (1996). Founding Chair, Distinguished Service Award Selection Committee (2020–2021). Founding Chair, Underground Storage and Utilization Technical Committee, including pioneering the use of social media such as LinkedIn® https://www.linkedin.com/in/usutc-arma-508b1a1b6/ and YouTube https://www.youtube.com/channel/UCLmVda-7Eb0-AFadr4AlKNw/ to host videos and related materials for ARMA (2020–2023). Invited reviewer for abstracts and proceedings papers for technical rock mechanics symposia including the 35th and 43rd U.S. Symposium on Rock Mechanics (1995, 2009) and the 50th and 55th U.S. Rock Mechanics/Geomechanics Symposia (2016, 2021). Worked with ARMA, publishers, and scientific societies to engage high-quality journals as potential outlets for publishing peer-reviewed special journal issues from ARMA topical and interdisciplinary sessions (2015–2016).
Interstate Oil & Gas Compact Commission (IOGCC)	Member of the Natural Gas and Liquids Storage Work Group, sponsored by the IOGCC, States First (now State Oil & Gas Regulatory Exchange), and the Ground Water Protection Council, which was tasked with collecting and synthesizing the technical bases to refine US regulations for safe storage of natural gas in underground media (both porous-rock and engineered). Member, Standing Committees on Energy Resources, Research, and Technology; Environment & Safety.
American Geophysical Union (AGU)	Invited member, Edward A. Flynn III Award Committee (for unselfish cooperation in research) (1996–1998). Member, Physical Properties of Earth Materials focus group (1996–present); Steering Group (1996–1998).

S&P Global Platts	Panelist, "Rulemakings and Regulations," at the *16th Annual Platts Gas Storage Outlook Conference*, Houston, Texas, January 8–9, 2018. Panelist, "Growing Regulatory Oversight Concerning Gas Storage Well Operations," at the *15th Annual Platts Gas Storage Outlook Conference*, Houston, Texas, January 12–13, 2017.
AAPG	Charter Member, AAPG's Petroleum Structure and Geomechanics Division (2013).
International Union of Geological Sciences (IUGS)	Elected Secretary, Commission on Comparative Planetology of the IUGS, a trans-national body charged with disseminating technology and scientific advances to the general public (1996–1999).

Editorial Service

Role	
Editorial Board	*GeoScience Engineering* (2019–present) *Lithosphere* (2011–2013)
Associate Editor	*Journal of Geophysical Research*, rock mechanics (1993–1996)
Co-Editor	*Enabling Secure Subsurface Storage in Future Energy Systems* (with J. Miocic, N. Heinemann, K. Edlmann, J. Alcalde), *Geological Society of London Special Publication*, **528**, https://doi.org/10.1144/SP528. (2022–2023) *Planetary Tectonics* (with T.R. Watters), Cambridge University Press, 556 p., ISBN 9780521765732 (2008–2010) *Proceedings of the 33d Symposium on Engineering Geology and Geotechnical Engineering* (with R. Siddharthan), 267 p. (1998) *Rock Mechanics: Proceedings of the 35th U.S. Symposium* (with J.J.K. Daemen), Balkema, Rotterdam, 956 p. (1995)
Guest Editor	*Rock Mechanics and Rock Engineering* (2019) *Journal of Structural Geology* (2016) *Interpretation* (2016–2017)

Organization of National and International Scientific Forums

Year or Agency	
2024	Invited member of the Technical Committee of the Hydrogen and Energy Storage Conference, 5th EAGE Global Energy Transition

	(GET2024) Conference and Exhibition, November 4–7, 2024, Rotterdam, The Netherlands. Scientific Advisory Board, Slope Tectonics Conference, Brno-Křtiny, Czech Republic, September 10–14, 2024.
American Rock Mechanics Association (ARMA)	Organizer and Founding Chair, Underground Storage and Utilization Technical Committee (USUTC) of ARMA, including establishing its technical focus, long-term goals, and webinar series; and pioneering the use of social media such as LinkedIn® and YouTube for the global geomechanics audience. Member of the Organizing Committee: • Workshops: ○ "Underground Hydrogen Storage," held at the *57th US Rock Mechanics/Geomechanics Symposium*, Atlanta, Georgia, June 29, 2023. ○ "Emerging Opportunities in Geologic Hydrogen Storage and Carbon Sequestration," held at the *56th US Rock Mechanics/Geomechanics Symposium*, Santa Fe, New Mexico, June 30, 2022. • Annual Symposia: ○ *57th US Rock Mechanics/Geomechanics Symposium*, Atlanta, Georgia, June 2023. ○ *3rd International Geomechanics Symposium* with the theme "The Role of Geomechanics in Energy Efficiency and Energy Sustainability," Abu Dhabi, United Arab Emirates (UAE), November 7–9, 2022. ○ Technical Program Chair and member of the Organizing Committee, *52nd US Rock Mechanics/Geomechanics Symposium*, Seattle, Washington, June 17–22, 2018; Symposium Co-Chairs: Bill Dershowitz and Conrad Felice. ○ Co-Chair of the Symposium and Co-Editor of the reviewed *Proceedings* volume, *35th U.S. Symposium on Rock Mechanics*, Lake Tahoe, June 1995 (with J. Daemen, UNR Mining Engineering). Responsible with Jaak Daemen for the scientific program, meeting planning and execution, and *Proceedings* publication for the premier rock mechanics meeting in the U.S. The symposium turned a profit while keeping participant costs reasonable. • Sessions: ○ Session Co-Organizer, "Underground Storage and Utilization of Gases, Liquids, and Solids" with Osman Hamid, Johannes Miocic, and Niklas Heinemann, for ARMA's *55th Rock Mechanics/Geomechanics Symposium*, Houston, June 2021. ○ Co-Chair (with U. Mutlu, Co-Chair, Rockfield Global Technologies America, LLC) of the interdisciplinary session

	on "Subsurface Integrity" at the *50th US Rock Mechanics/Geomechanics Symposium*, Houston, Texas, June 26–29, 2016.
European Geosciences Union (EGU)	"Secure Subsurface Storage for Future Energy Systems" with Johannes Miocic, Benjamin Emmel, Anja Sundal, and Qi Li, for European Geosciences Union virtual annual meeting vEGU, Vienna, May 2021.
American Geophysical Union (AGU)	"Subsurface Storage of Natural Gas, CO_2, and Hydrogen: Key Learnings and Future Opportunities," B. Schwartz, R. Goteti, T.A. Dewers, and F. Molaei, and R.A. Schultz, 2021.
Geological Society of America (GSA)	*Session Organizer and Co-Chair,* "Structure and Tectonics of Planets and Satellites" at the GSA Annual Meeting, Reno, November 13, 2000. The invited papers from the session were published in a peer-reviewed book by Cambridge University Press, *Planetary Tectonics*, edited by T.R. Watters and R.A. Schultz. Joint meeting of the Cordilleran and Rocky Mountain Sections, Reno, May 1993. Local Organizing Committee; I was responsible for meeting logistics, revenue generating exhibits, and security, and was the meeting's full-time on-site contact person and logistics team leader. The meeting turned a profit from the exhibits.
NASA	*NASA/USGS Mars/Venus Geologic Mappers' Meeting*, Reno (June 1996). I was invited to organize and host this annual international gathering of planetary science professionals. Responsible for all logistics, budgeting, planning, and execution of the meeting and the associated all-day field trip to examine recent surface breaks along Basin and Range normal faults in western Nevada. Resulted in new mapping protocols that were adopted by NASA and USGS and continue to be used in planetary mapping.
ConocoPhillips	*Technical Program Committee*, Global Geomechanics Workshop, ConocoPhillips, November 2012.
University of Nevada, Reno (UNR)	*1999 Canyonlands Initiative*, the completion of a shallow seismic study of grabens in Canyonlands National Park. Involved participants from UNR, California, and Texas with related peer-reviewed publications. *1997 Canyonlands Initiative*, a focused study of grabens in Canyonlands National Park. Involved participants from UNR, Pomona College, University of Massachusetts Amherst, and the Texas Bureau of Economic Geology. *1996 Canyonlands Initiative*, a four-institution scientific investigation of the grabens of Canyonlands National Park, Utah (August 1996). I initiated and organized this project with UNR as the lead

	organization, along with Pomona College, California State University Fresno, and University of Massachusetts Amherst; grabens were investigated using methods from structural geology, salt tectonics, geological engineering, and geophysics. *33rd Symposium on Engineering Geology and Geotechnical Engineering*, held in Reno, March 1998. Conference co-organizer and co-editor of *Proceedings* volume. Conference brought together academicians, students, and industry professionals nationally and especially from throughout the Great Basin and Pacific Northwest.
Various	*Session Co-Organizer and Co-Chair*, "Faulting and Fault Related Processes on Planetary Surfaces" (D. Ferrill, R.A. Schultz, and R.T. Pappalardo), at the *Fall Meeting*, *American Geophysical Union*, December 10–11, 2003. Technical papers were published as a special issue in *Journal of Structural Geology* in 2006. *Session Co-Chair*, "Mars Tectonism and Volcanism," *35th Lunar and Planetary Science Conference*, Houston, March 15, 2004. *Technical Committee*, 2nd NASA/ARO/ASCE* Workshop on Granular Materials in Lunar and Martian Exploration held as part of the 10th ASCE Aerospace Division International Conference on Engineering, Construction and Operations in Challenging Environments (Earth & Space 2006), Houston, March 5–8, 2006 (*U.S. Army Research Office, American Society for Civil Engineering). *Session Co-Chair,* Property Measurements, Computational: at 10th ASCE Aerospace Division International Conference on Engineering, Construction and Operations in Challenging Environments (Earth & Space 2006), Houston, March 2006. Organizer and convener of technical sessions at meetings including Geological Society of America, American Geophysical Union, European Geosciences Union, Lunar and Planetary Science Conference, and American Rock Mechanics Association (ARMA)'s annual U.S. Rock Mechanics/Geomechanics Symposia.

Membership in Professional Societies

- Petroleum Engineering Department Heads Association (part of SPE; 2024–2025).
- American Rock Mechanics Association (Founder and Charter Member, 1996–present).
- National Association of Corporate Directors (2021–2023).
- Society of Petroleum Engineers (Member, 2013–present).
- Interstate Oil and Gas Compact Commission (2016–2025).
- BoardSource (2021–2024)
- American Geophysical Union (1981–present);
    - Physical Properties of Earth Materials (PPEM: Steering Group, 1996–1998).
- Geological Society of America (Member, 1991–2020; Fellow, 2016).
- American Association of Petroleum Geologists (Member, 2013–2020);
    - Petroleum Structure and Geomechanics Division (Charter Member, 2013).
- European Geosciences Union (Member, 2010–2011, 2020–2023, 2026).
- Association of Engineering Geologists (Member, starting in 1991; currently inactive).
- Union of Concerned Scientists (Member, 2014; currently inactive).

Research Summary

I have engaged in fundamental and applied scientific research with corporate scientists and engineers, international colleagues, and others into areas that can add value in the oil-and-gas, precious minerals, underground storage, and mining sectors, with publications and presentations (invited and contributed) as appropriate. Some of my work is described in this section.

Corporate

Orion Geomechanics LLC

My technical and project-management consulting work has engaged a variety of companies and organizations to add value to their operations. This work has focused on applying academic (fault mechanics, rock-mass deformation, deformation and compaction bands) and industry-related subject-matter expertise to hydrocarbon and precious-metals resource characterization and extraction. More recently my focus has been on underground energy storage.

In addition to my technical, project-management, and consulting-expert activities, I continue to be engaged in research on issues of academic interest and importance including formal publications as well as participation at academic meetings and panels as author or co-author. Primary focus has been on storage integrity and assessing probabilistic rates of methane leakage occurrences at underground natural gas storage facilities in the US and worldwide, and evaluation of critical factors such as exposure in risk identification and mitigation programs.

Current research involves geologic hazard identification and mitigation strategies that can improve the safety, sustainability, and resilience of underground gas storage facilities, particularly hydrogen. This involves the midstream Storage and Transport energy sector (i.e., pipelines and storage) within the broad field of subsurface integrity, with potential implications for the operation of underground natural gas, fuel, and waste storage and sequestration facilities (such as CO_2) in

the US and worldwide. I collaborate with scientists from the US and abroad including applied scientists from a variety of companies, universities, and organizations. My technical background allows me to engage in technical discussions regarding underground storage safety and strategies for shifting to low-carbon energy choices. Some of my work has included:

- Underground hydrogen storage, including caprock integrity and screening criteria for new or repurposed facilities.
- Underground natural gas storage, including subsurface asset integrity, statistical baselining of occurrences with or without product loss, regulatory compliance assessment, asset integrity product development, hydrogen storage, and reservoir geomechanics.
- Statistical assessment using Bayesian methods to quantify historical occurrences at underground natural gas storage facilities.
- Thermal shock and its relationship to wellbore integrity and hazard mitigation.
- Growth, petrophysics, and scaling of deformation and compaction bands in eolian reservoir analogs from both extensional and contractional tectonic environments.
- Structural geology and geomechanics of hydrocarbon and precious metals exploration and development, mostly in the US Basin and Range, including strike-slip fault-related controls on ore deposits; deformation at relay-ramps along graben systems; connectivity between structural basins along extensional fault systems; and strength and deformability of the rock mass in basalts and open-pit gold mines.

Clients have included:

- *Southern California Gas Company* (Los Angeles, California): Geomechanical considerations in underground gas storage.
- *STORENGY SAS* (Paris, France and Houston, Texas): Business development for underground natural gas storage (pro bono and compensated).
- *Geostock SAS* (Paris, France): Geomechanics of underground natural gas storage facilities.
- *Wild Well Control* (Houston, Texas): Thermal shock and wellbore integrity.
- *WSP* (Houston, Texas): Reservoir geomechanics of natural gas storage facility (pro bono).
- *Geostock Sandia*, *LLC* (Houston, Texas): Geomechanics product development for the underground natural gas storage industry.
- *Weatherford International Customer Advisory Board* (Houston, Texas): Geomechanics product development in oilfield services.
- *Shell International Exploration and Production Company* (Houston, Texas): Deformation and compaction bands in eolian reservoir analogs.
- *Chevron Petroleum Technology Company* (San Ramon, California): Deformation at relay-ramps along graben systems; connectivity between structural basins along extensional fault systems.
- *Newmont Gold Company* (Carlin, Nevada): Strength and deformability of fractured carbonate rock masses in open-pit gold mines.
- *Noranda Exploration*, *Inc*. (Reno, Nevada): Strike-slip fault-related controls on ore deposits.
- *Kennecott Exploration Company* (Reno, Nevada): Strike-slip fault-related controls on ore deposits.

Technical work in the underground natural gas and hydrogen storage industries has led to presentations, panels, and publications as author or coauthor in venues including *Geological Society of London Special Publications*, *Journal of Natural Gas Science and Engineering*, *Risk Analysis*, the *15th* and *16th Annual Platts Gas Storage Outlook Conferences*, *Oil and Gas Journal*, *Solution Mining Research Institute*, and *American Rock Mechanics Association*'s *Rock Mechanics/Geomechanics Symposia*.

Technical work in the upstream oil-and-gas industry and in the precious-metals industry has led to presentations and publications as author or coauthor in venues such as *Geological Society of America Bulletin*, *Journal of Structural Geology*, *American Association of Petroleum Geologists Bulletin*, and *Journal of Geophysical Research* as well as proprietary reports to corporate clients.

ConocoPhillips

- Reservoir and overburden characterization and geomechanics, including heavy oil, fractured and stress-sensitive reservoirs, deepwater systems.
- Designing technical workflows and analytical tools for subsurface containment assurance (jointly with colleagues from geology and geomechanics, reservoir engineering, and completions).
- Subsurface integrity and critically stressed faults in actively deforming convergent plate margins, including InSAR and geodetic monitoring of subsurface faulting in southern Sumatra, Indonesia.
- Overburden deformation, heave, and subsidence in heavy-oil fields for reservoir monitoring and safe operation.
- Mechanics of porous-rock deformation and the formation and evolution of deformation band arrays in porous sandstone reservoir analogs.

While at ConocoPhillips I prepared and delivered approximately 50 internal reports, major presentations, and knowledge-sharing documents (3 invited) and generated 6 external presentations and publications (3 invited) as author or coauthor.

Academic

University of North Dakota

My research focus at UND centered on emerging topics in Energy Engineering, specifically underground hydrogen storage. I currently have one Ph.D. student working on the techno-economics of converting wind energy to hydrogen and storage in either salt caverns or depleted reservoirs in the Williston Basin of western North Dakota and am on the advisory committees for several others.

The University of Texas at Austin

From September 2015 through August 2017, I was Senior Research Scientist with the Center for Petroleum and Geosystems Engineering[1] at UT, applying my expertise from academia and industry to several research groups in petroleum-related geomechanics including UT's FRAC industrial affiliates consortium. I also collaborated with scientists and graduate students in the Jackson School of Geosciences' Department of Geological Sciences, the Bureau of Economic

Geology (BEG), the State-wide Center for Integrated Seismicity Research (CISR), and BEG's Structural Diagenesis Initiative as well as scientists from other universities and institutes from around the world.

My primary responsibility centered on providing technical leadership to geomechanics research and education efforts, including securing funding, that spanned traditional disciplinary and organizational boundaries including Petroleum and Geosystems Engineering, Geological Sciences, and the Bureau of Economic Geology. I also mentored graduate students as well as junior faculty within the Department of Petroleum and Geosystems Engineering and BEG.

Collaborative research at UT included applications of geomechanics to wastewater injection and induced seismicity, vertical hydrofracture propagation and completions in layered reservoirs, laboratory studies of subcritical crack propagation, and field and theoretical analysis of deformation and compaction bands in porous reservoir analog rocks. I instituted work on Subsurface Integrity of hydrocarbon fields and underground natural gas storage facilities that addressed critical national needs for risk management, production safety, and social license-to-operate while minimizing costs to the operating company.

Storage of CO_2, natural gas, and related liquids remains a critical national and worldwide need. The US Strategic Petroleum Reserve houses petroleum in salt domes and caverns around the US for use in national emergencies. Carbon dioxide and hydrogen storage are important evolving technologies that can reduce the carbon footprint of several industries and thereby reduce atmospheric greenhouse gas emissions. Natural gas is stored in depleted hydrocarbon fields, salt domes and layers, unused aquifers, and mined hard-rock caverns as part of the US and international energy infrastructure. Effective utilization of these facilities hinges on well integrity; subsurface integrity; monitoring; promoting organizational efficiencies; and engagement between stakeholders including industry, State and Federal regulators, universities, and the public.

I was involved with writing a comprehensive reference document sponsored by States First, the Ground Water Protection Council, and the Interstate Oil and Gas Compact Commission with input from State and Federal regulators, industry associations, and organizations including the US Pipeline and Hazardous Materials Safety Administration (PHMSA), US Environmental Protection Agency, and the Environmental Defense Fund that provides technical and legal context that could potentially be used by operators and regulators of subsurface storage facilities.

University of Nevada

My research while at UNR (1990–2011) was focused on solving problems in (1) fracture, deformation band, and fault mechanics, (2) rock-mass mechanics, and (3) planetary structure and tectonics, using appropriate combinations of field and theoretical techniques over a wide range of scales. Specifically, my students and I were interested in understanding how deformation band networks and fault systems nucleate, grow, accumulate displacement, interact, and influence the dynamics of crustal deformation at the outcrop, reservoir, and regional scales.

Our work utilized approaches developed in traditionally separate specialties, primarily field geology and engineering fracture mechanics, to address interrelated problems in rock and crustal mechanics and tectonics on the Earth and other planetary bodies. Our expertise in analyzing the rock mass mechanics, tectonics, and faulting of the Moon, Mercury, Mars, and Venus permitted the extension and modification of geomechanical concepts, developed for a particular set of *P*-*T*-*x*-gravity conditions (Earth), to a broader range of geologic contexts, such as Mars, in lithospheric structure and planetary evolution.

Most of the work was funded by competitive grants from NASA with additional funding from the U.S. Department of Energy, National Science Foundation, international agencies, and private industry. Research at UNR included:

Fracture, Deformation Band, and Fault Mechanics

- Field and theoretical studies of joint, fault, and deformation band propagation
- Mechanics of deformation bands and their 3-D arrays
- Displacement-length scaling, and displacement accumulation, along faults
- Mechanics and tectonics of compaction bands
- Hydrology of opening-mode fracture networks
- Faulting in porous rocks at high strain rates (Upheaval Dome impact structure, Utah)

Rock-Mass Mechanics

- State of stress and deformation of rock masses
- Effects of band and fault arrays on reservoir-scale properties
- Stability of subglacial volcanic edifices
- Large-scale deformability and strength of basaltic rock masses
- Mechanical development of grabens in jointed rocks

Planetary Structure and Tectonics

- Fault-population statistics, mechanics, paleoseismology, and tectonics of extensional fault systems and planetary rifts (Valles Marineris on Mars)
- Growth of blind thrust faults and related folding in planetary wrinkle ridges
- Tectonics of igneous dike injection and graben growth in the Tharsis region of Mars
- Origin, stability, and development of interior layered deposits in Valles Marineris
- Deformation sequence and critical-taper wedge mechanics in the Thaumasia province, Mars
- Characterization and quantification of contractional strain to bound thermal history models of early Mars
- Analysis of graben sequence and stratigraphic restriction in the Caloris impact basin, Mercury

Funding

Research funding earned during graduate and postdoctoral work was $154,018[8]. Grant support received while a professor at UNR, as project lead or co-lead, was $4,869,295; most of the awards supported M.S. and Ph.D. graduate students as Research Assistants.

As a Senior Research Scientist at The University of Texas at Austin (UT) and funded primarily by UT's FRAC Consortium, I contributed to a variety of new and ongoing projects. Research support received while at UT, individually or with colleagues, totaled $531,262 through August 2017.

A total of approximately $7,762,500 in technical projects were planned and managed, individually or with colleagues, for ConocoPhillips between 2012 and March 2015.

Total research funding received from external/academic sources (Purdue, NRC postdoc, UNR, UT, Orion Geomechanics LLC, UND) is $5,580,589; total funding acquired including ConocoPhillips is $14,566,042.

Summary			
	Academic/External	*Corporate*	*Totals*[8]
University of North Dakota	–	–	–
Orion Geomechanics LLC	$171,906	$1,011,061.46[9]	$1,011,061.46
UT Austin	$531,262	–	$531,262
ConocoPhillips	–	$7,762,500	$7,762,500
University of Nevada, Reno	$4,724,803	$144,492	$4,869,295
NASA Goddard	$84,418	–	$84,418
Purdue (as Ph.D. student)	$68,200	$2,400	$70,600
Totals:	**$5,580,589**	**8,985,453**	**$14,566,042**

University of North Dakota			
Title	*Sponsor*	*Amount*	*Period*

[8] Amounts not adjusted for inflation
[9] Since 2016

Total raised at UND:	$0	

Orion Geomechanics LLC			
Title	*Sponsor*	*Amount*	*Period*
Subsurface Hydrogen Assessment, Storage, and Technology Acceleration (SHASTA): Phase 1.5 Extension	U.S. Department of Energy; Subcontract Number B655896 to LLNL[10]	$65,000[11]	January – June 2025
University Professor of Fracture Mechanics (Guest Professor, May–June 2023): Stylolites at micro, outcrop, and regional scales	Structural Processes Group, Department für Geodynamik und Sedimentologie, Universität Wien, Austria	€ 6,672 ($6,906)	May – June 2023
Subsurface Hydrogen Assessment, Storage, and Technology Acceleration (SHASTA; A. Goodman, National Energy Technology Laboratory, PI; N. Huerta, Pacific Northwest National Laboratory, Co-PI; J. White, Lawrence Livermore National Laboratory, Co-PI)	U.S. Department of Energy (Office of Oil & Natural Gas, and Office of Fossil Energy & Carbon Management); Subcontract Number B655896 to LLNL	$6,750,000 $100,000	January 2023 – March 2024
Total raised at Orion Geomechanics LLC (non-proprietary):		$ 171,906	

[10] Lawrence Livermore National Laboratory
[11] Amount indicated is the portion of the total grant managed by R.A. Schultz

The University of Texas at Austin			
Title	*Sponsor*	*Amount*	*Period*[12]
Structural-diagenetic characterization of natural fractures in the Lajas Formation, Neuquén Basin, Argentina (E. Ukar, BEG, PI)	YPF[a]	$231,262	Sept. 2016 – Jan. 2018
Diagenetic alteration of compaction bands	GDL Foundation	$5,000	Jan. 2016 – Dec. 2017
Theoretical analysis of what determines the size of an earthquake triggered by fluid injection (J.E. Olson, PI)	CISR[b]	$147,500	June 2016 – Dec. 2018
Fluid flow analysis of Fort Worth Basin (J.E. Olson, PI)	CISR	$147,500	Jan. 2016 – Dec. 2018
Total raised at UT Austin:		$ 531,262	

[a] Yacimientos Petroliferos Fiscales, the vertically integrated national oil company of Argentina.

[b] Center for Integrated Seismicity Research, a collaborative multidisciplinary, multi-university, government- and industry-funded consortium, State of Texas.

ConocoPhillips			
Title	*Sponsor*	*Amount*	*Period*[13]
Sumatra GPS (Indonesia)[a]	CTO[b]	~$5,000,000	2015 – 2020
Sumatra GPS Scoping	CTO	$25,000	Q1 2015
Containment Assurance (L.E. Summers, PI)	ConocoPhillips	$2,085,000	2014 – 2015
CBT[c] Development: Containment Awareness Training	ConocoPhillips	$57,500	Q1 – Q2 2014
MLN[d] Injection Containment Support	Algeria BU[e]	$145,000	Q1 2013
Chalk and Ekofisk Overburden Geomechanics	Norway BU	$450,000	2012 – 2013

[12] Projects terminated in September 2017
[13] Projects terminated in April 2015

Total raised at ConocoPhillips:	$ 7,762,500

[a] This project was developed to deploy a GPS network with broadband seismometers and accelerometers on several onshore gas fields in southern Sumatra to monitor induced seismicity and ground deformation in relation to activities such as production, wastewater injection, and disposal. It was a collaborative effort between ConocoPhillips (Houston, Texas); ConocoPhillips Indonesia (Jakarta); the Bandung Institute of Technology (ITB), Indonesia; and UNAVCO (Boulder, Colorado). Dollar value is estimated based on projected project expenditures

[b] CTO, Chief Technology Officer of ConocoPhillips.

[c] CBT, Computer-Based Training: an internal online e-Learning module for global corporate awareness-level training in subsurface containment assurance that became required training for petrotechnical personnel. Optimized for laptops and mobile devices (iPads).

[d] MLN, Menzel Lejmat North field, Algeria.

[e] BU, Business Unit: an operating company within ConocoPhillips Company.

University of Nevada

Title	*Sponsor*	*Amount*	*Period*[14]
Impact of fault rock properties on CO_2 storage in sandstone reservoirs (A. Torabi, PI)	Norwegian Research Council	$1,666,222 $60,000**Error! Bookmark not defined.**	Jan. 2011 – Dec. 2014
Deformation bands and planetary stratigraphy	NASA	$279,000	July 2009 – June 2012
Deformation bands and planetary stratigraphy	NASA	$279,000	July 2010– June 2013
Mechanics of compaction bands	Shell International Exploration and Production Co.	$60,000	June 2007 – July 2008
Visiting (Invited) Professor: Faulting of carbonate rocks	Université Paris-Sud[3], Orsay, France	~$4,000	June 2007 – July 2007
Mechanisms of faulting in the Upheaval Dome impact structure	NASA	$165,000	July 2006 – June 2009
Growth and scaling of Martian grabens and thrust faults	NASA	$306,003	July 2005 – June 2008

[14] Projects terminated in June 2011 on retirement from UNR and move to ConocoPhillips

Origin of the interior layered deposits in Valles Marineris, Mars	NASA	$60,000	April 2005 – April 2007
4-D Mechanics of wrinkle ridges and fault-related folds (NNG04GA14G)	NASA	$45,000	Jan. 2004 – Dec. 2005
Visiting Research Professor: Fault segmentation in 3-D	Université Paris-Sud[3], Orsay, France	~$4,000	June 2003 – July 2003
Fault segmentation and Martian paleohydrology (NAG5–13436)	NASA	$45,000	July 2003 – June 2004
Forward mechanical modeling of Martian structures and the 4-D tectonics of Tharsis (NAG5–12222)	NASA	$258,000	July 2002 – June 2005
Geomechanics of soft-rock faulting on Mars (NAG5–11447)	NASA	$150,000	July 2002 – June 2005
Growth of deformation bands into Riedel and echelon geometries	American Chemical Society/Petroleum Research Fund	$60,000	Aug. 2001 – Aug. 2003
Studies of faulting in 3-D on Mars and Mercury	NASA	$36,000	July 2001 – June 2002
Comprehensive structural model for planetary wrinkle ridges (NAG5–9001)	NASA	$116,300	July 2000 – June 2003
Comparative studies of tectonic features on the terrestrial planets (T. Watters, NASM, PI)	NASA	$99,980	June 1999 – May 2002
Studies of tectonic features on Mars (T. Watters, NASM, PI)	NASA	$88,791	May 1999 – April 2002
Nevada Regional Planetary Outreach Facility (with A. Johnson, Fleischmann Planetarium, Co-I) (NAG5–8267)	NASA	$30,000	July 1999 – June 2002
Geometry and mechanics of faulting on Mars (NAG5–8267)	NASA	$254,000	July 1999 – June 2002

Visiting Research Fellowship: Dike mechanics in 3D	Le Centre Nationale de la Recherche Scientifique (CNRS), France	$12,00	Dec. 1998 – Feb. 1999
A Field Guide to Fractures in Rock	Oxford University Press	$1,500	Nov. 1997 – May 1998
Numerical geomechanics studies of planetary faulting (NAG5-6881) (with J. Lin, WHOI, Co-I)	NASA	$165,00	Jan. 1998 – Sept. 2000
High-resolution topography of Canyonlands grabens	Chevron, Inc.	$24,492	Jan. 1997 – Aug. 1997
Performance verification of elevated temperature testing capabilities	U.S. Department of Energy (Yucca Mountain Project)	$50,198	June 1995 – Sept. 1996
Support for 35th US Rock Mechanics Symposium (with J. Daemen, UNR) (CMS–9423751)	U.S. National Science Foundation	$29,658	Mar. 1995 – Feb. 1996
Fracture networks and rock-mass properties		$50,209	Oct. 1994 – Sept. 1996
Studies of planetary faulting (NAGW–4151)	NASA	$111,383	Aug. 1994 – Sept. 1998
Acquisition of new equipment for rock mechanics testing (with R. Watters, UNR)	U.S. Department of Energy (Yucca Mountain Project)	$248,541	Oct. 1992 – Sept. 1996
Strength testing of Calico Hills tuff, Yucca Mountain repository site, Nevada (with R. Watters and J. Carr, UNR)	U.S. Department of Energy (Yucca Mountain Project)	$44,872	Oct. 1992 – Sept. 1994
Geometry and kinematics of deformation in the northern Walker Lane: A study of intra-continental strain in the Basin and Range Province (with P. Cashman, UNR) (EAR–9105818)	U.S. National Science Foundation	$73,216	June 1991 – Nov. 1993

Preliminary analysis of Magellan spacecraft images of Venus	University of Nevada	$6,930	Jan. 1991 – June 1992
Early Mars: Impact basins, crustal dichotomy, and volcanic resurfacing (with H. Frey)	NASA	$54,000	Oct. 1990 – Sept. 1993
	Total raised at UNR:	$ 4,869,295	

NASA Goddard Space Flight Center

Title	*Sponsor*	*Amount*	*Period*
Geologic mapping of the Ophir Planum region of Mars (NAGW–2347)	NASA	$18,218	April 1989 – Dec. 1992
Analysis of growth and development of Martian canyons, NRC Postdoctoral Fellowship	U.S. National Academy of Sciences/National Research Council	$66,200	Feb. 1988 – Feb. 1990
	Total raised as a Postdoc:	$ 84,418	

Purdue University

Title	*Sponsor*	*Amount*	*Period*
Early tectonic evolution of Mars: Crustal dichotomy to Valles Marineris (with H. Frey, NASA Goddard)	NASA	$54,000	Jan. 1987 – Jan.1990
Structural mapping along the Garlock fault, California and curved strike-slip faults in southern Nevada	Chevron USA	$2,400	1984 – 1985
Field work support	Purdue University	$1,000	1984
The origin of echelon steps along strike-slip faults (with A. Aydin), David Ross Fellowship	Purdue University	$13,200	Aug. 1983 – July 1985
	Total raised as a Ph.D. student:	$ 70,600	

Project Management

My project management experience spans several decades and organizations including universities, government, and corporate. Particular strengths include identifying important issues, planning, and execution of multiple simultaneous projects; personnel supervision and development; budgeting; and effective engagement with a range of diverse constituencies and technical disciplines from senior management through the public.

In May 2019 I earned a Certificate in Strategic Project Management from Rice University by examination as part of an eight-week online professional development course. The goal was to learn through theory and practical exercises how to apply strategic thinking by aligning project, program, or portfolio goals with an organization's strategic goals.

Project Management experience includes:

- *University of North Dakota* — Chair of the Department of Energy and Petroleum Engineering.
- *International Energy Agency* — Task 42, Hydrogen Technology Collaboration Programme (Hydrogen TCP), Task 42: Underground Hydrogen Storage Workplan; Task Coordination Team (TCT), Co-Lead, Subtask F: "Planning, Regulation, Safety & Society"
- *American Rock Mechanics Association* — Created and led the Underground Storage and Utilization Technical Committee, including creating social media presence on LinkedIn® and YouTube (2020–present); Technical Program Chair, 52nd US Rock Mechanics/Geomechanics Symposium, Seattle (2018)
- *Integrity Subsurface LLC* — Formulated technical feasibility study of underground natural gas, CO_2, and hydrogen storage facility in offshore California for an international group of stakeholders and investors
- *Orion Geomechanics LLC* — Managed the development of projects and provided subject-matter expertise for corporate and legal clients including designing an asset integrity management system for underground natural gas storage facilities
- *FRAC Consortium* — Engaged with UT leadership team to deepen and expand industry involvement and stakeholder value (with S. Laubach, J. Gale, and J. Olson)
- *Subsurface Containment Assurance* — Global field assessments, training, and software deployment, ConocoPhillips, ~$2.1 million (with L.E. Summers, Co-Lead)
- *Sumatra Geodetic Monitoring Program* — Geodetic and geophysics project definition and leadership, involving ConocoPhillips; ConocoPhillips Indonesia; the Bandung Institute of Technology (ITB), Indonesia; and UNAVCO; ~$5 million
- *Geomechanics Research Projects* — University of Nevada and The University of Texas at Austin, includes personnel supervision, ~$5.6 million individually or with colleagues
- *Canyonlands Grabens Initiative* — Research partnership between 3–5 universities and research institutes, supported through NASA for 3 separate years

While at UT I assisted the leadership in representing and guiding its FRAC Consortium with industry sponsors including ExxonMobil, Total, BP, and Repsol. This included engagement strategies to support member companies in accessing FRAC results and expertise for their

particular areas of need. I also worked to realign FRAC priorities with industry needs in the petroleum engineering and completions realm.

From 1995–1999 I organized and managed a multi-institution research consortium from UNR focused on extensional deformation in the Paradox Salt Basin, Utah USA. We engaged other universities to join us, such as the elite undergraduate Keck schools (e.g., Pomona College, Amherst College); Trinity University (San Antonio, Texas); University of Massachusetts, Amherst; California State University Fresno; Cardiff University (Great Britain), and others including the University of Bergen (Norway) and the Texas Bureau of Economic Geology that had students, faculty, and/or researchers whose work would benefit from access to the graben faults we studied in Canyonlands National Park. The work was funded by NASA, partly to support fundamental research into the deformation of similar sedimentary sequences and related paleohydrologic processes on Mars; additional materials and support were provided by Chevron. My team organized the research and logistics, and we presented our findings at several national meetings and published them in several joint peer-reviewed papers as well as graduate student theses and dissertations. Other research groups that worked with us continued to work there and to publish their own findings.

On my selection as Foundation Professor at the University of Nevada in 2010 I managed several initiatives at the university level. Some of these included engaging potential donors to increase private endowments in collaboration with the Vice President for Development and the Mackay School of Earth Sciences and Engineering; increased the admissions standards for several departments within the College of Science; and championed and managed the framing and development of a consistent university-wide website, with the Vice President for Academic Affairs (these were deployed initially in the College of Science and in the Department of Geological Sciences and Engineering beginning in summer 2011, largely due to my efforts). I also worked closely with the Vice President for Research and Dean of the Graduate School in identifying and developing promising areas for improvement, including the important area of grants administration; as a Faculty Senator for the College of Science; and actively worked on the Advisory Board, Fleischmann Planetarium and Science Center (Reno, Nevada), including its proposed expansion into the regional Great Basin Exploration Center.

While at ConocoPhillips I managed, individually or with colleagues, several significant technical programs. The results were used by the company to enhance the safety, production, and value of assets across the company's global portfolio. I also co-monitored several industry-university research partnerships including Stanford University's Rock Fracture Project and The University of Texas at Austin/Bureau of Economic Geology Fracture Research and Application (FRAC) Consortium as well as being the company's Subject Matter Expert for reservoir monitoring, subsurface integrity, and containment geomechanics.

Graduate Students Advised and/or Mentored

To date, I have advised and/or mentored, individually or with colleagues, a total of 6 postdoctoral scholars, 31 Ph.D. students, 37 M.S. students, 3 Ph.D. corporate summer interns, and several advanced undergraduates on topics including geological engineering, analytical and numerical modeling of field observations, planetary structural geology, deformation bands, fault and fracture mechanics, overburden characterization, fault stability in overburden sequences, reservoir geomechanics, and wastewater injection/induced seismicity.

A common thread in my advisement and mentoring philosophy has been a focus on achieving and sustaining quality in all parts of the academic program. This has included training undergraduate and graduate students in how to prepare, and then consistently deliver, excellent oral, poster, and written presentations at a variety of technical and non-technical forums.

Graduate students advised and/or mentored are listed in the next table, followed by details for students for whom I was principal advisor and/or mentor.

Summary Listing

University of North Dakota

Student	*Degree*	*Specialty*	*Committee Chair*
Rachael E. Josephs *	Ph.D.	Energy Engineering	Schultz
Nassim Bouabdallah ‘25	Ph.D.	Petroleum Engineering	Michael
Abdelmalek Abes	Ph.D.	Petroleum Engineering	Michael
Chukwuemeka Kalu	M.S.	Petroleum Engineering	Michael
Prasad Pothana ‘25	Ph.D.	Petroleum Engineering	Ling
Mauricio A. Vasquez Pinto	Ph.D.	Geology	Egenhoff
Ghoulem Ifrene ‘25	Ph.D.	Geology	Egenhoff

* Date indicates year thesis/dissertation completed

Universität Wien, Vienna, Austria

Student	*Degree*	*Specialty*	*Committee Chair*
Zhaoliang Hou ’23[1] *	Ph.D.	Structural Geology and Geomechanics	Grasemann
Sophia Swaton ‘23	M.S.	Structural Geology	Grasemann

[1] Student advisement as graduate committee member; informal mentor otherwise
* Date indicates year thesis/dissertation completed

The University of Texas at Austin			
Student	*Degree*	*Specialty*	*Committee Chair*
Abdulaziz Almansour '17[1] *	M.S.	Energy and Earth Resources	Laubach
Qiqi Wang '16	M.S.	Petroleum Geology	Gale
Tianyu Li '18	M.S.	Petroleum Engineering	Olson
Valerie Gono	Ph.D.	Petroleum Engineering	Olson
Mohsen Babazadeh '19[1]	Ph.D.	Civil Engineering	Olson
Andreas Michael	Ph.D.	Petroleum Engineering	Olson/Balhoff
Kaimin Yue '17[1]	Ph.D.	Petroleum Engineering	Olson
Weiwei Wang '17	Ph.D.	Petroleum Engineering	Olson/Prodanović
Andreas Michael '16	M.S.	Petroleum Engineering	Olson/Balhoff
Nana Asiamah '15[1]	M.S.	Petroleum Engineering	Olson
Valerie Gono '15	M.S.	Civil Engineering	Olson
Hunjoo Lee '15[1]	Ph.D.	Petroleum Engineering	Olson
[1] Student advisement at UT as graduate committee member; informal mentor otherwise * Date indicates year thesis/dissertation completed			

ConocoPhillips			
Student	*Degree*	*Specialty*	*Committee Chair*
Shang (Shawn) Deng '14	Ph.D. (Stanford)	Structural Geology and Geomechanics	Pollard/Aydin
Xiaopeng Tong '13	Ph.D. (Scripps)	Fault Mechanics	Sandwell
F. Rall Walsh, III '17	Ph.D. (Stanford)	Geomechanics	Zoback

University of Nevada			
Student	*Degree*	*Specialty*	*Committee Chair*
Christian Klimczak '11	Ph.D.	Geomechanics	Schultz
Amanda L. Nahm '10	Ph.D.	Planetary Geology	Schultz

Cheryl L. Goudy ‘05	Ph.D.	Planetary Geology	Schultz
Chris H. Okubo ‘05	Ph.D.	Geo-Engineering	Schultz
Scott J. Wilkins ‘02	Ph.D.	Planetary Geology	Schultz
Wendy R. (Orr) Key ‘09	M.S.	Geological Sciences	Schultz
Kimi S. Artita ‘06	M.S.	Geological Engineering	Schultz
Anjani T. Polit ‘05	M.S.	Geological Engineering	Schultz
Daniel P. Neuffer ‘05	M.S.	Geological Engineering	Schultz
Clara M. Balasko ‘03	M.S.	Geological Engineering	Schultz
Paul A. Caruso ‘02	M.S.	Geological Engineering	Schultz
William H. Roadarmel ‘98	M.S.	Geological Engineering	Schultz
Edward C. Wellman ‘97	M.S.	Geological Engineering	Schultz
Jason M. Moore ‘97	M.S.	Geological Engineering	Schultz
Andrea N. (Fori) Catura ‘97	M.S.	Geological Engineering	Schultz
Paul L. Piscoran ‘96	M.S.	Geological Engineering	Schultz
Qizhi Li ‘93	M.S.	Geological Engineering	Schultz
Kathleen A. Ward ‘93	M.S.	Geological Engineering	Schultz
William Gates ‘94	Ph.D.	Geological Engineering	Watters
Rick Quine ‘93	Ph.D.	Geological Engineering	Watters
James Jung ‘10	M.S.	Geological Engineering	Watters
Tom Badger ‘02	M.S.	Geological Engineering	Watters
Skip Leedy ‘93	M.S.	Geological Engineering	Watters
Darin Duran ‘93	M.S.	Geological Engineering	Watters
Rowdy Bristol ‘96	M.S.	Geological Engineering	Carr
Yang Chunhe ‘00	Ph.D.	Geo-Engineering	Daemen
Carol Geertson ‘97	M.S.	Mining Engineering	Daemen
Leo Gilbride ‘95	M.S.	Mining Engineering	Daemen
Davood Bahrami ‘02	M.S.	Mining Engineering	Danko
Robert Ruess	M.S.	Computer Science	Looney

Brett Rabe ‘00	M.S.	Materials Science	Fuerstenau
Tung Q. Nguyen ‘02	Ph.D.	Civil Engineering	Norris
Christiane Andrews ‘01	M.S.	Secondary Education	Robinson
Michael Jennings ‘98	M.S.	Rock Physics	McCall
Matthew Reeves ‘06	Ph.D.	Hydrology/Hydrogeology	Bensen
Michael Widmer	Ph.D.	Hydrology/Hydrogeology	Wheatcraft
Zhuping Sheng ‘96	Ph.D.	Hydrology/Hydrogeology	Helm
Terry Panhorst ‘96	Ph.D.	Economic Geology	Larson
Jeff Phinisey ‘95	M.S.	Economic Geology	Price
Zakir Kanbur ‘97	M.S.	Geophysics	Louie
Craig dePolo ‘98	Ph.D.	Neotectonics	Anderson
John Caskey ‘96	Ph.D.	Neotectonics	Wesnousky
Ryan Murphy ‘04	M.S.	Structural Geology	Faulds
Yang Zhang	Ph.D.	Structural Geology	Schweickert

University of North Dakota

As part of my responsibilities as Professor in the College of Engineering and Mines’ Department of Energy and Petroleum Engineering, I advised or mentored, individually or with colleagues, 7 Ph.D. students and 1 M.S. student.

1. **Rachael E. Josephs**
   - Ph.D., Energy Engineering, expected in Summer 2026 (Schultz, committee chair); “Techno-economic analysis of hydrogen production and storage in salt caverns in North Dakota.” Honors and awards:
     - Al Golden Scholarship (July 2024 - July 2025) North Dakota Petroleum Foundation, USA
     - Best Poster Award Nomination (November 2024) United States Association of Energy Economics (41st North American Conference).
     - Excellence in Graduate Mentoring (August 2024) UND Interdisciplinary Renewable & Environmental Collaborative (REU)
     - Pre-Post-Doctoral Award / Traineeship (January - May 2025) School of Graduate Studies, University of North Dakota.
     - 1st Place, Three Minutes Thesis (3MT) Competition (January 2025) School of Graduate Studies, University of North Dakota.

- 2nd Place, Western Regional 3MT (March 2025) - Advancing to National Competition in December 2025! Western Association of Graduate Schools (WAGS)
- Lillian Elsinga Outstanding Student Leader Award (April 2025) University of North Dakota.

2. **Ghoulem Ifrene**
   - Ph.D., Geology, December 2025 (S. Egenhoff, committee chair); "Numerical and Experimental Simulations of Fluid Flow in X-Crossing Rough Fracture Surfaces."
   - Work published in *Polymer Engineering and Science* and *Advances in Water Resources*.
3. **Abdelhakim Khouissat**
   - Ph.D., Petroleum Engineering, December 2025 (A. Michael, committee chair); "Dynamic Wellbore-Integrity Framework for Post-Blowout Capping of Offshore Wells."
4. **Nassim Bouabdallah**
   - Ph.D., Petroleum Engineering (A. Michael, committee chair); "Play-Agnostic Thermo-Poro-Hydro-Mechanical (TPHM) Modeling of Hydraulic Fracture Initiation from Perforated Wells."
5. **Abdelmalek Abes**
   - Ph.D., Petroleum Engineering (A. Michael, committee chair); "Laboratory-Data-Driven Modeling of CO_2-EOR Applications in Carbonate Reservoirs."
6. **Chukwuemeka Kalu**
   - M.S., Petroleum Engineering (A. Michael, committee chair); "Optimization of Hydraulic Fracturing from Horizontal Wells: Laboratory-Scale Experiments on Transparent Gelatin Blocks."
7. **Prasad Pothana**
   - Ph.D., Petroleum Engineering, December 2025 (Ling, committee chair); Rock physics and petrophysical evaluation of diagenetic effects in the Broom Creek CO_2 storage site.
8. **Mauricio A. Vasquez Pinto**
   - Ph.D., Geology (S. Egenhoff, committee chair)

Universität Wien

As part of my responsibilities as at the Universität Wien from May through June 2023, I advised or mentored, individually or with colleagues, 1 postdoctoral scholar, 1 Ph.D., and 1 M.S. student from the Structural Processes Group, Department of Geology, Universität Wien (Vienna, Austria).

1) **Zhaoliang Hou**
   - Ph.D., Structural Geology and Geomechanics, August 2023; "Fault zone microstructures and the associated fluid-rock interactions in highly porous rocks," 121 p. (Bernhard Grasemann, committee chair).
   - Work supported in part by Glock Health, Science and Research GmbH, Deutsch-Wagram,

Austria and published in *Geological Society of America Bulletin*.

2) **Sophia Swaton**
   - M.Sc., Structural Geology, August 2023; "Fragmentation and pulverization in carbonate rocks" (Bernhard Grasemann, committee chair). I served as an informal technical mentor given my prior work on this subject.

The University of Texas at Austin

As part of my responsibilities as Senior Research Scientist at UT, I advised or mentored, individually or with colleagues, 2 postdoctoral scholars and 8 Ph.D. and M.S. students from two academic departments in UT's Cockrell School of Engineering as listed in this section (2015–2017). Fault zone microstructures and the associated fluid-rock interactions in highly porous rocks

1. **Hunjoo Lee**
   - Ph.D., Petroleum Engineering, December 2015; "Fracture Propagation in Naturally Fractured Reservoirs," 189 p. (Jon Olson, committee chair).
   - Work supported by ExxonMobil, Pennsylvania General Energy, and UT's FRAC Consortium and published in *Journal of Geophysical Research*, *International Journal of Fracture*, *Engineering Fracture Mechanics*, and 1 ARMA paper.
   - Hunjoo was a postdoctoral scholar at UT from January 2016 through December 2020 and is now Assistant Professor at Oklahoma State University.

2) **Valerie Gono**
   - Ph.D., Petroleum Engineering, through May 2018 (Jon Olson, committee chair).
   - M.S., Civil Engineering, December 2015; "On Shaky Grounds: Understanding the Correlation Between Induced Seismicity and Wastewater Injection in the Fort Worth Basin," M.S. thesis, 102 p. (Jon Olson, committee chair).
   - Summer intern with Halliburton (2016) and QRI (2017).
   - Work supported by the Research Partnership to Secure Energy for America (RPSEA) and CISR and published in 1 AAPG abstract.
   - Currently working for ORTEC USA in Houston.

3) **Nana Asiamah**
   - M.S., Petroleum Engineering, December 2015; "Multi-Frac Propagation in Unconventional Shale," 148 p. (Jon Olson, committee chair).
   - Work supported by UT's FRAC Consortium.
   - Formerly with ZT Systems in New Jersey, currently with CACI International Inc.

4) **Weiwei Wang**
   - Ph.D., Petroleum Engineering, August 2017; "The Effect of Cemented Natural Fractures on Hydraulic Fracture Propagation" (Jon Olson and Maša Prodanović, committee co-chairs).

- Summer intern with Shell (2 summers, 2014 and 2016).
- Work supported by Shell and UT's FRAC Consortium and published in *Journal of Petroleum Science and Engineering*, 1 SPE conference paper, 1 URTeC conference paper, and 1 AGU abstract.
- Currently working for Shell in Louisiana.

5) **Kaimin Yue**
   - Ph.D., Petroleum Engineering, August 2017; "Fracture Height Containment in Unconventional Reservoirs," 177 p. (Jon Olson, committee chair).
   - M.S., Petroleum Engineering, May 2015; "Height Containment of Hydrofractures in Unconventional Reservoirs," M.S. report, (Jon Olson, committee chair).
   - Summer intern with Weatherford International (2014, 2015) and Schlumberger (2016).
   - Work supported by UT's FRAC Consortium and published in SPE *Drilling & Completion*, *Engineering Fracture Mechanics*, 1 ARMA paper, and 1 URTeC conference paper.
   - Formerly with Texas Oil and Gas Institute and MindMesh, Inc., now with Pegasus Vertex, Inc., Houston.
6) **Andreas Michael**
   - Ph.D., Petroleum Engineering, through May 2018 (Jon Olson and Matthew Balhoff, committee co-chairs); Ph.D., Petroleum Engineering, Louisiana State University, December 2020.
   - M.S., Petroleum Engineering, May 2016; "Hydraulic Fracturing Optimization: Experimental Investigation of Multiple Fracture Growth Homogeneity via Perforation Cluster Distribution," M.S. report, 90 p. (Jon Olson and Matthew Balhoff, committee co-chairs).
   - Work supported by UT's FRAC Consortium.
   - Currently Assistant Professor at University of North Dakota.
7) **Mohsen Babazadeh**
   - Ph.D., Civil Engineering; August 2019; "Developing coupled fluid flow and geomechanics simulators to model fracture deformation," 201 p. (Jon Olson, committee chair).
   - Work supported by UT's FRAC Consortium and CISR, and published in 1 SPE conference paper, 1 AAPG abstract, and 1 AGU abstract.
   - Formerly with Schlumberger, now with ConocoPhillips.
8) **Tianyu Li**
   - M.S., Petroleum Engineering, December 2018 (Jon Olson, committee chair).
   - Work supported by UT's FRAC Consortium.
   - Currently working for Pioneer Natural Resources Company in Irving, Texas.

ConocoPhillips

A total of 3 Ph.D. graduate students have completed summer internship projects under my co-supervision while at ConocoPhillips (2011–2015). Work completed during the internship projects was typically used in the company after the student departed.

1) **Shang (Shawn) Deng**
   - Ph.D. Stanford University, December 2014; Internship project title: "Characterization and Stability Evaluation of Faults in Ekofisk Overburden;" co-advised with Peter Hennings (2012).
   - Hired in 2014 as a full-time employee as a Geomechanicist with ConocoPhillips; with SINOPEC since 2015.
2) **Xiaopeng Tong**
   - Ph.D. University of California, San Diego/Scripps Institution of Oceanography, Spring 2013; Internship project title: "Geodetic Investigation on the Suban Field, Southern Sumatra;" co-advised with Khalid Soofi (2012). Project was published in *Indonesian Petroleum Association Proceedings* and in *The Leading Edge*.
   - Previously research faculty at the University of Washington, now Associate Research Professor at Institute of Geology and Geophysics, Chinese Academy of Sciences.
3) **F. Rall Walsh, III**
   - Ph.D. Stanford University, Summer 2017; Internship project title: "A Case Study in Fracture Flow for Water Disposal at the Suban Gas Field;" co-advised with Peter Hennings (2013). Rall has published multiple papers with his Stanford advisor, Prof. Mark Zoback, in the area of wastewater injection-induced seismicity and quantitative risk analysis.
   - Formerly with Decision Geomechanics LLC, currently with EOG Resources in Houston.

University of Nevada

A total of 2 postdoctoral scholars, 5 Ph.D. and 13 M.S. graduate students, and 2 advanced undergraduate students have completed thesis and/or research projects under my supervision while at UNR (1990–2011). I provided quality equipment and advisement to my students, who I regarded as an integral part of my teaching and research group. In return I expected, and received, hard work and a quality product. Most of my students were funded by external grants awarded to R.A. Schultz.

1) **Kathleen A. Ward**
   - M.S., Geological Engineering, December 1993; "Dike Emplacement and Deformation in the Donner Summit Pluton, Central Sierra Nevada, California," 76 pp.
   - Work partly funded by grants from the Geological Society of America and UNR. Ms. Ward's thesis proposal was honored by GSA with the Outstanding Student Research Award; this distinction was given to only 41 of 533 applicants in 1992. Served as Graduate Teaching Assistant (TA) for UNR's Summer Field Camp. Work published in Geological Society of America *Field Guide* (reviewed) and 1 AGU abstract.
   - Kathleen was a commissioned officer with the U.S. Coast Guard, working in environmental cleanup projects. Formerly Senior Director, Global Supply Chain, with Cepheid in Sunnyvale, California, she is now Senior Director with Danaher Corporation in San Jose, California.
2) **Qizhi Li**
   - M.S., Geological Engineering, December 1993; "Uniaxial Test and Mechanical Behavior Analysis of the Tuffaceous Beds of Calico Hills, Yucca Mountain, Nevada," 72 pp.
   - Work funded by U.S. Department of Energy and published in DOE *Proceedings* volume and *Engineering Geology*.
   - Li has been a geological engineer with several geotechnical firms in Reno, Nevada.
3) **Paul C. Piscoran**
   - M.S., Geological Engineering, May 1996; "Mode-I Fracture Array Evolution and Corresponding Rock Mass Properties: A Displacement Discontinuity Boundary Element Method," 308 pp.
   - TA for UNR's Summer Field Camp (2 years); received Outstanding Graduate Student Award from UNR by UCCSN Regents for 1996. Work funded by U.S. Department of Energy and published in DOE *Proceedings* volume and 2 AGU abstracts.
   - Formerly a regional sales manager with several roofing and construction engineering firms, and with Nova Consulting Group, Paul is with Technical Assurance, and Owner and Director of A_Cubed Athletics in Reno, Nevada.
4) **Andrea N. (Fori) Catura**
   - M.S., Planetary Geomechanics, May 1997; "Faulting Across Valles Marineris, Mars: Regional Scale Statistics and Analysis," 74 pp.

- TA for UNR's Summer Field Camp. Work funded by NASA and published in *Journal of Structural Geology*, 3 Lunar and Planetary Science Conference extended abstracts, and 1 AGU abstract. Awarded First Place ($500) for individual graduate student research category, MSM Open House Poster Competition, April 1996.
- Formerly a Senior Systems Engineer with Lockheed-Martin in Sunnyvale, California, Andrea is now an independent contractor.

5) **Jason M. Moore**
   - M.S., Geological Engineering, May 1997; "Displacement-Length Scaling, Kinematics and Mechanical Implications of Canyonlands National Park Grabens," 76 pp.
   - TA for UNR's Summer Field Camp (2 years). Work funded in part by Chevron, Inc. and published in Utah Geological Association *Proceedings* volume, 2 Lunar and Planetary Science Conference extended abstracts, 2 AGU abstracts, and *Geological Society of America Bulletin*. His presentation at Fall 1996 AGU was awarded an Honorable Mention in the Outstanding Student Paper evaluation from all papers delivered at the meeting (Tectonophysics Section).
   - Formerly with Science Applications International Company in Las Vegas, where he was in charge of chemical waste remediation projects; then a registered Engineering Geologist with Cotton & Associates in Los Gatos, California; URS Corporation/AECOM, Fresno, California; Senior Geologist with Ninyo and Moore Geotechnical and Environmental Science Consultants; and Associate Engineering Geologist with Group Delta in San Diego, California; Jason is now with Fugro in Southern California.

6) **Edward C. Wellman**
   - M.S., Geological Engineering, May 1997; "Fracture, Faulting, and Gouge Development in Tuff: A Case Study at Hoover Dam, Clark County, Nevada and Mojave County, Nevada," 36 pp.
   - TA for UNR's Summer Field Camp. Work published in 2 AGU abstracts; his work on the Mars Pathfinder lander/rover team was published as an article in *Science*.
   - Edward is a registered Geological Engineer; formerly with Call & Nicolas in Tucson and with Condor Earth Technologies in Sonora, California; Vice President of Call & Nicolas in Tucson, Arizona; and Principal Consultant with SRK Consulting in Denver, Colorado., he is currently with Independent Geomechanics LLC in Tucson.

7) **Paul A. Caruso**
   - M.S., Geological Engineering, May 2002; "Seismic Triggering of Martian Landslides and Slope Stability for Valles Marineris, Mars," 73 pp.
   - Work funded by NASA, and published in 1 AGU abstract and 2 Lunar and Planetary Science Conference extended abstracts.

8) **Scott J. Wilkins**
   - Ph.D., Planetary Geomechanics, August 2002; "Mechanical and Statistical Aspects of Brittle Faulting: From Coseismic Rupture to Cumulative Deformation," 181 pp.
   - TA for UNR's Cordilleran Transect Summer Field Camp. Work funded by NASA and published in 4 Lunar and Planetary Science Conference extended abstracts, 2 GSA abstracts, 2 AGU abstracts, an extended abstract for the Tharsis Workshop, and in

Geophysical Research Letters, *Bulletin of the Seismological Society of America*, *Journal of Geophysical Research*, *Geology*, and *Journal of Structural Geology*. His M.S. thesis work was written up and published while at UNR in 2 papers in *Journal of Structural Geology*. Scott coauthored additional papers following his doctoral studies with us in *Geology* and *Journal of Structural Geology*. He was awarded Best Student Paper in Tectonophysics at Fall AGU (2000) and Best Doctoral Student in Geo-Engineering at UNR (Spring 2002). Scott was selected to receive the nationally competitive W.H. Mendenhall Fellowship with the U.S. Geological Survey, Menlo Park, California, to work on seismotectonics of the San Andreas Fault near Parkfield.

- Formerly a research structural geologist with Shell International Exploration and Production Company, and Senior Geological Advisor with Anadarko in Houston, Texas, now with Chesapeake.

9) **Clara M. Balasko**
   - M.S., Geological Engineering, May 2003; "Mechanism and Sequence of Formation of Deformation Bands into Spatially Localized or Distributed Sets: Ladders, Riedels, and Echelon Arrays of Utah," 47 pp. Matriculated in Fall 2000.
   - Work funded by the NASA Nevada Space Grant Consortium and the American Chemical Society's Petroleum Research Fund, and published in *Geophysical Research Letters* and 2 AGU abstracts. Awarded Best Master's Student in Geological Engineering at UNR (Spring 2002). Formerly a geological engineer with SRK in Reno, Nevada, Clara is now Geotechnical Manager with BHP in Tucson.

10) **Daniel P. Neuffer**
   - M.S., Geological Engineering, August 2005); "Mechanisms of Slope Failure in Valles Marineris, Mars and Wells Gray-Clearwater Volcanic Field, British Columbia." Matriculated in Spring 2004.
   - Work funded by NASA and published in *Canadian Journal of Earth Sciences*, *Quarterly Journal of Engineering Geology and Hydrogeology*, 1 Lunar and Planetary Science Conference extended abstract, and 1 AGU abstract. He was awarded best Master's student in Geological Engineering (2006) and outstanding graduate student in UNR's Department of Geological Sciences and Engineering (2006).
   - The recipient of the Best Young Author Award for 2006 from the *Quarterly Journal of Engineering Geology and Hydrogeology*, Dan was a geological engineer with RTW Professional Engineers and Consultants, Inc., formerly in Elko, Nevada; now a Senior Consultant with SRK in Anchorage, Alaska.

11) **Anjani T. Polit**
   - M.S., Geological Engineering, December 2005; "Influence of Mechanical Stratigraphy and Strain on the Displacement-Length Scaling of Normal Faults on Mars." Matriculated in Fall 2003.
   - Work funded by NASA and published in *Journal of Structural Geology*, 2 Lunar and Planetary Science Conference extended abstracts, and 2 AGU abstracts.
   - Anjani is working in Mars spacecraft operations with the HiRISE Martian imaging experiment and is a Mission Implementation Engineer at the Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona.

12) **Chris H. Okubo**
   - Ph.D., Geo-Engineering, May 2005; "Brittle Strain Localization within Fault-Related Folds: Grain-scale to Lithospheric Deformation." Matriculated in Fall 2000.
   - Work funded by NASA, and published in *Geophysical Research Letters*, *Computers and Geosciences*, *Geological Society of America Bulletin* (2 papers), *Geology*, *Journal of Structural Geology* (2 papers), *Journal of the Geological Society of London*, *Geology*, *Earth and Planetary Science Letters*, 9 Lunar and Planetary Science Conference extended abstracts, and 4 AGU abstracts. He was awarded Honorable Mention for his oral presentations at the Lunar and Planetary Science Conferences in 2002, 2004, and 2005, best doctoral student in UNR's interdisciplinary Geo-Engineering program (2005) and outstanding graduate student in UNR's Department of Geological Sciences and Engineering (2005).
   - Chris started in July 2005 as a postdoctoral scholar and staff scientist with the HiRISE Martian imaging experiment at the Lunar and Planetary Laboratory at the University of Arizona, Tucson; he is now Deputy Center Director and Research Operations Lead with the Astrogeology Science Center, U.S. Geological Survey, Flagstaff, Arizona.

13) **Cheryl L. Goudy**
   - Ph.D., Planetary Geomechanics, May 2005; "Remotely Sensed Surface Deformation on Mars and Earth: Mechanics and Analysis." Matriculated in Fall 2002.
   - Cheryl was supported during her first year by an innovative collaboration between my research group and the Nevada Bureau of Mines and Geology (John Bell and Geoff Blewitt, supporting research advisors) and later by NASA, a Nevada Space Grant Fellowship, and as a Visiting Scholar with the Department of Geomatics, University of Newcastle (UK). Her work has been published in *Geology*, *Geophysical Research Letters*, *Journal of Geophysical Research*, a poster at the InSAR conference in Reno (September 2002), 2 Lunar and Planetary Science Conference extended abstracts, and 1 AGU abstract.
   - Formerly a research geoscientist with Shell's New Detection Methods and Scanning Technologies Team in The Hague, Netherlands and advising graduate students in her own right, Cheryl is now with Shell in Houston, Texas.

14) **Kimi S. Artita**
   - M.S., Geological Engineering, professional paper (nonthesis) option; May 2006; "Strike-Slip Fault Geometries on Mars: Implications for the Material Properties of the Martian Crust." Matriculated in Fall 2003.
   - Work funded by NASA and published in 2 Lunar and Planetary Science Conference extended abstracts and 1 AGU abstract.
   - Kimi is currently with CDM Smith in Pennsylvania.

15) **Wendy (Orr) Key**
   - M.S., Geology, May 2009; "Fault Formation in Porous Rocks at High Strain Rates." Matriculated in Fall 2007.
   - Work funded by NASA and published in *Geological Society of America Bulletin*, 2 Lunar and Planetary Science Conference extended abstracts, 1 AEG abstract, and 1 AGU abstract. Wendy was invited to participate in National Geographic's documentary on Canyonlands

National Park, Utah, as the expert in the origin of Upheaval Dome (November 2008) that aired in 2009.

- Formerly with Kleinfelder, Inc., in Reno, AMEC Geomatrix, Rancho Cordova, California, Geosyntec Consultants, Sacramento, California, and Environmental Health and Safety Manager at Comcast Cable in Sacramento, Wendy is now a Senior Geologist with Geosyntec Consultants.

16) **Amanda Nahm**

- Ph.D., Planetary Structural Geology, May 2010; "Geomechanical and Tectonic Investigations of the Geologic History of Mars at Local, Regional, and Global Scales." Matriculated in Fall 2006.
- Work funded by NASA and published in *Geophysical Research Letters*, *Journal of Geophysical Research*, *Icarus* (2 papers), 3 Lunar and Planetary Science Conference extended abstracts, 1 7th International Mars Conference extended abstract, 2 GSA abstracts, and 2 AGU abstracts. Winner of the UNR College of Science Best Graduate Student Poster competition (2008). Amanda presented her research by invitation at NASA Goddard Space Flight Center, Greenbelt, Maryland, in November 2008, worked in the Laboratoire de Planétologie et Géodynamique de Nantes, Université de Nantes, France (May–July 2009), and taught GEOL 100 at UNR during her fourth academic ye ar. Amanda was chosen as the Outstanding Ph.D. Graduate Student in the Department for 2010.
- Previously a postdoctoral scholar at the NASA Lunar Science Institute's Center of Lunar Science and Exploration at the Lunar and Planetary Institute in Houston from June 2010 through July 2011; Research Assistant Professor at the University of Texas at El Paso; Postdoctoral Scholar at the University of Idaho; Humboldt Fellow with DLR in Germany; researcher with the Arctic Planetary Science Institute; Amanda is now a Program Officer with the Planetary Science Division of NASA, Washington, DC.

17) **Christian Klimczak**

- Ph.D., Geomechanics, May 2011; "Processes of Progressive Deformation with Applications to Jointing, Faulting and Fluid Flow." Matriculated in Fall 2007.
- Work funded by NASA and published in *Hydrogeology Journal*, *Icarus*, *Journal of Geophysical Research*, *International Journal of Earth Sciences* (*Geologische Rundschau*), *Journal of Structural Geology*, *International Journal of Rock Mechanics and Mining Sciences*, 4th Marie Curie Summer School on Porous and Aqueous Materials Conference, 3 AGU abstracts, 1 EGU abstract, and 1 Lunar and Planetary Science Conference extended abstract. Named Outstanding International Graduate Student (UNR) for 2009 and Outstanding Graduate Student in the Department of Geological Sciences and Engineering for 2011, he received the Richard Call Memorial Scholarship for research in rock mechanics (2010).
- Christian started in May 2011 as a postdoctoral fellow with the Carnegie Institution of Washington, working with the MESSENGER mission to Mercury, and is now Associate Professor of Structural Geology at the University of Georgia.

Postdoctoral Scholars

1) **Dr. Daniel Mège** worked with me at UNR during Fall 1996 as a postdoctoral scholar, with expenses paid by the French Government. He studied mechanics of dike emplacement and related near-surface deformation processes such as shallow graben formation. Formerly on the faculty of the Université Pierre et Marie Curie, Paris VI as a tenured professor (Habilitation à diriger les recherches (HDR) thesis approved, December 2001), he was with the Université de Nantes, France (2004–2011) and has organized and led a research and teaching program in planetary science, sponsored by the Polish Academy of Science, in Wroclaw, Poland since then. His Ph.D. dissertation was written on the topic of faulting on Mars, with special reference to rifting at Valles Marineris, and he is coauthor of a chapter in *Planetary Tectonics*.
2) **Dr. Roger Soliva** joined my research group at UNR in Spring 2005 as a postdoctoral scholar, following his Ph.D. work entitled "Normal fault growth in layered rocks: The role of vertical restriction and linkage on scaling laws and fault spatial distribution" which was completed at the Université de Paris-Sud, Orsay, France in November 2004. His postdoctoral research on vertically restricted fault populations was published in *Geophysical Research Letters*, *Tectonics*, 2 AGU abstracts, and 1 Lunar and Planetary Science Conference extended abstract and he is coauthor of a chapter in *Planetary Tectonics*. Dr. Soliva has served on the faculty of the Université Montpellier II, France since Fall 2005.
3) **Dr. Hunjoo Lee** started as a postdoctoral scholar with the Center for Petroleum and Geosystems Engineering at The University of Texas at Austin in January 2016, following completion of his Ph.D. studies there. He was co-advised by Jon Olson and myself. His work focused on laboratory and theoretical investigations of mechanical interactions between natural fractures and hydrofractures generated during stimulation of unconventional reservoirs and was funded by UT's FRAC industry consortium. His expanded Ph.D. and postdoctoral research in which I was involved was published in 2 ARMA papers, 1 SPE paper, *International Journal of Rock Mechanics and Mining Sciences*, and *Journal of Structural Geology*. Dr. Lee serves on the faculty of Oklahoma State University, Stillwater.
4) **Dr. Omid Razavi** started as a postdoctoral scholar with Jon Olson's reservoir geomechanics research group in the Center for Petroleum and Geosystems Engineering at The University of Texas at Austin during Fall 2016, following completion of his Ph.D. studies there. He brought additional expertise in drilling engineering and laboratory experimentation to the research team. His work on drilling-related and experimental rock mechanics in which I was involved was supported by UT's FRAC Consortium and published in 1 ARMA paper and 1 SPE paper. Omid is currently a Principal Technical Professional with Halliburton in Houston.
5) **Dr. Zhaoliang Hou**, Structural Processes Group, Department of Geology, University of Vienna. Zhaoliang started his postdoc after he finished his Ph.D. at the same institution under the supervision of Bernhard Grasemann. I mentored him during my stay as Guest Professor at the university in May 2023. Now Associate Professor with China University of Geosciences, Beijing, his work has been published in *Geological Society of America Bulletin*.
6) **Dr. Shree Bade** started working on hydrogen-related topics as an informal postdoctoral scholar in December 2025, following completion of his Ph.D. studies at UND.

University and Professional Teaching

Teaching and related educational outreach activities have been one of my recognized core capabilities. My teaching style, including presentations at scientific conferences, is enthusiastic and engaging to encompass the typically wide range of learning modalities and technical competencies of the audience.

Critical thinking and comprehension, instead of rote memorization, have been fundamental components of my teaching philosophy. The ability to relate theory to observation was stressed in all classes. It was also emphasized that creativity is not random but can be taught and developed. Creativity, inspiration, and intuition complement training in analytical reasoning and are recognized as being useful in scientific pursuits.

University of North Dakota

Taught various graduate courses in Energy and Petroleum Engineering as listed in the following table.

	Undergraduate		*Graduate*
1	***PTRE 465: Petroleum Geomechanics*** ○ Required course for B.S. degree in petroleum engineering. ○ No required text but Zoback, *Reservoir Geomechanics* (2007), and Zoback and Kohli, *Unconventional Reservoir Geomechanics* (2019), Cambridge University Press, are recommended.	1	***PTRE 531: Reservoir Geomechanics*** ○ Includes more advanced material than PTRE xx. ○ No required text but Zoback, *Reservoir Geomechanics* (2007), and Zoback and Kohli, *Unconventional Reservoir Geomechanics* (2019), Cambridge University Press, are recommended.
2	***PTRE 493: Fracture Mechanics of Rock*** ○ Course was developed as a joint in-person/online class for UND. ○ Fundamental concepts and techniques of engineering fracture mechanics with particular emphasis on geologic cracks, faults, and deformation bands. ○ Text: *Geologic Fracture Mechanics* (2019), Cambridge University Press.	2	***PTRE 593: Fracture Mechanics of Rock*** ○ Course was developed for graduate credit as a joint in-person/online class for UND. ○ Fundamental concepts and techniques of engineering fracture mechanics with particular emphasis on geologic cracks, faults, and deformation bands. ○ Text: *Geologic Fracture Mechanics* (2019), Cambridge University Press.

		3	***PTRE 501: Graduate Cooperative Education*** ○ This course was designed for graduate students to spend a period of time in industry and get field/laboratory experience. A written report, presentation and feedback from the industry advisor was necessary.
		4	***ENE 591-03/04 Research in Energy Engineering*** (UND01-2630-ENE591-24514-24515) ○ Personalized tutoring and mentoring for Energy Engineering Ph.D. students
		5	***ENE 999: Dissertation in Energy Engineering*** (UND01-2510-ENE999-36514-36515) ○ Personalized tutoring and mentoring for EPE Ph.D. students.

IngeoExpert

My short course offered initially at the Universität Wien has been expanded into an online course, entitled "Fracture Mechanics of Rock for Geologists" for worldwide distribution. IngeoExpert Training Center is an online training center that delivers specialized courses in Civil Engineering, Geology, Environmental Science, Mining, Architecture and Technical Software.

Universität Wien

Taught short-course for graduate students on "280100 VU Fracture Mechanics for Geologists (2023S)" during May 2023 as Guest Professor with the Department of Geology, Universität Vienna, Josef-Holaubek-Platz 2/UZAII, A1090 Vienna, Austria; my faculty sponsor was Bernhard Grasemann. The text was *Geologic Fracture Mechanics* (2019), Cambridge University Press.

TopCorp Training for Oil-and-Gas Industry Regulators

During 2016 I participated as a subject matter expert and instructor in TopCorp (http://www.topenergytraining.com/TOPCORP) training, sponsored by Colorado School of Mines, UT, and Penn State University, teaching aspects of oil-and-gas engineering to regulators from the Division of Oil, Gas, and Geothermal Resources (DOGGR; now California Geologic Energy Management Division, CalGEM), State of California, Bakersfield, California. Particular

topics included Subsurface Integrity, and Geologic Hazard Identification and Mitigation, and Structural Traps. Four groups totaling 120 regulators including supervisors participated in the training workshops. The material and interactive group activities on subsurface risking were of particular value and enjoyment, with the Aliso Canyon, California natural gas blowout fresh in the minds of the regulators, State and national leaders, and the public. The training was updated and presented by invitation twice in 2022 and again in 2024.

The University of Texas at Austin

My responsibilities as Senior Research Scientist with the Center for Petroleum and Geosystems Engineering[15] at The University of Texas at Austin did not require a formal teaching component, but I engaged with existing courses within various Departments as appropriate and requested. During Fall 2015 I participated by invitation in Prof. Randy Marrett's graduate class in Brittle Structures including a field visit to the San Rafael Swell in Utah to co-mentor geoscience students in brittle structures and deformation bands there.

ConocoPhillips

While with ConocoPhillips and their Subsurface Containment Assurance Team, I co-led the development and deployment of a computer-based training course on this topic. The course cut across traditional institutional silos by emphasizing the relationships between drilling, wells, operations, reservoir engineering, completions, geosciences, and management in identifying and mitigating subsurface fluid losses in oil-and-gas fields. The course used an innovative and engaging multimedia format, video clips of company employees from various asset groups, and regular learning assessments. It was also the first course of its kind at ConocoPhillips designed to be compliant with mobile devices such as iPads. This 50-minute-long eLearning course was taken by technical employees and their managers from many business units, assets, and fields worldwide and led to raising the level of subsurface containment awareness across the company.

University of Nevada

The following 16 courses were conceived, developed, and implemented for the geological engineering/geological sciences programs while serving on the faculty of the University of Nevada, Reno. The dual 400/600-level course number indicates that both advanced undergraduates and graduate students could enroll; 700-level classes were for advanced graduate students only. Most of these courses were taught multiple times unless otherwise noted.

	Undergraduate		*Graduate*
1	***Introduction to Geomechanics*** (GE 481/681) ○ Essentials of rock fracture relevant to geological engineering, including stress and strain, properties and	1	***Mechanics of Fractures in Rock*** (GE 744) ○ Graduate-level seminar introduced fundamental concepts and techniques of engineering fracture mechanics

[15] Now the Center for Subsurface Energy and the Environment

	classification of continuous and discontinuous rock masses, and mechanism of rock fracture. ○ Course provided upper-division students in geology and geological engineering with a sound working knowledge of the fundamental concepts of rock mechanics, including interrelationships between deformation behavior of lab samples and outcrop-scale rock masses from a process point of view. ○ Text: Brady, B.H.G. and E.T. Brown, *Rock Mechanics for Underground Mining*, 2nd edition, Chapman and Hall, 1993; supplemental readings from Bieniawski, Z.T., *Engineering Rock Mass Classifications*, Wiley, 1989. Previous text: Goodman, R.E., *Introduction to Rock Mechanics*, 2nd edition, Wiley, 1989.		with particular emphasis on geologic cracks and faults. ○ Participants systematically read research papers, present summaries of key papers to the class, visited and discussed selected field examples of fractures, and wrote a concise yet comprehensive term paper on one aspect of rock fracture mechanics. ○ Texts: Atkinson, B.K., editor, *Fracture Mechanics of Rock*, Academic, 1987; Scholz, C.H., *The Mechanics of Earthquakes and Faulting*, Cambridge, 2002.
2	***Environmental Geology*** (GE 480/680) ○ Relationships between geological materials, processes, and mankind's safety, health, and quality of environment. ○ Course covered topics of importance to seniors in geology, geological engineering, mining engineering, and environmental sciences as well as nonscientists, engineers, and planners, including environmental processes and problems, mitigation strategies, and environmental policy. ○ Quality written reports were required on environmental issues, policies, and decisions including group project on evaluation of Environmental Impact Statement. ○ Text: National Research Council, *Solid-Earth Sciences and Society*,	2	***Topics in Advanced Geomechanics*** (GE 745) ○ Advanced seminar and workshop focusing on quantitative analysis of joints and faults using numerical boundary element methods and UDEC. The boundary element method was used to analyze selected problems in brittle fracture mechanics. ○ Course provided the theoretical basis for the methods as well as its Fortran implementation. Students were expected to modify the code and use it intelligently in geomechanics. ○ Text: Crouch, S.L. and A.M. Starfield, *Boundary Element Methods in Solid Mechanics*, George Allen and Unwin, 1983.

	1993 (required); supplemental readings from Brown, L.R., ed., *State of the World*, Worldwatch Institute, 1995.		
3	***General Geology for Honors Students*** (GEOL 101H) ○ Taught by request of the Department in Fall semester 2002. ○ We took a "big picture" approach to the Earth as a system and as a planet, staring with its formation with the rest of the Solar System and moving on to recent times and processes, such as climate change, from there. The course material was integrated with the lab, GEOL 103. ○ Text: Lunine, J.I., *Earth: Evolution of a Habitable World*, Cambridge University Press, 1999.	3	***Computational Fracture Mechanics*** (GEOL 702T) ○ High-level workshop designed to provide experience in idealizing and solving problems in rock fracture using 2-D and 3-D computer codes such as boundary elements, finite elements, and UDEC. ○ Students chose and solved their own research projects and presented their findings both orally and in a comprehensive written report. Readings were assigned as appropriate from pertinent books and journals.
4	***Physical Geology*** (GEOL 101) ○ The standard beginning class for majors and others interested in a good class in basic geology. The course material was integrated with the lab, GEOL 103. ○ Text: Tarbuck and Lutkins, *Earth: An Introduction to Physical Geology*, Prentice-Hall, 2002.	4	***Geomechanics Professional Seminar*** (GEOL 701T/702T) ○ Weekly required seminar for my geomechanics research group that provided preparation and development for graduate-level research and post-graduate careers, including writing exercises and advanced skills for oral and poster preparation for scientific conferences.
5	***Special Problems*** (GEOL 495) ○ Seminar and supervised study of new findings on the geology, volcanology, and tectonics of Mars and Venus; also specialized topics in rock mass characterization. Included directed readings from journal articles.	5	***Workshop on Martian Tectonic Modeling*** (GEOL 702T) ○ This graduate workshop introduced students to research in planetary tectonics by posing and solving a cutting-edge problem as a class. Students learned from selected literature review and critiques with hands-on mechanical modeling of selected structures such as grabens and pit crater chains. ○ Two published papers with the key student participants as author or

			coauthor resulted from this workshop [*Schultz et al*., 2004; *Goudy and Schultz*, 2005].
6	***Planetary Science*** (GE 486/686) ○ Planetary formation and evolution based on meteorite studies; planetary development as revealed by planetary surfaces; context of Earth in the solar system. ○ Texts: Lewis, J.S., *Physics and Chemistry of the Solar System*, Academic, 1995; Greeley, R., *Planetary Landscapes*, 2nd edition, 1994.	6	***Deformation of Sandstone and Porous Geomaterials*** (GEOL 701T) ○ In this graduate workshop we covered the basics of critical-state soil and weak-rock mechanics and the deformation of porous granular aggregates, including yield caps and research literature on strain localization for this important class of materials. ○ Co-taught with Prof. Raj Siddharthan, Department of Civil and Environmental Engineering, UNR and resulted in a peer-reviewed journal article [*Schultz and Siddharthan*, 2005], which won the Top Cited Award by Elsevier for papers from 2005–2010.
7	***Introduction to Geological Engineering*** (GE 106) ○ Taught in Fall 1995 during Prof. R. Watters' sabbatical leave in Scotland. Course was restructured using material from textbook and lectures from professional geological engineers, along with formal homeworks and exams. ○ Text: Waltham, A.C., *Foundations of Engineering Geology*, Blackie Academic and Professional, London, 1994.	7	***Seminar in Planetary Tectonics*** (GEOL 702T) ○ Graduate students read, discussed, and wrote their own reviews of chapters in the edited volume *Planetary Tectonics* (published subsequently by Cambridge University Press in 2010), while identifying several outstanding research problems from each planetary body (terrestrial planets, icy satellites, asteroids). ○ A peer-reviewed paper was coauthored and published in *Icarus* based on work done by the students in this class [*Klimczak et al*., 2010] which has since stood the test of time and additional data from the Messenger orbital spacecraft mission to Mercury.
8	***Geology for Engineers*** (GE 250)		

	○ Condensed introduction to geologic principles and aspects of structural geology, hydrology, earthquakes, and geophysics relevant to engineers. Course included an abbreviated lab each week. ○ Text: Pipkin, B.W., et al., *Geology and the Environment*, current edition, Thomson Brooks/Cole.		
9	***Structure, Tectonics, and Earth Physics I*** (GEOL 332) ○ This basic required course in structural geology was completed reimagined and revised for Fall 2010 to cover material of interest to a broad set of Earth scientists and engineers. ○ Text: Twiss and Moores, *Structural Geology*, 2nd edition, Freeman, 2007.		

University and Professional Service

University of North Dakota

Department of Energy and Petroleum Engineering (EPE)

Refreshed and updated EPE[16] webpages to more clearly indicate faculty, staff, and adjunct personnel.

Led effort to improve safety and compliance of EPE teaching and research labs including instituting new mandatory training requirement for faculty, staff, and students.

Engaged with EPE student chapters (SPE, IADC, ARMA, AEE) to facilitate coordination of activities between them.

Authored Promotion, Tenure, and Evaluation document.

Explored collaborations between EPE, CEMRI[17], EERC[18].

Administrative PI, "NDIC Contract No. G-055-107" (during award closure), ~$3 million.

College of Engineering and Mines (CEM)

Committees:

- Academic Leadership Council

[16] Department of Energy and Petroleum Engineering, UND
[17] College of Engineering and Mines Research Institute, UND
[18] Energy & Environmental Research Center, UND

- Promotion and Tenure Committee (Chair)
- Strategic Planning - Service Value Committee
- Outreach and Recruiting Steering Committee

U.S. and International

Interviews:

- NPR's Marketplace Morning Report: "Amid Trump's calls to "drill, baby, drill," OPEC+ meets Monday to decide how it will respond." Caleigh Wells, January 31, 2025.

Invited participant in International Gas Union's Underground Storage Working Groups WOC 1 and 3:

- Online Committee Fall Meeting, Germany, September 2025.
- Storage Committee Report of Study Group 1: UGS database," International Gas Union, May 2025, 67 p.

Orion Geomechanics LLC

Served as an invited panelist to discuss "Rulemakings and Regulations," at the *16th Annual Platts Gas Storage Outlook Conference*, Houston, Texas, January 8–9, 2018.

American Rock Mechanics Association:

- Board of Directors (2021–present).
- Chair, Distinguished Service Award selection committee (2020–2021).
- Founding Chair, Underground Storage and Utilization Technical Committee and Community, including pioneering the use of social media such as LinkedIn® and YouTube to host videos and related materials for ARMA.
- Technical Program Chair and member of the Organizing Committee, *52nd US Rock Mechanics/Geomechanics Symposium*, Seattle, Washington, June 17–22, 2018. Supervised and worked with approximately 60 disciplinary (track) leads, session developers, and staff from ARMA and Catalyst/OmniPress to produce the technical program of oral and poster presentations from more than 800 submitted abstracts. Also chair of the technical poster session on Sanding and Injection Geomechanics.
- Worked with Gang Han (Aramco Services Company, Houston) to draft a proposal for the ARMA Distinguished Service Award, Fall 2019; served as first Chair of the selection committee in 2020–2021.

Engaged with PHMSA's Risk Ranking Team to support their implementation of new federal regulations for underground natural gas storage facilities (US Department of Transportation's Pipeline and Hazardous Materials Safety Administration).

Invited participant in International Gas Union's Underground Storage Working Groups WOC 1 and 3:

- "The evolving energy landscape in the USA," presented to the International Gas Union, Underground Storage (UGS) Committee Spring Meeting, Germany, April 2026.
- "Restructuring science and energy in the USA: Spring 2025," presented to the International Gas Union, Underground Storage (UGS) Committee Spring Meeting, Budapest, Hungary, March 2025.
- "Renewable energy storage developments in USA – 2024," presented to the International Gas Union, Underground Storage (UGS) Committee Spring Meeting, Paris, France, April 10–11, 2024.
- "The future of petroleum engineering in American universities," presented to the International Gas Union, Underground Storage (UGS) Committee Fall Meeting, Gdańsk, Poland, October 10, 2024.
- Presented invited talk on "Renewable energy storage – Development in USA" in Brno, Czech Republic, June 1, 2023.
- Presented invited talk on "Certification of US underground natural gas storage facilities" in Prague, Czech Republic, May 20–23, 2019, with field visit to Innogy's Háje rock cavern underground natural gas storage facility.
- Presented invited talk on "How can we quantify leakage rates at underground natural gas storage facilities?" in San Francisco, California, October 30–November 2, 2018, with field visit to Los Medanos underground natural gas storage facility.

Worked with James Giles to organize and set the agenda for the *17th Annual Platts Gas Storage Outlook Conference*, held in Houston, Texas, January 2019.

Invited to contribute definitions and terms for structural geology and geomechanics to TecTask3, International Union of Geological Sciences (IUGS), Spring 2019.

Participated and engaged with colleagues at the 2019 SPE GCS *Geomechanics Congress on Recent Advancements in Petroleum Geomechanics*, Houston, Texas, May 17, 2019.

Discussed underground natural gas, CO_2, and hydrogen storage opportunities with Nafta a.s., Bratislava, Slovakia, May 24, 2019.

Visited Vysoká škola báňská–Technická univerzita Ostrava (VSB), Czech Republic, to discuss subsurface geological engineering projects with Martin Klempa, Faculty of Mining and Geology (Hornicko-geologická fakulta), May 27, 2019.

The University of Texas at Austin

As part of Prof. Jon Olson's research group and the Center for Petroleum and Geosystems Engineering (PGE), I provided mentoring to several postdoctoral scholars, Ph.D. and M.S. students, and petroleum geology and tectonics graduate students in the Jackson School of Geosciences and its Bureau of Economic Geology.

Beginning in September 2015 I initiated and implemented a set of management and professional enrichment tools for graduate student advisement and mentoring in Prof. Jon Olson's research group including individual and research group meetings, systematic training for oral and poster presentations, critical analysis of presentation and publication mechanics, and systematic preparation of conference and journal publications including enhanced writing skills. These activities were acknowledged by peers and colleagues as resulting in improved student performance.

Invited to judge student poster presentations at the Center for Petroleum and Geosystems Engineering's 2015 Research Showcase in Petroleum and Geosystems Engineering (sponsored by Saudi Aramco and Chevron), AVAYA Auditorium, September 8, 2015. Also participated in CPGE Advisory Board Meeting, September 9, 2015.

As part of the FRAC industry consortium with BEG, I adopted and championed the use of the then-newly instituted PowerPoint branding templates for PGE and Cockrell School of Engineering. These were tested at the September 2015 FRAC meeting with feedback and recommendations subsequently submitted to the Department.

Represented Petroleum and Geosystems Engineering at the ExxonMobil/Bureau of Economic Geology Unconventional Reservoirs Research Meeting, The Woodlands, Texas, October 26, 2015 and discussed current status of geomechanics projects and possible future directions.

From Fall 2015 through August 2017 I was involved as Co-PI on projects funded by the Texas Center for Integrated Seismicity (CISR) in the areas of wastewater injection geomechanics and subsurface integrity that also involved graduate-student support.

Beginning in 2015 I initiated the design and implementation of a new web-based archive and database to facilitate access to measurements of geomechanical properties such as subcritical crack growth parameters made by UT researchers on PGE laboratory equipment. The website was to compile and open the entire UT collection of measurements and supporting documents such as theses, dissertations, Matlab scripts, reports, and publications to the global research community.

Invited instructor for the TopCorp multi-university partnership for regulators and policymakers in the oil-and-gas field in areas of structural geology, reservoir integrity, induced seismicity, and surface subsidence and monitoring in California and elsewhere (Spring and Fall 2016).

Explored the capabilities and benefits to PGE research of Rockfield's ELFEN finite-element software package, including attendance at the global launch event of Rockfield Global Technologies America LLC in Houston (2015–2016).

Represented Petroleum and Geosystems Engineering and participated in the SPE/SEG Workshop: Injection Induced Seismicity—Engineering Integration, Evaluation and Mitigation, Fort Worth, Texas, March 28–30, 2016.

Investigated the creation of a peer-reviewed edited volume on *Subsurface Integrity*, to be published by Cambridge University Press, with Co-Editor U. Mutlu (Rockfield Global Technologies America LLC).

Served as a judge for PGE's Regional Paper Contest Practice to prepare students for the SPE competition (Spring 2016). UT students swept the top spots in all three divisions (Undergraduate, Master's, and Ph.D.).

Member of the Natural Gas and Liquids Storage Work Group, sponsored by the Interstate Oil & Gas Compact Commission, States First (now State Oil & Gas Regulatory Exchange), and the Ground Water Protection Council, which was tasked with reformulating regulations for safe storage of natural gas in underground sites as part of the US national energy infrastructure (2016–2017). Also was appointed to the IOGCC and its Standing Committees on Energy Resources, Research, and Technology, and Environment & Safety by David J. Porter, Chairman of the Texas Railroad Commission (2016).

Worked with Steve Laubach (UT BEG) to help organize a meeting and follow-on publication on Fracture Mechanics and Fracture Pattern Evolution in Deep, Hydrothermal and Reactive Environments, sponsored by U.S. Department of Energy, Office of Basic Energy Sciences

(Chemical Sciences, Geosciences, and Biosciences Division), May 8–10 2016, National Conference Center, Leesburg, Virginia.

Participated in the Workshop on Well Integrity for Natural Gas Storage in Depleted Reservoirs and Aquifers, sponsored by the DOE Interagency Task force on Natural Gas Storage Safety, in Broomfield, Colorado, July 12–13, 2016, followed by the one-day Pipeline and Hazardous Materials Safety Administration (PHMSA) Public Workshop on Underground Natural Gas Storage Safety, July 14, 2016 at the same venue.

Worked onsite at Repsol (Houston office) to apply subject-matter experience in geomechanics and related software from the FRAC consortium to address requested issues with this industrial consortium sponsor.

Involved in planning and executing the 2016 FRAC Consortium annual meeting, Lost Pines Resort, Bastrop, Texas, including technical program and coordinating follow-up summaries and feedback reports.

Retained by major law firm as consulting expert in cases involving subsurface integrity.

Served as a panelist to discuss "Growing Regulatory Oversight Concerning Gas Storage Well Operations" at the *15th Annual Platts Gas Storage Outlook Conference*, Houston, Texas, January 12–13, 2017.

Session moderator, Underground Storage and Structures: Geomechanics for Civil Engineering, at the *51st U.S. Rock Mechanics/Geomechanics Symposium*, San Francisco, California, June 28, 2017.

Interviewed by Dennis Webb, reporter for *The Daily Sentinel* (Grand Junction, Colorado), for his article on "Gas firms aim to comply with new regs," July 3, 2017; available online at http://www.gjsentinel.com/news/articles/gas-firms-aim-to-comply-with-new-regs.

Invited to review research reports to California Council on Science and Technology related to underground natural gas storage facilities in California (2017).

University of Nevada

Department of Geological Sciences and Engineering

Recruitment of students for Geological Engineering Program, Department of Geological Sciences, and Mackay School of Mines (1990–2011).

Geological Sciences Departmental Committee on Graduate Program Review (1991); helped draft and prepare new written guidelines for our graduate students that are still in active use.

Chair of the thesis and dissertation advisory/examination committees for 18 graduate students who completed their M.S. and Ph.D. degrees under my supervision from 1991 through 2011 (not including unsuccessful students); served on the thesis/dissertation committees for 26 other students.

Developed 6 new courses in geomechanics for the Geological Engineering program. The courses were popular and considered effective in training students in rock fracture principles.

Reactivated and strengthened the dual-level class in Environmental Geology for geological engineers and other students.

Developed and instituted a new research program in rock fracture, involving graduate students, that incorporates field, experimental, and theoretical rock mechanics; recognized internationally for its innovation, high quality, and relevance to important issues in several different disciplines.

Served on Departmental Curriculum Committee as representative from geological engineering; reviewed and streamlined graduate programs across disciplines within the Department (1993–1994).

Reinstituted and organized Department-wide Seminar Series for invited speakers from other institutions (1993–1994). Organized and hosted all visits, and promoted the Department during these events.

Coordinator, UNR Field Camp, second session (1994).

Developed 2 new upper division classes in Planetary Science that built upon existing strengths and coursework in aerospace remote sensing and rock mechanics (1995–1996).

Organized creation of World Wide Web homepages for myself, the Geomechanics Laboratory, and five graduate students (1995); and web pages for the Geological Engineering Program and two GE students (1996). The entire integrated suite of Geomechanics web pages was reorganized and upgraded in 2000 and again in 2011.

Served on Departmental Curriculum Committee as representative from Geological Engineering; helped redefine procedures for Ph.D. advisory/examination committees within the Department (1996).

Participated in Geological Engineering conversion to ABET 2000 assessment methods (1998).

Organized creation of new recruiting brochures for Geological Engineering (1998–2011).

Created and maintained the new web site for UNR's Geological Engineering Program (2000–2011).

Served on the search committee for the Introductory Geology Teaching faculty position (Spring and summer, 2001) and participated in the search committee and interviews for the Petrologist/Geochemist faculty position.

Taught GEOL 101 as a Departmental service course in Spring 2001, GEOL 101H (Honors section) in Fall 2002, and GEOL 100 in Spring 2006.

Undergraduate Student Coordinator, Department of Geological Sciences (summer 2003).

Assisted in crafting the Strategic Plan for Department of Geological Sciences (Fall 2003).

Proposed and championed new curricula for Department of Geological Sciences undergraduate degrees, including new B.S. degrees in GeoSystems Science (replacing Geology), B.S. in GeoSystems Engineering (combining Geological Engineering, Geophysics, and Hydrology into a single degree with discipline-specific modules), and a B.A. in GeoSystems Science that included lower-level math with broader science requirements than the existing Geology B.S. degree.

Acting Chair of the Department of Geological Sciences' Personnel Committee for the evaluation of Promotion applications (Fall 2004).

Contributed to producing the ABET document for accreditation visits for Geological Engineering undergraduate B.S. degree program (1990–2011).

Acting Chair of the Department of Geological Sciences and Engineering's Personnel Committee for the evaluation of Promotion applications (Fall 2005).

Member of the Department of Geological Sciences and Engineering's Committee on Faculty Role Statements and Evaluation (2005).

Member of the Department of Geological Sciences and Engineering's Personnel Committee for the evaluation of tenured and research faculty (2006).

Served on the Department of Geological Sciences and Engineering's Course and Curriculum Committee as representative from Geological Engineering (2006–2011).

Chair of the Department of Geological Sciences and Engineering's Personnel Committee for the Annual Evaluation process of academic, research, and administrative faculty (2006–2007).
Coordinator, Geological Engineering Program, Department of Geological Sciences and Engineering, University of Nevada, Reno (2007–2011).
Member of the Department of Geological Sciences and Engineering's Faculty Search Committee for Assistant Professor of Hydrogeology (2008).
Search Committee member, postdoctoral scholar in remote sensing (2008).
Revised the Geological Engineering B.S. degree requirements (2009).
Member of the Search Committee, faculty hire in Geological Sciences and Engineering (2009–2010); resulted in the first new faculty hire in 15 years for the department.
Participated in revision of the Geology B.S. degree requirements (2010, 2011).
Director of Graduate Programs, Department of Geological Sciences and Engineering, University of Nevada, Reno (2010–2011).
Webmaster, Department of Geological Sciences and Engineering, University of Nevada, Reno (2010–2011).

Mackay School of Mines (MSM)/College of Science

Geotechnical/Geological Hazards Advisory Committee for Truckee Meadows Regional Planning Commission, Nevada (1991–1994).
Initiated and supervised improvements in student-related infrastructure in geological engineering facility (rooms LMR 164, 165, 167, 168) including hardware and software renovation, connection to the Internet via newly installed ethernet cabling and hubs, and acquisition of new computing equipment and storage peripherals (1995–1996).
Served on the MSM Search Committee to hire a new structural geologist/field mapper for the Nevada Bureau of Mines and Geology (1996–1997). Dr. Faulds later became the Nevada State Geologist and Director of the Bureau of Mines and Geology.
Coordinated major computational upgrades for Geological Engineering Node, MSM high-performance distributed computing system, using three new Silicon Graphics workstations tied to an ONYX2 SGI mainframe (1997–1998).
Served on MSM Education Committee (1998).
Served on MSM Keck Equipment Committee (1998).
Served on the search committee for the Applied Research Geologist/Remote Sensing and GIS position (Summer, 1999).
Organized the MSM-wide Earth Sciences seminar series for Spring 2001 including acquisition of speakers, scheduling, and budgeting.
Elected to MSM Personnel Committee from Department of Geological Sciences (Fall 2003).
Keck Museum Directorate (2001–2002).

University of Nevada, Reno

Asked to serve on thesis and dissertation advisory/examination committees for graduate students in geological engineering, structural geology, neotectonics, rock physics, hydrology, geophysics, mining engineering, education, and economic geology.
Frequently advised undergraduate students and visitors to UNR on academic programs, particularly during summers and semester breaks.
University Appeals Committee (1992–1995).
University Committee for Distinguished Teacher Award (1992–1993).

Served on numerous ad hoc committees to improve Geological Engineering program at UNR.
University International Activities Committee (1993–1996).
Served on Research Grants Subcommittee, International Activities Committee (1993–1995).
Participated by invitation in university-wide seminars on "Critical Thinking in the Classroom, How Students Learn, and Mentoring Graduate Students," Los Angeles, California (1994).
Invited for on-camera interview by Intensive English Language Center on the importance of good English in international students taking university-level courses in science and engineering (1994).
Chair, University Appeals Subcommittee (1995).
Served on Faculty Senate's School of Medicine Reorganization Ad Hoc Review Committee to advise on merger of Anatomy and Physiology Departments (1995).
Chair, University Salary and Benefits Policy Committee (1995–1996).
University Merit Policy Committee (1995–1996).
Member (ex officio), UCCSN System-wide Compensation Committee (1995–1996).
Invited to serve on the Faculty Senate's Redfield Advisory Committee to recommend academic programs for the inaugural building at the University of Nevada's Redfield Campus (1996).
Attended UNR workshop as departmental representative on producing Strategic Plans for departments and units (Fall 2003).
Member of the Search Committee, faculty hire in Experimental Atmospheric Physics, Department of Physics, College of Science (2004–2005).
Advisory Board, Fleischmann Planetarium and Science Center, including its proposed expansion into the regional Great Basin Exploration Center (1997–2002).
Member of the Search Committee, Associate Director of Fleishmann Planetarium (representative from College of Science; Spring 2004).
Served by invitation as Faculty Mentor for Prof. Zong Tian, Department of Civil and Environmental Engineering (Traffic Engineering; 2005–2008).
Elected Faculty Senator, College of Science (2010–2011).

State of Nevada

Invited to work with Gifted and Talented Program on interdisciplinary Mars studies, Sarah Winnemucca Elementary School, Reno, October/November 1994.
Attended Fred Pryor Seminar on "Management Problems of the Technical Person in a Leadership Role," April 20, 1995, to augment and refine graduate student advisement capabilities.
Presented a live interview with Sam Evans and Channel 2 News on the current scientific results from the Mars Pathfinder mission (July 7, 1997).
Established ties with the Keck Consortium of leading undergraduate geology colleges as an additional tool for recruiting new graduate students in Geological Sciences (1998–2011).
Identified and tested new web-based advertising for graduate students (Earthworks-jobs site); approximately 10:1 applicants to accepted students for each new NASA RA position.
Developed and strengthened advisement capabilities with CareerTrack's "Professional Supervision Skills" three-part workshop (1999).

Publications

Summary of Publications and Presentations

Entries as author or coauthor include approximately:

- 1 book, another due out in 2026
- 7 edited volumes
- 19 chapters in books and edited volumes
- 124 papers in peer-reviewed journals and conference proceedings
- 268 contributed abstracts and presentations
- 110 additional invited seminars or presentations to academia, trade groups, and industry

Books

Year	
2026	Schultz, R.A. (2026), 地质断裂力学 (*Geologic Fracture Mechanics*, Chinese edition), Cambridge University Press and Petroleum Industry Press, contract signed June 12, 2022; to be published in 2026.
2019	Schultz, R.A. (2019), *Geologic Fracture Mechanics*, Cambridge University Press, 608 p., ISBN 9781107189997, available at Publisher and Amazon (published worldwide in September 2019).

Edited Volumes

Year	
2023	Miocic, J., N. Heinemann, K. Edlmann, J. Alcalde, and R.A. Schultz, editors (2023), *Enabling Secure Subsurface Storage in Future Energy Systems*, *Geological Society of London Special Publication*, **528**, https://doi.org/10.1144/SP528, 514 p., August 31, 2023, ISBN 9781786205766 (#1 most cited SP for 2023).
2019	Schultz, R.A., guest editor (2019), Special Issue containing the best and keynote peer-reviewed papers from ARMA's *52nd US Rock Mechanics/Geomechanics Symposium*, in *Rock Mechanics and Rock Engineering*, **52**, 4863–5821.
2016–2017	Co-Editor, *Interpretation*, special section on "Natural Fracture Interpretation: What to Look For" (with S.E. Laubach, J.E. Olson, and R. Marrett); papers were published as individual contributions.
2010	Watters, T.R., and R.A. Schultz, editors (2010), *Planetary Tectonics*, Cambridge University Press, 556 p., ISBN 9780521765732.

2006	Schultz, R.A., and R.T. Pappalardo, guest editors (2006), Special Issue on "Faulting and Fault Related Processes on Planetary Surfaces," *Journal of Structural Geology*, **28**, 2122–2270.
1998	Schultz, R.A., and R. Siddharthan, editors (1998), *Proceedings of the 33d Symposium on Engineering Geology and Geotechnical Engineering*, 267 p.
1995	Daemen, J.J.K., and R.A. Schultz, editors (1995), *Rock Mechanics: Proceedings of the 35th U.S. Symposium*, Balkema, Rotterdam, 956 p.

Chapters in Books and Edited Volumes

Year	
2026	
2023	Miocic, J., N. Heinemann, K. Edlmann, J. Alcalde, and R.A. Schultz (2023), Enabling secure subsurface storage in future energy systems: an introduction, in *Enabling Secure Subsurface Storage in Future Energy Systems*, edited by J. Miocic, N. Heinemann, K. Edlmann, J. Alcalde, and R.A. Schultz, *Geological Society of London Special Publication*, **528**, pp. 1–14, https://doi.org/10.1144/SP528-2023-5 (published online August 26, 2022). Babarinde, O., B. Schwartz, J. Meng, S. Kim, J. Segura, R.A. Schultz, and H. Soroush (2023), An overview of carbon sequestration and its geomechanical aspects, in *Enabling Secure Subsurface Storage in Future Energy Systems*, edited by J. Miocic, N. Heinemann, K. Edlmann, J. Alcalde, and R.A. Schultz, *Geological Society of London Special Publication*, **528**, pp. 61–72, https://doi.org/10.1144/SP528-2022-51 (published online August 26, 2023). Schultz, R.A., N. Heinemann, B. Horváth, J. Wickens, J.M. Miocic, O.O. Babarinde, W. Cao, P. Capuano, T.A. Dewers, M. Dusseault, K. Edlmann, R.A. Goswick, A. Hassanpouryouzband, T. Husain, W. Jin, J. Meng, S. Kim, F. Molaei, T. Odunlami, U. Prasad, Q. Lei, B.A. Schwartz, J.M. Segura, H. Soroush, S. Voegeli, S. Williams-Stroud, H. Yu, and Q. Zhao (2023), An overview of underground energy-related product storage and sequestration, in *Enabling Secure Subsurface Storage in Future Energy Systems*, edited by J. Miocic, N. Heinemann, K. Edlmann, J. Alcalde, and R.A. Schultz, *Geological Society of London Special Publication*, **528**, pp. 15–35, https://doi.org/10.1144/SP528-2022-160 (published online October 27, 2022). Schultz, R.A., S. Williams-Stroud, B. Horváth, J.M. Wickens, H. Bernhardt, W. Cao, P. Capuano, T.A. Dewers, R.A. Goswick, Q. Lei, M. McClure, U. Prasad, B.A. Schwartz, H. Yu, S. Voegeli, and Q. Zhao (2023), Underground energy-related product storage and sequestration: Site characterisation, risk analysis, and monitoring, in *Enabling Secure Subsurface Storage in Future Energy Systems*, edited by J. Miocic, N. Heinemann, K. Edlmann, J. Alcalde, and R.A. Schultz, *Geological Society of London Special Publication*, **528**, pp. 37–59,

	https://doi.org/10.1144/SP528-2022-66?ref=pdf&rel=cite-as&jav=AM (published online September 28, 2022).
2017	Fossen, H., R. Soliva, G. Ballas, B. Trzaskos, C. Cavalcante, and R.A. Schultz (2017), A review of deformation bands in reservoir sandstones: Geometries, mechanisms and distribution, in *Subseismic-Scale Reservoir Deformation*, edited by M. Ashton, S.J. Dee, and O.P. Wennberg, *Geological Society of London Special Publication*, **459**, pp. 9–33, https://doi:10.1144/SP459.4.
2015	Nahm, A.L., and R.A. Schultz (2015), Rupes Recta and the geological history of the Mare Nubium region of the Moon: Insights from forward mechanical modeling of the 'Straight Wall,' in *Volcanism and Tectonism Across the Inner Solar System*, edited by T. Platz, M. Massironi, P.K. Byrne, and H. Hiesinger, *Geological Society of London Special Publication*, **401**, pp. 377–394, https://doi:10.1144/SP401.4 (published online in 2013).
2010	Tanaka, K.L., R. Anderson, J.M. Dohm, V. Hansen, G. McGill, R. Pappalardo, R.A. Schultz, and T.R. Watters (2010), Planetary structural mapping, in *Planetary Tectonics*, edited by T.R. Watters and R.A. Schultz, Cambridge University Press, pp. 351–396. Schultz, R.A., R. Soliva, C.H. Okubo, and D. Mège (2010), Fault populations, in *Planetary Tectonics*, edited by T.R. Watters and R.A. Schultz, Cambridge University Press, pp. 457–510.
2008	Benedicto, A., V. Plagnes, P. Vergély, N. Flotté, and R.A. Schultz (2008), Fault and fluid interaction in a rifted margin: Integrated study of calcite-sealed fault-related structures (southern Corinth margin), in *The Internal Structure of Fault Zones: Implications for Mechanical and Fluid-Flow Properties*, edited by C.A.J. Wibberley, W. Kurz, J. Imber, R.E. Holdsworth, and C. Collettini, *Geological Society of London Special Publication*, **299**, pp. 257–275.
2007	Schultz, R.A., J.M. Moore, E.B. Grosfils, K.L. Tanaka, and D. Mège (2007), The Canyonlands model for planetary grabens: Revised physical basis and implications, in *The Geology of Mars: Evidence from Earth-Based Analogues*, edited by M.G. Chapman, Cambridge University Press, pp. 371–399.
1998	Austin, K., and R.A. Schultz (1998), The use of RMR in determining subsidence parameters, in *33rd Symposium on Engineering Geology and Geotechnical Engineering*, edited by R.A. Schultz and R. Siddharthan, pp. 49–54, University of Nevada, Reno.
1996	Schultz, R.A., and J.M. Moore (1996), New observations of grabens from the Needles District, Canyonlands National Park, Utah, in *Geology and Resources of the Paradox Basin*, edited by A.C. Huffman, Jr., W.R. Lund, and L.H. Godwin, Utah Geological Association *Guidebook* **25**, pp. 295–302.
1995	Schultz, R.A., and T.R. Watters (1995), Elastic buckling of fractured basalt on the Columbia Plateau, Washington State, in *Rock Mechanics: Proceedings of the 35th*

	U.S. Symposium, edited by J.J.K. Daemen and R.A. Schultz, pp. 855–860, Balkema, Rotterdam.
1993	Schultz, R.A., K.A. Ward, and M.J. Hibbard (1993), Dike emplacement in the Donner Summit pluton, northern Sierra Nevada, California, in *Crustal Evolution of the Great Basin and Sierra Nevada,* edited by M.M. Lahren, J.H. Trexler, Jr., and C. Spinosa, pp. 277–284, Geological Society of America Guidebook, Cordilleran/Rocky Mountain Sections, Reno, Nevada.
1992	Schultz, R.A., and R.C. Bradt (1992), Cleavage of ceramic and mineral single crystals, in *Fracture Mechanics of Ceramics*, **10**: *Fracture Fundamentals*, *High-Temperature Deformation*, *Damage*, *and Design*, edited by R.C. Bradt, D.P.H. Hasselman, D. Munz, M. Sakai, and V.Ya. Shevchenko, pp. 135–153, Plenum, New York. Lucchitta, B.K., A.S. McEwen, G.D. Clow, P.E. Geissler, R.B. Singer, R.A. Schultz, and S.W. Squyres (1992), The canyon system on Mars, in *Mars*, edited by H.H. Kieffer, B.M. Jakosky, C.W. Snyder, and M.S. Matthews, pp. 453–492, University of Arizona Press, Tucson. Schultz, R.A. (1992), Studies of faulting on the Earth and other planets, in *Trends in Geophysical Research*, **1**, pp. 97–111, Council of Scientific Research Integration, Trivandrum, India (INVITED REVIEW CHAPTER).
1990	Aydin, A., R.A. Schultz, and D. Campagna (1990), Fault-normal dilation in pull-apart basins: Implications for the relationship between strike-slip faults and volcanic activity, in *Active and Recent Strike-Slip Tectonics*, edited by M. Boccaletti and A. Nur, *Annales Tectonicae* (*International Journal of Structural Geology and Tectonics*), **4**, pp. 45–52.
1989	Aydin, A., and R.A. Schultz (1989), The effect of fault interaction on the stability of echelon strike-slip faults, in *Proceedings of Conference XLV on Fault Segmentation and Controls of Rupture Initiation and Termination*, edited by D.P. Schwartz and R.H. Sibson, *U.S. Geological Survey Open-File Report*, **89-315**, pp. 47–66.

Papers Submitted and in Preparation

Year	*Submitted*	*In Preparation*
2026	Ifrene, G., Kuldeep, S., R.A. Schultz, N. Nagel, and N. Bittner, Experimental investigation of inertial flow in 3D printed intersected rough fractures: Effects of JRC and intersection angle, *International Journal of Rock Mechanics and Mining Sciences*. Baroň, I., R. Melichar, F. Hartvich, M. Šutjak, T. Pánek, J.-J. Dong, T. Nguyễn, R.A. Schultz, T. Goslar, R. Braucher, and L. Kociánová, Clustered	Josephs, R.E., and R.A. Schultz, Technical and economic evaluation of North Dakota's wind energy potential for hydrogen production, *Renewable Energy*. Bade, S.O., R.A. Schultz, Assessing the economic potential of waste wind-to-hydrogen pathways using depleted reservoirs, *Journal of Hydrogen Energy*.

	intraplate earthquakes and stress-field switching in Central Europe, *Nature Communications*.	Sprenkeling, M., Tessa, S. van Gessel, R.A. Schultz, et al., SEL and UHS, in prep. Baroň, I., J. Jelének, M. Rowberry, R. Melichar, M. Papsi-Isaba, R.A. Schultz, J. Belek, J. Stemberk, L. Sokol, H. Hausmann, C. Freudenthaller, L. Plan, G. Winkler, B. Grasemann, and R. Bürgmann, Unusual fault kinematic behavior preceding and following the Spring 2021 earthquake series, Vienna Basin, Austria, *Geophysical Research Letters*.

Research Papers[19]

Year	*Journal Papers*	*Conference Papers*
2026	Pothana, P., K. Ling, and R.A. Schultz (2026), Rock physics and petrophysical evaluation of diagenetic effects in the Broom Creek CO_2 storage site, *Geoenergy Science and Engineering*, 257, 214229, https://doi.org/10.1016/j.geoen.2025.214229.	
2025	Ifrene, G., S. Kuldeep, R.A. Schultz, P. Pothana, N. Nagel, and S. Egenhoff (2025), DNS simulations of inertial flow phenomena in 3D intersecting rough fractures: Impact of roughness and intersection angle on non-linear flow regimes, 105093, *Advances in Water Resources*, **205**, November 2025 https://www.sciencedirect.com/science/article/pii/S0309170825002076?dgcid=coauthor. Ifrene, G., R.A. Schultz, P. Pothana, N. Nagel, K. Singh, and S. Egenhoff (2025), Triaxial analysis of mechanical properties in additively manufactured layered material, *Polymer Engineering*	

[19] Chapters in books and edited volumes listed separately.

	and Science, **65**, 4227–4239, May 30, 2025, https://doi.org/10.1002/pen.27288. Selected for "Best Researcher Award." Hibbard, L., J.A, White, D.G. Clarke, S. Harrison, R.A. Schultz, A. Goodman, F. Hasiuk, and N. Huerta (2025), Underground hydrogen storage resource assessment for Cook Inlet, Alaska, *Applied Energy*, **377**, 124135, https://doi.org/10.1016/j.apenergy.2024.124135.	
2024	Hou, Z., K. Qiu, A. Rogowitz, R.A. Schultz, J. Deng, and B. Grasemann (2024), Progressive development of stylolites in cryptocrystalline quartz from western Sichuan Basin, China, *Geological Society of America Bulletin*, **136**, B37461, https://doi.org/10.1130/B37461.1.	
2023		
2022	Lee, H.P., R.A. Schultz, and J.E. Olson (2022), Inferring friction and stress states from the angle between wing fractures and solution surfaces, *Journal of Structural Geology*, **162**, 104706, https://doi.org/10.1016/j.jsg.2022.104706.	
2021		
2020	Schultz, R.A., and D.J. Evans (2020), Occurrence frequencies and uncertainties for US underground natural gas storage facilities by state, *Journal of Natural Gas Science and Engineering*, **84**, 103630, December 15, 2020, https://doi.org/10.1016/j.jngse.2020.103630. Yue, K., H.P. Lee, J.E. Olson, and R.A. Schultz (2020), Apparent fracture toughness for LEFM applications in hydraulic fracture modeling,	

	Engineering Fracture Mechanics, **230**, 106984, May 1, 2020, https://doi.org/10.1016/j.engfracmech.2020.106984.	
2019	Schultz, R.A., D.W. Hubbard, D.J. Evans, and S.L. Savage (2019), Characterization of historical methane occurrence frequencies from US underground natural gas storage facilities with implications for risk management, operations, and regulatory policy, *Risk Analysis*, **39**, https://doi.org/10.1111/risa.13417 published online November 6, 2019 (printed as *Risk Analysis*, **40**, March 2020, 588–607). Corrigendum, *Risk Analysis*, **41**, published online February 6, 2021, https://doi.org/10.1111/risa.13710. Yue, K., J.E. Olson, and R.A. Schultz (2019), The effect of layered modulus on fracture modeling and height containment, SPE-195683-PA, *SPE Drilling & Completion*, **34**, https://doi:10.2118/195683-PA. Almansour, A., S.E. Laubach, J.E. Bickel, and R.A. Schultz (2019), Value of information analysis of a fracture prediction method. SPE-198906-PA, *SPE Reservoir Evaluation & Engineering*, **22**, https://doi:10.2118/198906-PA. "Introduction to Selected Contributions from the 52nd US Rock Mechanics/Geomechanics Symposium held in Seattle, Washington June 17–20, 2018," *Rock Mechanics and Rock Engineering*, **52**, 4863, doi:10.1007/s00603-019-02010-4 (published online November 21, 2019).	
2018	Lee, H.P., J.E. Olson, and R.A. Schultz (2018), Numerical analysis of interaction between propagating opening mode fractures with veins	Yue, K., J.E. Olson, and R.A. Schultz (2018), Layered modulus effect on fracture modeling and height containment. Paper 2898691 presented

	using the Discrete Element Method, *International Journal of Rock Mechanics and Mining Sciences*, **103**, 275–288, https://doi:10.1016/j.ijrmms.2018.01.005. Wang, W., J.E. Olson, M. Prodanović, and R.A. Schultz (2018), Interaction between cemented natural fractures and hydraulic fractures assessed by experiments and numerical simulations, *Journal of Petroleum Science and Engineering*, **167**, 506–516 https://www.sciencedirect.com/science/article/pii/S092041051830281X.	at the *Unconventional Resources Technology Conference* (URTeC), Houston, Texas, July 23–25, 2018. Wang, W., J.E. Olson, M. Prodanović, and R.A. Schultz (2018), The impact of natural fracture thickness on hydraulic fracture interaction mechanics. Paper 2902343 presented at the *Unconventional Resources Technology Conference* (URTeC), Houston, Texas, July 23–25, 2018.
2017	Schultz, R.A., and D. Vereide (2017), Post-Aliso Canyon regulations focus on natural gas storage reliability, *Oil and Gas Journal*, **115**, 76–80, April 3, 2017 https://www.ogj.com/pipelines-transportation/article/17229273/post-aliso-canyon-regulations-focus-on-natural-gas-storage-reliability.	Schultz, R.A., C. Chabannes, and D. Vereide (2017), An asset integrity management system for underground natural gas storage in solution-mined salt caverns. Paper presented at the *Spring 2017 Solution Mining Research Institute* (SMRI) *Technical Conference*, Albuquerque, New Mexico, April 23–26, 2017. Evans, D.J., and R.A. Schultz (2017), Analysis of occurrences at underground fuel storage facilities and assessment of the main mechanisms leading to loss of storage integrity. Paper ARMA 17–265 presented at the *51st US Rock Mechanics/ Geomechanics Symposium*, San Francisco, California, June 25–28, 2017. Razavi, O., H.P. Lee, J.E. Olson, and R.A. Schultz (2017), Characterization of naturally fractured reservoirs using drilling mud loss data: The effects of fluid leak-off and fracture permeability. Paper ARMA 17–855 presented at the *51st US Rock Mechanics/Geomechanics Symposium*,

		San Francisco, California, June 25–28, 2017. Razavi, O., H.P. Lee, J.E. Olson, and R.A. Schultz (2017), Drilling mud loss in naturally fractured reservoirs: Theoretical modeling and field data analysis. Paper 17ATCE-P-2581-SPE presented at the *SPE Annual Technical Conference and Exhibition*, San Antonio, Texas, October 9–11, 2017.
2016	Schultz, R.A. (2016), Causes and mitigation strategies of surface hydrocarbon leaks at heavy-oil fields: Examples from Alberta and California, *Petroleum Geoscience*, **22**, online publication November 1, 2016, https://doi:10.1144/petgeo2016-070.	Schultz, R.A., U. Mutlu, and A. Bere (2016), Critical issues in subsurface integrity. Paper ARMA 16–037 presented at the *50th US Rock Mechanics/Geomechanics Symposium*, Houston, Texas, June 26–29, 2016 Yue, K., J.E. Olson, and R.A. Schultz (2016), Calibration of stiffness and strength for layered rocks. Paper ARMA 16–460 presented at the *50th US Rock Mechanics/ Geomechanics Symposium*, Houston, Texas, June 26–29, 2016. Lee, H.P., J.E. Olson, and R.A. Schultz (2016), The interaction analysis of propagating opening mode fractures with veins using Discrete Element Method. Paper ARMA 16–769 presented at the *50th US Rock Mechanics/Geomechanics Symposium*, Houston, Texas, June 26–29, 2016.
2015		
2014	Schultz, R.A., X. Tong, K.A. Soofi, D.T. Sandwell, and P.H. Hennings (2014), Using InSAR to detect active deformation associated with faults in Suban field, South Sumatra Basin, Indonesia, *The Leading Edge*, **33**, 882–888 https://library.seg.org/doi/10.1190/tle33080882.1.	Schultz, R.A., L.E. Summers, K.W. Lynch, and A.J. Bouchard (2014), Subsurface containment assurance program: Key element overview and best practice examples. Paper OTC 24851 presented at the *Offshore Technology Conference Asia*, March 25–28, 2014, Kuala Lumpur, Malaysia https://www.semanticscholar.org/paper/Subsurface-Containment-Assurance-Program-Key-and-Schultz-

		Summers/21213b9656b181ac1a9bcc3b88efab2334ea1604. Schultz, R.A., X. Tong, K.A. Soofi, D.T. Sandwell, and P.H. Hennings (2014), Satellite interferometry and the detection of active deformation associated with faults in Suban field, South Sumatra Basin, Indonesia, *Proceedings*, *Indonesian Petroleum Association*, 38th Annual Convention and Exhibition, Jakarta Convention Center, May 21–23, 2014.
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Theses and Dissertation

Year	*Title and Degree*	*Institution*
1987	*Mechanics of Curved Strike-Slip Faults*, Ph.D. dissertation, 142 p.	Purdue University, West Lafayette, Indiana
1982	*Martian Global Tectonics*, M.S. thesis, 113 p.	Arizona State University, Tempe, Arizona
1979	*The Petersburg Howardite*: *A Petrographic and Petrologic Study*, B.A. senior thesis, 59 p.	Rutgers University, New Brunswick, New Jersey

Abstracts and Presentations: Invited and Contributed

Year	*Invited Lectures and Presentations*	*Contributed Abstracts and Presentations*
2026	The evolving energy landscape in the USA, presented to the International Gas Union, Underground Storage (UGS) Committee Spring Meeting, Germany, April 2026. A global inventory of underground hydrogen storage sites and the evolving energy landscape in the USA, Keynote	

[20] The authors are not related.

	Presentation at the Annual Meeting of the European Geosciences Union (EGU), May 2026, *Geophysical Research Abstracts*, **28**, EGU/2026–7820.	
2025	Invited panelist, "Hydrogen TCP Task42 External Stakeholder Webinar: Building Confidence in UHS: Summary of final outcomes of TCP-Task 42," January 15, 2025. Restructuring science and energy in the USA: Spring 2025, presented to the International Gas Union, Underground Storage (UGS) Committee Spring Meeting, Budapest, Hungary, March 2025.	Ifrene, G., S. Kuldeep, R.A. Schultz, N. Nagel, and P. Pothana (2025), Inertial flow transitions in 3D intersecting rough fractures: Impact of geometry and roughness on non-Darcy regimes, *Eos* (*Transactions, American Geophysical Union*), **106**, supplement, PA21B–1130.
2024	The future of petroleum engineering in American universities, presented to the International Gas Union, Underground Storage (UGS) Committee Spring Meeting, Gdańsk, Poland, October 10, 2024. A vision for energy and petroleum engineering: Who we are, who we want to be, how do we get there? and A vision for energy and petroleum engineering: A mock class, presented to University of North Dakota, April 17, 2024. Renewable energy storage developments in USA – 2024, presented to the International Gas Union, Underground Storage (UGS) Committee Spring Meeting, Paris, France, April 10–11, 2024. Energy and petroleum engineering at UND: Who we are, who we want to be, how do we get there? presented to University of North Dakota, March 4, 2024.	Josephs, R.E., and R.A. Schultz (2024), Levelized cost of hydrogen storage (LCOHS): An analysis of underground storage in North Dakota, presented at 41st USAEE[21]/IAEE[22] North American Conference, November 3–6, 2024 https://virtual.oxfordabstracts.com/#/event/43962/submission/116. Buscheck, T.A., J.A. White, and R.A. Schultz (2024), Recommended practices for developing and operating subsurface hydrogen storage facilities, presented at the SHASTA Technical Workshop, Pittsburgh, Pennsylvania, April 3, 2024. Melichar, R., Baroň, I., M. Rowberry, J. Jelének, L. Sokol, M. Papí Isaba, C. Freudenthaler, H. Hausmann, L. Plan, B. Grasemann, J. Stemberk, J. Balek, R.A. Schultz, and R. Bürgmann (2024), Unusual fault kinematic behaviour and near-surface crustal stress variations before and during an earthquake series in the Vienna Basin (Austria) in Spring 2021, presented at the Annual Meeting

[21] United States Association for Energy Economics (USAEE)
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	Underground hydrogen storage: The missing link in low-carbon energy systems, Keynote presented to the University of North Dakota's ARMA Student Chapter, January 23, 2024.	of the European Geosciences Union (EGU), 19 April 2024, *Geophysical Research Abstracts*, **26**, EGU/2024–xxxx.
2023	Perspectives on SEL and UHS in the USA, presented at the Workshop on SEL, IEA Task 42 UHS webinar, September 20, 2023. Renewable energy storage – Developments in USA, presented to the International Gas Union, Underground Storage (UGS) Committee Spring Meeting, Brno, Czech Republic, June 1, 2023. Underground hydrogen storage: The missing link in low-carbon energy systems, presented to OMV Exploration & Production GmbH, Vienna, Austria, May 17, 2023. Underground hydrogen storage: The missing link in low-carbon energy systems, presented to the Austrian Geological Society, Vienna, Austria, May 4, 2023. Underground hydrogen storage: The missing link in low-carbon energy systems, presented to Université Montpellier II, conférences appliquées, France, April 20, 2023.	Overview, key recommendations, and current progress on Subtask F, presented at the IEA Task 42 UHS External Stakeholder Webinar, October 12, 2023.
2022	Underground hydrogen storage in depleted fields: Status and challenges, extended seminar and discussion presented at TotalEnergies, Pau, France, December 16, 2022 (virtual). Results from subtask F, presented at the Task 42 meeting and workshop, Clean Hydrogen Joint Undertaking (JU), Brussels, Belgium, International Energy Agency's (IEA) Hydrogen Technology Collaboration Programme (Hydrogen TCP), Task 42: Underground Hydrogen Storage	Mège, D., J. Gurgurewicz, F. Schmitt, R.A. Schultz, S. Douté, and B. Langlais, (2022), Hydrothermal activity at the edge of the Borealis impact basin in Valles Marineris, *Lunar and Planetary Science LIII*; Houston, Texas, March 2022. Mège, D., J. Gurgurewicz, F. Schmitt, R.A. Schultz, S. Douté, and B. Langlais, (2022), Hydrothermal activity at the edge of the Borealis impact basin in Valles Marineris, EPSC2022-116, Europlanet Science

	Workplan, Brussels, Belgium, 17–18 November 2022. Schultz, R.A., and S. Green, Opening remarks, presented at "Emerging Opportunities in Geologic Hydrogen Storage and Carbon Sequestration Workshop," ARMA *56th U.S. Rock Mechanics/Geomechanics Symposium*, Santa Fe, New Mexico, June 30, 2022. Traps, faults, and how to seal a gas storage reservoir, and Overview of underground gas and energy product storage, presented at TopCorp training for state oil-and-gas inspectors, Bureau of Economic Geology, The University of Texas at Austin, April 7 and 21, 2022; May 12, 2024.	Congress 2022, Palacio de Congresos de Granada, Spain, 22 September 2022, https://ui.adsabs.harvard.edu/link_gateway/2022EPSC...16..116M/doi:10.5194/epsc2022-116.
2021	Underground energy storage and the energy transition, seminar presented to the Energy Resources and Petroleum Engineering Program, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia, 27 October 2021 (Thomas Finkbeiner, sponsor; presentation given remotely).	Schultz, R.A., and D.J. Evans (2021), Bayesian occurrence frequencies for US underground natural gas storage facilities. Paper IPPTC 20218904 presented at *International Petroleum and Petrochemical Technology Conference* on "Transforming Oil & Natural Gas Industry through Intelligence," Beijing, China, 8–10 June 2021 (presentation given remotely). Schultz, R.A., B.A. Schwartz, and the Underground Storage and Utilization Technical Committee of ARMA (2021), Toward net-zero: Securing the nation's energy supply through underground energy storage and utilization, presented at the 2021 *Annual Forum of the Ground Water Protection Council*, session on "Energy Issues & Trends," Salt Lake City, Utah, September 28, 2021 (presentation given remotely). Gurgurewicz, J., D. Mège, F. Schmitt, R.A. Schultz, S. Douté, and B. Langlais, (2021), Megashears at the crustal dichotomy in Valles Marineris

		and implications for metalliferous mineralizations, presented at the *3rd National Mars Science Seminar*, Jagiellonian University in Kraków, Poland, 22 October 2021. Mège, D., J. Gurgurewicz, F. Schmitt, R.A. Schultz, S. Douté, and B. Langlais, (2021), The proto-Valles Marineris history illuminated by the interacting Martian dynamo and crustal dichotomy, presented at the *3rd National Mars Science Seminar*, Jagiellonian University in Kraków, Poland, 22 October 2021. Schultz, R.A., B.A. Schwartz, and the ARMA Underground Product Storage and Utilization Technical Committee (2021), Underground energy storage and utilization: Critical issues and future opportunities, presented at the *2nd ARMA / DGS / SEG International Geomechanics Symposium*, session on "Energy Storage, CO_2 Sequestration, and Geothermal," Al Khobar, Saudi Arabia, November 1–4, 2021 (presentation given remotely).
2020	Challenges to providing containment integrity for US underground natural gas storage facilities, presented at the ARMA Student Chapter, Jackson School of Geosciences, The University of Texas at Austin, March 12, 2020. Challenges to providing containment integrity for US underground natural gas storage facilities, presented to the Structural Processes Group, Institut für Geologie, Universität Wien, Vienna, Austria, May 12, 2020 (presentation given remotely).	Schultz, R.A., and D.J. Evans (2020), State-by-state comparison of off-normal occurrence frequencies for US underground natural gas storage facilities, presented at the Annual Meeting of the European Geosciences Union (EGU), 5 May 2020, *Geophysical Research Abstracts*, **22**, EGU/2020–1387 (presentation given remotely due to global Covid-19 pandemic). Schultz, R.A., and D.J. Evans (2020), Occurrence frequencies and uncertainties for underground natural gas storage facilities. Paper IFEDC 20206338 presented at *International Field Exploration and Development Conference* on "Efficient Development

		of Oil and Gas Driven by Digitalization," Chengdu, China, 23–25 September 2020 (presentation given remotely).
2019	Integrated energy storage opportunities in California (with J. Harris), presentation to potential clients and stakeholders, February 5, 2019. How can we characterize leakage risk at underground natural gas storage facilities? presented at Bureau of Economic Geology, The University of Texas at Austin, March 29, 2019. Certification of US underground natural gas storage facilities, presented at Underground Storage Committee meeting, International Gas Union, Prague, Czech Republic, May 21–22, 2019. Natural gas storage opportunities in the US, presented to Nafta a.s., Bratislava, Slovakia, May 24, 2019.	Mège, D., J. Gurgurewicz, S. Douté, F. Schmitt, and R.A. Schultz (2019), Regional-scale brittle-plastic deformation on Valles Marineris floor: Identification and implications, in *Lunar and Planetary Science L*, #2064. Schultz, R.A., D.W. Hubbard, D.J. Evans, and S.L. Savage (2019), Characterizing off-normal occurrence and leakage risk at underground natural gas storage facilities, presented at the *4th Applied Geoscience Geomechanics Conference: Through the Life Cycle of the Field*, Houston Geological Society, November 6–7, 2019. Schultz, R.A., D.W. Hubbard, D.J. Evans, and S.L. Savage (2019), Bayesian benchmarking of off-normal occurrence rates for US underground natural gas storage facilities, *Eos* (*Transactions, American Geophysical Union*), **100**, supplement, PA21B–1130, doi:10.1002/essoar.10501131.1.
2018	Panelist, "Rulemakings and Regulations," and presentation on "Bayesian benchmarking of leakage rates for underground natural gas storage facilities" at the *16th Annual Platts Gas Storage Outlook Conference*, Houston, Texas, January 8, 2018. Bayesian benchmarking of leakage rates for underground natural gas storage facilities, presented at US Pipeline and Hazardous Materials Safety Administration (PHMSA), Houston office, February 16, 2018. Subsurface integrity and risk mitigation for US underground natural gas storage facilities, presented at Université Paris-	

	Saclay, Orsay, France, September 11, 2018. Subsurface integrity, leakage rates and risk mitigation for US underground natural gas storage facilities, presented at Geostock-Entrepose, Paris, France, September 13, 2018. Subsurface integrity, leakage rates and risk mitigation for US underground natural gas storage facilities, presented at STORENGY, Paris, France, September 14, 2018. Subsurface integrity and risk mitigation for US underground natural gas storage facilities, presented at Université Montpellier II, France, September 19, 2018. How can we reduce leakage risk at underground natural gas storage facilities? presented at Université Montpellier II, conférences appliquées, France, September 21, 2018. How can we quantify leakage rates at underground natural gas storage facilities? presented at Underground Storage Committee meeting, International Gas Union, San Francisco, California, October 30–November 2, 2018.	
2017	Subsurface integrity in oil and gas fields from a geomechanics perspective, with applications to underground natural gas storage, presented at School of Natural Sciences, Mathematics, and Engineering, California State University, Bakersfield, March 30, 2017. Subsurface integrity in oil and gas fields from a geomechanics perspective, with applications to underground natural gas storage, presented at Department of Geosciences and Geological and Petroleum Engineering, Missouri	Chabannes, C., and R.A. Schultz (2017), Capturing risk and integrating workflows in the post- Aliso Canyon era. Paper presented at the *15th Annual Platts Gas Storage Outlook Conference*, Houston, Texas, January 12–13, 2017. Babazadeh, M., J.E. Olson, and R.A. Schultz (2017), Fluid injection and earthquake size in faulted reservoirs. Paper presented at the *American Association of Petroleum Geologists Annual Convention and Exhibition*, Houston, Texas, April 2–5, 2017.

	University of Science and Technology, Rolla, May 4, 2017. Scientific and technical leadership principles, presented at Department of Geosciences and Geological and Petroleum Engineering, Missouri University of Science and Technology, Rolla, May 4, 2017. Analysis of occurrences at underground fuel storage (UFS) facilities and assessment of the main mechanisms leading to loss of storage integrity (Evans, D., and R.A. Schultz), presented at the Energy Geosciences Division, Lawrence Berkeley National Laboratory, Berkeley, California, June 29, 2017. Subsurface integrity and risk management planning for underground natural gas storage, presented at the Energy Geosciences Division, Lawrence Berkeley National Laboratory, Berkeley, California, June 29, 2017. Subsurface integrity and risk mitigation for underground natural gas storage, Lunch and Learn presented at the Texas Oil and Gas Institute, Houston, Texas, August 1, 2017.	Schultz, R.A., C. Chabannes, and D. Vereide (2017), An asset integrity management system for underground natural gas storage in solution-mined salt caverns. Paper presented at the *Spring 2017 Solution Mining Research Institute* (SMRI) *Technical Conference*, Albuquerque, New Mexico, April 23–26, 2017. Evans, D.J., and R.A. Schultz (2017), Analysis of occurrences at underground fuel storage facilities and assessment of the main mechanisms leading to loss of storage integrity. Paper ARMA 17–265 presented at the *51st US Rock Mechanics/Geomechanics Symposium*, San Francisco, California, June 25–28, 2017. Razavi, O., H.P. Lee, J.E. Olson, and R.A. Schultz (2017), Characterization of naturally fractured reservoirs using drilling mud loss data: The effects of fluid leak-off and fracture permeability. Paper ARMA 17–855 presented at the *51st US Rock Mechanics/ Geomechanics Symposium*, San Francisco, California, June 25–28, 2017. Babazadeh, M., J.E. Olson, and R.A. Schultz (2017), Fluid injection and earthquake size in faulted reservoirs, to be presented at the Center for Petroleum and Geosystems Engineering's 2017 Research Showcase in Petroleum and Geosystems Engineering (sponsored by Chevron), Thompson Conference Center, September 11, 2017. Razavi, O., H.P. Lee, J.E. Olson, and R.A. Schultz (2017), Drilling mud loss in naturally fractured reservoirs: Theoretical modeling and field data analysis. Paper 17ATCE-P-2581-SPE presented at the *SPE Annual Technical*

		Conference and Exhibition, San Antonio, Texas, October 9–11, 2017. Babazadeh, M., J.E. Olson, and R.A. Schultz (2017), Wastewater injection and slip triggering: Results from a 3D coupled reservoir/rate-and-state model, *Eos (Transactions, American Geophysical Union)*, **98**, supplement.
2016	Subsurface integrity, faults, and hydrocarbon traps, plus other topical material, presented at TopCorp training workshop for the Division of Oil, Gas, and Geothermal Resources (DOGGR), Department of Conservation, State of California, Bakersfield, February and October 2016. Subsurface integrity in oil and gas fields from a geomechanics perspective: Opportunities for Ohio, presented at School of Earth Sciences, The Ohio State University, June 6, 2016. Subsurface integrity in oil and gas fields from a geomechanics perspective, with applications to underground natural gas storage, presented at Department of Civil and Environmental Engineering, University of Pittsburg, Pennsylvania, October 7, 2016.	Schultz, R.A., U. Mutlu, and A. Bere (2016), Critical issues in subsurface integrity. Paper ARMA 16–037 presented at the *50th US Rock Mechanics/ Geomechanics Symposium*, Houston, Texas, June 26–29, 2016. Yue, K., J.E. Olson, and R.A. Schultz (2016), Calibration of stiffness and strength for layered rocks. Paper ARMA 16–460 presented at the *50th US Rock Mechanics/Geomechanics Symposium*, Houston, Texas, June 26–29, 2016. Lee, H.P., J.E. Olson, and R.A. Schultz (2016), The interaction analysis of propagating opening mode fractures with veins using Discrete Element Method. Paper ARMA 16–769 presented at the *50th US Rock Mechanics/Geomechanics Symposium*, Houston, Texas, June 26–29, 2016. Lee, H.P., J.E. Olson, and R.A. Schultz (2016), The interaction analysis of propagating opening mode fractures with veins using the Discrete Element Method: Insights into hydraulic fracture complexity, presented at the Center for Petroleum and Geosystems Engineering's 2016 Research Showcase in Petroleum and Geosystems Engineering (sponsored by Chevron), AVAYA Auditorium, September 6, 2016. Michael, A., J.E. Olson, M.T. Balhoff, and R.A. Schultz (2016). Mitigation of stress shadow effects via non-uniform

		perforation cluster distribution: A laboratory case study, poster presented at the Center for Petroleum and Geosystems Engineering's 2016 Research Showcase in Petroleum and Geosystems Engineering (sponsored by Chevron), AVAYA Auditorium, September 6, 2016. Schultz, R.A. (2016) Directions in PGE geomechanics research, presented at the 2016 FRAC Consortium annual meeting, Lost Pines Resort, Bastrop, Texas, September 20–22, 2016, with accompanying abstract. Michael, A., J.E. Olson, M.T. Balhoff, and R.A. Schultz (2016), Stress shadow migration via perforation cluster spacing in hydraulic fracturing operations, poster presented at the 2016 FRAC Consortium annual meeting, Lost Pines Resort, Bastrop, Texas, September 20–22, 2016, with accompanying abstract. Wang, W., J.E. Olson, M. Prodanović, and R.A. Schultz (2016), Interaction between cemented natural fractures and hydraulic fractures assessed by experiments and numerical simulations, talk presented at the 2016 FRAC Consortium annual meeting, Lost Pines Resort, Bastrop, Texas, September 20–22, 2016, with accompanying abstract. Yue, K., J.E. Olson, and R.A. Schultz (2016), Effect of modulus contrast on hydraulic fracture height containment in layered reservoirs, talk presented at the 2016 FRAC Consortium annual meeting, Lost Pines Resort, Bastrop, Texas, September 20–22, 2016, with accompanying abstract. Lee, H.P., J.E. Olson, and R.A. Schultz (2016), The interaction analysis of propagating opening mode fractures

		with veins using the Discrete Element Method: Insights into hydraulic fracture complexity, talk presented at the 2016 FRAC Consortium annual meeting, Lost Pines Resort, Bastrop, Texas, September 20–22, 2016, with accompanying abstract. Babazadeh, M., J.E. Olson, and R.A. Schultz (2016), Fluid injection and earthquake size in faulted reservoirs, poster presented at the 2016 FRAC Consortium annual meeting, Lost Pines Resort, Bastrop, Texas, September 20–22, 2016, with accompanying abstract. Gono, V., J.E. Olson, J.F.W. Gale, and R.A. Schultz (2016), Geomechanical analysis of seismicity related faults in the Fort Worth Basin, poster presented at the 2016 FRAC Consortium annual meeting, Lost Pines Resort, Bastrop, Texas, September 20–22, 2016, with accompanying abstract.
2015	Outlook and opportunities for CSM's Chevron Center of Research Excellence (CoRE), presented at Department of Geology and Geological Engineering, Colorado School of Mines, Golden, Colorado, October 2, 2015.	Ballas, G., R. Soliva, H. Fossen, and R.A. Schultz (2015), Tectonic control on cataclastic strain distribution and permeability reduction in porous sandstone reservoirs, presented by R. Soliva at the *4th International Conference on Fault and Top Seals*, Alméria, Spain, September 20–24, 2015. Michael, A., J.E. Olson, M.T. Balhoff, and R.A. Schultz (2015). Multi-frac propagation experiments on transparent media. Poster presented at the 2015 FRAC Consortium annual meeting, The University of Texas at Austin, Texas, September 23–25, 2015, with accompanying abstract. Babazadeh, M., J.E. Olson, and R.A. Schultz (2015), Geomechanics and fluid injection in faulted reservoirs, presented at the 2015 FRAC Consortium annual meeting, The

		University of Texas at Austin, Texas, September 23–25, 2015, with accompanying abstract. Sosa Massaro, A., S. Barredo, M. Frydman, M. Ramos, J.E. Olson, R.A. Schultz, and D.N. Espinoza (2015), Geomechanical properties of Vaca Muerta Formation, poster presented at the 2015 FRAC Consortium annual meeting, The University of Texas at Austin, Texas, September 23–25, 2015, with accompanying abstract. Lee, H.P., J.E. Olson, J. Holder, R.A. Schultz, and J. Gale (2015), Overview of Task 3.5: Natural fracture cement bond strength in shales, presented by H.P. Lee and R.A. Schultz at ExxonMobil/Bureau of Economic Geology Unconventional Reservoirs Research meeting, The Woodlands, Texas, October 26, 2015. Olson, J.E., and R.A. Schultz (2015), Overview of PGE projects for CISR: Fluid injection geomechanics, presented at CISR/TexNet Meeting, UT Bureau of Economic Geology, November 23, 2015, with regular follow-on meetings at later dates through 2016 and 2017. Wang, W., M. Prodanović, J.E. Olson, and R.A. Schultz (2015), Numerical modeling of fracture propagation in naturally fractured formations, *Eos (Transactions, American Geophysical Union)*, **96**, supplement, NG13A–1878.
2014	Summary of Sumatra Geodetic Characterization Project (SuGAP), presented to Arief Syafi'i and staff, Center for Geodetic Control Network and Geodynamics, Geospatial Information Agency (BIG), Bogor, Indonesia, March 19, 2014. Satellite interferometry and the detection of active deformation associated with	Schultz, R.A., L.E. Summers, K.W. Lynch, and A.J. Bouchard (2014), Subsurface containment assurance program: Key element overview and best practice examples, oral presentation at the *2014 Offshore Technology Conference Asia*, March 25–28, 2014, Kuala Lumpur, Malaysia. Paper OTC 24851.

	faults in Suban field, South Sumatra Basin, Indonesia (Schultz, R.A., X. Tong, K.A. Soofi, D.T. Sandwell, and P.H. Hennings), presented at Earth Observatory of Singapore, May 28, 2014.	Schultz, R.A., X. Tong, K.A. Soofi, D.T. Sandwell, and P.H. Hennings (2014), Satellite interferometry and the detection of active deformation associated with faults in Suban field, South Sumatra Basin, Indonesia, oral presentation at the *38th Indonesian Petroleum Association Convention and Exhibition*, Jakarta Convention Center, May 21–23, 2014.
2013	The ConocoPhillips subsurface containment assurance program—Overview, current status, and path forward (Summers, L., R.A. Schultz, K. Lynch, and A. Bouchard), presented by K. Lynch at the ConocoPhillips *2013 Global Subsurface Symposium*, The Woodlands Waterway Marriott, Woodlands, Texas, November 20, 2013. The ConocoPhillips subsurface containment assurance program—Implementation and toolset (Schultz, R.A., L. Summers, K. Lynch, and A. Bouchard), presented at the ConocoPhillips *2013 Global Subsurface Symposium*, The Woodlands Waterway Marriott, Woodlands, Texas, November 20, 2013.	Zimbelman, J.R., W.B. Garry, J.E. Bleacher, L.S. Crumpler, S. Self, J.C. Aubele, S.M. Baloga, L.S. Glaze, and R.A. Schultz (2013), Inflation processes at the McCartys lava flow field, New Mexico, with application to identifying inflated lava flows on planetary surfaces, in *Lunar and Planetary Science XLIV*, #2120. Klimczak, C., and R.A. Schultz (2013), Regional joints and the occurrence of oriented arches in Arches National Park, Utah, Annual Meeting, Geological Society of America, *Abstracts with Programs*, **45**, abstract #228–4. Nahm, A.L., and R.A. Schultz (2013), Forward mechanical modeling of the Rupes Recta (Straight Wall) normal fault, the Moon: Implications for the geologic history of Nubium Basin, Annual Meeting, Geological Society of America, *Abstracts with Programs*, **45**, abstract #117–11. Schultz, R.A., R. Soliva, and H. Fossen (2013), Formation of compaction bands within deformation band ladder stepovers, *Eos (Transactions, American Geophysical Union)*, **94**, supplement, MR13A–2235. Soliva, R., R.A. Schultz, G. Ballas, and A. Benedicto (2013), Strain localization in porous sandstone as a function of tectonic setting, burial and material

		properties, *Eos* (*Transactions, American Geophysical Union*), **94**, supplement, MR24A–03.
2012	Geomechanical field characterization—Principal elements and relationship to containment assurance, presented at the *2012 ConocoPhillips Geomechanics Workshop*, November 29, 2012, PowerPoint presentation, 26 p.	Soliva, R., G. Ballas, R.A. Schultz, A. Taboada, C. Wibberley, E. Saillet, and A. Benedicto (2012), Strain localization in porous sandstone as a function of tectonic setting, burial and material properties, presented at *3rd International Conference on Fault and Top Seals*, Montpellier, France, October 1–3, 2012.
2011	How lava flows break out from pahoehoe flow margins, presented at McCarty's Field Trip and Workshop, Grants, New Mexico, March 29, 2011. Comparison of compaction bands at the Nevada and Utah field sites, presented at Geo-FracNet Industrial Research Consortium workshop on "Unified physical approach to the origin of natural deformation localization bands (shear, compaction, dilatancy): Field and experimental data, theoretical analysis and numerical models," CNRS Route de Mende, Montpellier, France, May 9–10, 2011. From yielding to failure: Growth of deformation bands and faults in sedimentary sequences, presented at ConocoPhillips, Houston, Texas, June 1, 2011.	Schultz, R.A. (2011), The influence of near-surface stratigraphy on the growth and scaling of normal faults in Bishop Tuff, California, with planetary implications, in *Lunar and Planetary Science XLII*, #1471. Nahm, A.L., R.A. Schultz, and D.A. Kring (2011), Forward mechanical modeling of the Rupes Recta (Straight Wall) normal fault in eastern Mare Nubium, the Moon, presented at European Geosciences Union (EGU), *Geophysical Research Abstracts*, **13**, EGU/2011–8785. Klimczak, C., R. Soliva, R.A. Schultz, and J. Chéry, (2011), Growth of deformation bands in a multilayer sequence, presented at European Geosciences Union (EGU), *Geophysical Research Abstracts*, **13**, EGU/2011–4872. Soliva, R., R.A. Schultz, G. Ballas, A. Taboada, E. Saillet, C. Wibberley, and A. Benedicto (2011), The relationship between deformation band properties, tectonic regime and burial in porous sandstone, presented at European Geosciences Union (EGU), *Geophysical Research Abstracts*, **13**, EGU/2011–6377.

		Zimbelman, J., B. Garry, J. Bleacher, L. Crumpler, S. Self, S. Baloga, L. Glaze, R. Schultz, and J. Aubele (2011), Investigation of terraced margins present around some basaltic lava flows on the terrestrial planets, presented at *International Union of Geodesy and Geophysics*, Melbourne, Australia, June 28–July 7, 2011. Schultz, R.A., and R. Soliva (2011), Propagation energies inferred from deformation bands in sandstone, *Eos (Transactions, American Geophysical Union)*, **92**, supplement, T33C–2433. Klimczak, C., and R.A. Schultz (2011), Compactional shear bands in dilational sands and soils, *Eos (Transactions, American Geophysical Union)*, **92**, supplement, T33C–2426.
2010	Wrinkle ridges on Mars: Absence of décollement tectonics (Schultz, R.A., A.L. Nahm, and L.G.J. Montési), presented at European Geosciences Union (EGU), *Geophysical Research Abstracts*, **12**, EGU/2010–1969, Vienna, Austria. Wrinkle ridges, critical taper orogenic belts, and global contraction on Mars, Université Montpellier II, France, April 30, 2010. Wrinkle ridges, critical taper orogenic belts, and global contraction on Mars, DLR, Berlin, Germany, May 11, 2010. Growth of deformation and compaction bands in porous sedimentary rocks, presented at GFZ German Research Centre for Geosciences, Potsdam, Germany, May 12, 2010.	Mège, D., N. Arnaud, H. Diot, T. Korme, and R.A. Schultz (2010), Ethiopian flood basalt province: 1. Dyke swarms of northwestern Ethiopia, *6th International Dyke Conference*, February 4–7, 2010, Varanasi, India. Nahm, A.L., and R.A. Schultz (2010), A test of global contraction models for Mars using observations, in *Lunar and Planetary Science XLI*, #2086. Schultz, R.A. (2010), Relationship of compaction bands in Utah, USA, to monoclinal folding, presented at European Geosciences Union (EGU), *Geophysical Research Abstracts*, **12**, EGU/2010–1970. Tewksbury, B.J., J.P. Hogan, S.M. Kemp, T.T. Keren, C.M. Tewksbury-Christle, R.A. Schultz, and C.J. Mehrtens (2010), Deformation bands and the expression in siliciclastic cover rocks of slip on basement faults in southern Egypt, Annual Meeting, Geological

		Society of America, *Abstracts with Programs*, **42**, abstract #194–4. Klimczak, C., R. Soliva, R.A. Schultz, J. Chéry, and I. Summerson (2010), Growth of deformation bands in a multilayer sequence, *Eos (Transactions, American Geophysical Union)*, **91**, supplement, T41B–2130.
2009	Growth of deformation bands and faults in porous sedimentary sequences, presented at Total CSTJF (Centre Scientifique et Technique Jean Féger), Pau, France, June 29–30, 2009.	Nahm, A.L., and R.A. Schultz (2009), Evaluation of the orogenic belt hypothesis for the formation of the Thaumasia Highlands, Mars, in *Lunar and Planetary Science XL*, #1069. Orr Key, W.R., and R.A. Schultz (2009), Fault formation at impact craters in porous sedimentary rock targets, in *Lunar and Planetary Science XL*, #xxx. Klimczak, C., Nahm, A.L., and R.A. Schultz (2009), Evaluation of the origin hypotheses of Pantheon Fossae, Mercury, in *Lunar and Planetary Science XL*, #xxx. Schultz, R.A., and A.L. Nahm (2009), Transient and long-term displacement-length scaling of planetary faults, in *Lunar and Planetary Science XL*, #1075. Cavailhes, T., Soliva, R., A. Benedicto, D. Loggia, R.A. Schultz, and C.A.J. Wibberley (2009), Are cataclastic shear bands fluid barriers or capillarity conduits? Insight from the analysis of redox fronts in porous sandstones from Provence, France, *2nd International Conference on Fault and Top Seals*, Montpellier, France, September 21–24, 2009. Key, W.R.O., and R.A. Schultz (2009), Fault formation at impact craters in porous sedimentary rock targets, presented at Association of Environmental and Engineering

		Geologists (AEG) meeting, Lake Tahoe, CA, September 25, 2009. Nahm, A.L., N. Mangold, V. Ansan, and R.A. Schultz (2009), Structural mapping and lithospheric flexure in the formation of the Thaumasia Highlands, Mars, Portland Annual Meeting, Geological Society of America, *Abstracts with Programs*, **41**, p. 412. Fossen, H., R.A. Schultz, A. Torabi, and J. Tveranger (2009), Petrophysically selective compaction bands in Navajo Sandstone, Portland Annual Meeting, Geological Society of America, *Abstracts with Programs*, **41**, p. 568. Klimczak, C., and R.A. Schultz (2009), Strain localization in porous sandstone associated with the Northern Harz Mountains Border Fault, Germany, *Eos (Transactions, American Geophysical Union)*, **90**, supplement, T43A–2050. Schultz, R.A. (2009), Tectonic controls on compaction bands in sandstone, *Eos (Transactions, American Geophysical Union)*, **90**, supplement, T43A–2051.
2008	What controls displacement-length scaling of geologic structures? presented at University of Bergen, Norway, February 26, 2008. What controls displacement-length scaling of geologic structures? presented at The Institute for Physics of Geological Processes (PGP), University of Oslo, Norway, February 28, 2008. Compaction bands: A reexamination of the Mollema and Antonellini (1996) site, presented at Shell International Exploration and Production Company, Houston, Texas, March 12, 2008. Tectonic controls on compaction bands at Buckskin Gulch, Utah, presented at Shell International Exploration and	Nahm, A.L., and R.A. Schultz (2008), Stress calculations for thrust faults in the southern Thaumasia region, Mars, in *Lunar and Planetary Science XXXIX*, #1111 (on CD-ROM). Orr, W., and R.A. Schultz (2008), Review of faults associated with complex impact structures in sedimentary rock targets, with reference to the Upheaval Dome impact structure, Utah, U.S.A., in *Lunar and Planetary Science XXXIX*, #1076 (on CD-ROM). Dimitrova, L.L., W.E. Holt, A.J. Haines, and R.A. Schultz (2008), Stress models, global contraction, and surface faults on Mars, in *Lunar and Planetary Science XXXIX*, #1848 (on CD-ROM).

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1995	Session Organizer and Chair, "Planetary Rock Mechanics" at the *35th U.S. Symposium on Rock Mechanics*, Lake Tahoe, Nevada/California, June 5, 1995.	Schultz, R.A., and D.A. Senske (1995), Relationship between uplift, faulting, and strain across Valles Marineris, Mars, in *Lunar and Planetary Science XXVI*, 1253–1254. Fori, A.N., and R.A. Schultz (1995), Analysis of fault lengths across West Candor plateau, Valles Marineris, Mars, in *Lunar and Planetary Science XXVI*, 415–416. Schultz, R.A., and T.R. Watters (1995), Elastic buckling of fractured basalt: Case study of the Columbia Plateau, Earth, using an improved strength criterion, in *Lunar and Planetary Science XXVI*, 1255–1256.

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1993		Tanaka, K.L., and R.A. Schultz (1993), Large, ancient, compressional structures on Mars, in *Lunar and Planetary Science XXIV*, 1401–1402. Schultz, R.A. (1993), Strength and deformation properties of basaltic lava flows on planetary surfaces, in *Lunar and Planetary Science XXIV*, 1263–1264. Schultz, R.A., and M.T. Zuber (1993), Observations, models, and mechanisms of failure of surface rocks surrounding planetary surface loads, American Geophysical Union Fall Meeting, *Eos (Transactions, American Geophysical Union)*, **74**, supplement, 384.

		Li, Q., and R.A. Schultz (1993), Uniaxial strength testing of Calico Hills tuff, Yucca Mountain: Preliminary results, *5th International Conference on High-Level Radioactive Waste Management*.
1992	Invited participant and discussion leader at the *Workshop on Mountain Belts on Venus and Earth*, San Juan Capistrano, California, January 13–15, 1992. Strike-slip fault geometry and continental deformation, seminar presented at Distinguished Lecture Series, Department of Geology and Geophysics, University of Utah, February 6, 1992. Brittle strength properties of basaltic rocks and rock masses on the terrestrial planets, invited paper presented at American Geophysical Union Fall Meeting, *Eos (Transactions, American Geophysical Union)*, **73**, supplement, 327, December 9, 1992.	Schultz, R.A. (1992), Limitations on the applicability of Byerlee's law and the Griffith criterion to shallow crustal conditions, in *Lunar and Planetary Science XXIII*, 1239–1240. Schultz, R.A. (1992), What's the difference between a rock and a rock mass (and why is it important?), in *Lunar and Planetary Science XXIII*, 1243–1244. Schultz, R.A. (1992), Progress on the search for strike-slip faulting on Venus, in *Lunar and Planetary Science XXIII*, 1241–1242. Schultz, R.A., and M.T. Zuber (1992), Why are strike-slip faults that are "predicted" by lithospheric deformation models rarely observed on planetary surfaces? in *Lunar and Planetary Science XXIII*, 1247–1248. Schultz, R.A., and K.L. Tanaka (1992), Growth of the Coprates rise, Mars, as a result of lithospheric folding, in *Lunar and Planetary Science XXIII*, 1245–1246. Reidy, A.M., C.A. Sanford, H. Frey, and R.A. Schultz (1992), A search for large impact basins in the southern hemisphere of Mars II: South Polar B?, in *Lunar and Planetary Science XXIII*, 1137–1138. Schultz, R.A. (1992), Further results of mapping in Coprates Chasma, presented at *Mars Geologic Mappers Meeting*, Salt Lake City, Utah, September 17–18, 1992. Ward, K.A., and R.A. Schultz (1992), Dike emplacement and deformation of

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1990	Applications of fracture analysis to problems in geomechanics, seminar presented at Mackay School of Mines, University of Nevada, Reno, March 15–16, 1990. Identification and analysis of echelon strike-slip faults on Mars, presented at Recent Scientific Results and Future Plans in the Exploration of the Solar System, *Brown University – Vernadsky Institute* (*U.S.S.R.*) *Microsymposium 11*, Providence, Rhode Island, March 19–21, 1990. Formation of interior basins associated with curved strike-slip faults in Alaska (Schultz, R.A., and A. Aydin), presented at *Penrose Conference on Transpressional Tectonics of Convergent Plate Margins* (Geological Society of America), Western Washington University, Bellingham, Washington, August 25–30, 1990. Formation of folds and basins associated with echelon strike-slip faults, seminar presented at Kennecott Exploration Company, Reno, Nevada, September 14, 1990. Secondary structures associated with strike-slip faulting, seminar presented	Schultz, R.A., and H.V. Frey (1990), Geology, structure, and statistics of multi-ring basins on Mars, in (a) *Lunar and Planetary Science XXI*, 1111–1112; also in (b) Scientific Results of the NASA-Sponsored Study Project on Mars: Evolution of Volcanism, Tectonics, and Volatiles (edited by S.C. Solomon, V.L. Sharpton, and J.R. Zimbelman), *Lunar and Planetary Institute Technical Report, 90–06,* p. 265–266 (1990); also in (c) *Reports of Planetary Geology and Geophysics Program 1990*, NASA Technical Memorandum 4300, 49–50 (1990). Schultz, R.A. (1990), Possible deficiency of large Martian craters and relative cratering of the terrestrial planets, in (a) *Lunar and Planetary Science XXI*, 1107–1108; also in (b) *Reports of Planetary Geology and Geophysics Program 1989*, NASA Technical Memorandum 4210, 446–447 (1990); also in (c) Scientific Results of the NASA-Sponsored Study Project on Mars: Evolution of Volcanism, Tectonics, and Volatiles (edited by S.C. Solomon, V.L. Sharpton, and J.R. Zimbelman), *Lunar and Planetary*

	at Newmont Gold Company, Carlin, Nevada, September 27, 1990 and again in summer of 1991.	*Institute Technical Report, 90-06,* p. 261–262 (1990). Schultz, R.A. (1990), Complex early rifting in Valles Marineris: Results from preliminary geologic mapping of the Ophir Planum region of Mars, 1:500,000 scale, in (a) *Lunar and Planetary Science XXI,* 1103–1104; also in (b) *Reports of Planetary Geology and Geophysics Program 1989*, NASA Technical Memorandum 4210, 476–477 (1990); also in (c) Scientific Results of the NASA-Sponsored Study Project on Mars: Evolution of Volcanism, Tectonics, and Volatiles (edited by S.C. Solomon, V.L. Sharpton, and J.R. Zimbelman), *Lunar and Planetary Institute Technical Report, 90–06,* p. 259–260 (1990). Schultz, R.A. (1990), Strike-slip faulting, wrinkle ridges, and time variable stress states in the Coprates region of Mars, in (a) *Lunar and Planetary Science XXI*, 1109–1110; also in (b) *Reports of Planetary Geology and Geophysics Program 1989*, NASA Technical Memorandum 4210, 505–506 (1990); also in (c) Scientific Results of the NASA-Sponsored Study Project on Mars: Evolution of Volcanism, Tectonics, and Volatiles (edited by S.C. Solomon, V.L. Sharpton, and J.R. Zimbelman), *Lunar and Planetary Institute Technical Report, 90–06,* p. 263–264 (1990). Frey, H.V., and R.A. Schultz (1990), MEVTV study: Early tectonic evolution of Mars — Crustal dichotomy to Valles Marineris, in (a) *Lunar and Planetary Science XXI*, 391–392; also in (b) *Reports of Planetary Geology and Geophysics Program 1989*, NASA Technical Memorandum 4210, 478–479 (1990);

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1989	Strike-slip fault geometry and continental deformation, seminar presented at Rutgers University, New Brunswick, New Jersey, February 1, 1989. Basins associated with curved strike-slip faults (Schultz, R.A., and A. Aydin), presented by Aydin at *International Workshop on Recent and Active Strike-Slip Tectonics*, April 18–20, Florence University, Italy, 1989. Do pit-crater chains grow up to be Valles Marineris canyons? presented at *MEVTV Workshop*: *Tectonic Features*	Schultz, R.A., and H.V. Frey (1989), Topography and structure of Valles Marineris, Mars, in *Fourth International Conference on Mars*, Tucson, Arizona, 183–184. Frey, H.V., and R.A. Schultz (1989), Overlapping impact basins and the origin of the Martian crustal dichotomy, Elysium, and Tharsis, in *Fourth International Conference on Mars*, Tucson, Arizona, 106–107. Schultz, R.A. (1989), Structural mapping and interpretation of Valles Marineris, Mars, in (a) *Lunar and Planetary*

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1988	Characteristic geometry of echelon faults and its relevance to fault surface morphology and fault zone behavior (Aydin, A., and R.A. Schultz), *U.S.G.S. Workshop on Fault Segmentation and Controls of Rupture Initiation and Termination*, March 7–9,	Frey, H.V., and R.A. Schultz (1988), Large impact basins and the origin of the crustal dichotomy on Mars, in *Reports of Planetary Geology and Geophysics Program 1987*, NASA Technical Memorandum 4041, 436–438.

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1987		Frey, H.V., R.A. Schultz, and T.A. Maxwell (1987), The Martian crustal dichotomy: Product of accretion and not a specific event? in (a) *Lunar and Planetary Science XVII*, 241–242 (1986); also in (b) *Reports of Planetary Geology and Geophysics Program 1986*, NASA Technical Memorandum 89810, 469–471 (1987). Schultz, R.A. (1987), Why do lunar normal faults propagate upward? in *Lunar and Planetary Science XVIII*, 892–893. Schultz, R.A., and A. Aydin (1987), Mechanical analysis of interior basins associated with curved faults in Alaska, Geological Society of America Winter Meeting, *Geological Society of America, Abstracts with Programs*, **19**, 835. Schultz, R.A., and A. Aydin (1987), The influence of curvature on stresses and displacements around strike-slip faults, American Geophysical Union Fall

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1985		Kessler, D.J., H.A. Zook, A.E. Potter, D.S. McKay, U.S. Clanton, J.L. Warren, L.A. Watts, R.A. Schultz, L.S. Schramm, S.J. Wentworth, and G.A. Robinson (1985), Examination of returned Solar-Max surfaces for impacting orbital debris and meteoroids, in (a) *Lunar and Planetary Science XVI*, 434–435 (1985); also in (b) *Proceedings of the Solar Maximum Repair Mission Degradation Study Workshop*, NASA Goddard Space Flight Center, Greenbelt, Maryland, May 9–10, 1985, Document No. 408-SMRM-79-0001, 245–246. Tharp, T.M., T.J. Holdredge, D.T. Coffin, D. Eberly, G.C. Ohlmacher, R.A. Schultz, S.P. Sittler, and R.G. Tomlinson (1985), Behavior of roof-beams in limestone caves: Implications for cave morphology and character of karst landforms, Geological Society of America Winter Meeting, Geological Society of America*, Abstracts with Programs*, **17**, 734. Aydin, A., R.A. Schultz, and D.D. Pollard (1985), Why do strike-slip faults overlap? American Geophysical Union Fall Meeting, *Eos (Transactions, American Geophysical Union)*, **66**, 1067–1068. Schultz, R.A., and A. Aydin (1985), Stress and displacement around curved strike-slip faults, American Geophysical Union Fall Meeting, *Eos (Transactions, American Geophysical Union)*, **66**, 1089.
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Technical Reports

Year(s)	
2022–2025	"Storage Committee Report of Study Group 1: UGS database," International Gas Union, May 2025, 67 p. Multiple reports to SHASTA (Subsurface Hydrogen Assessment, Storage, and Acceleration) Project, funded by US DOE under contract DE-AC05-76RL01830 via subcontract number B655896 to Lawrence Livermore National Laboratory (LLNL), including: • "Global Compilation of Underground Hydrogen Storage Projects." • "Renewable Hydrogen Production & Storage: An Example from North Dakota" (R.E. Josephs and R.A. Schultz). • "Recommended Practices for Developing and Operating Subsurface Hydrogen Storage Facilities in Porous Reservoirs" (T.A. Buscheck, J.A. White, and R.A. Schultz). • "Subsurface Hydrogen Storage: Industrial Perspectives Report," 33 p. • Quarterly and interim status reports.
2022–2025	Multiple reports to the International Energy Agency's (IEA) Hydrogen Technology Collaboration Programme (Hydrogen TCP), Task 42: Underground Hydrogen Storage Workplan, including: • "Hydrogen TCP-TASK42 Activity Summary Report," March 2025, 98 p. • "Building Confidence in Underground Hydrogen Storage: Final report of Hydrogen TCP-Task 42," March 2025, 71 p. • "Hydrogen TCP-Task 42: Underground Hydrogen Storage, Technology Monitor Report 2023." International Energy Agency, Paris, 153 p. including appendices (April 2023). • Progress, semi-annual, and yearly reports (coauthor of Subsurface Integrity; Planning, Regulation, Safety & Society; and Enabling UHS chapters).
2018–2021	Multiple reports to the American Rock Mechanics Association (ARMA), including: • "ARMA Communications Task Force Report, Containing Recommendations, Suggested Action Items, and Supporting Materials," 77 p., June 2022. • Schultz, R.A. and the USUTC Team, "ARMA's Technical Committee on Underground Storage and Utilization," *ARMA Letters,* **32**, Fall 2021 issue, 12–26. • "Seattle Highlights," report on the *52nd US Rock Mechanics/Geomechanics Symposium*, Seattle, Washington, *ARMA Letters*, **25**, 2–3, Fall 2018 issue. • Periodic and annual reports from the Distinguished Service Award Selection Committee and the Underground Storage and Utilization Technical Committee.

2016–present	Proprietary technical reports to companies and legal firm serving the underground gas storage and oilfield services industries.
2016–2017	States First (now State Oil & Gas Regulatory Exchange), Interstate Oil & Gas Compact Commission, and Ground Water Protection Council (2017), "Underground Gas Storage Regulatory Considerations: A Guide for State and Federal Regulatory Agencies," May 2017, 122 p. I was lead author on Chapter 7, Reservoir Integrity.
2015–2017	Multiple technical reports to industry sponsors of UT's FRAC Consortium including ExxonMobil and Shell.
2011–2015	Authored or coauthored approximately 50 significant internal technical reports and presentations to technical workshops and senior management for ConocoPhillips Company (through March 2015).
1988–2011	Multiple technical progress and final reports to funding agencies including NASA, DOE, NSF, U.S. National Research Council, American Chemical Society/Petroleum Research Fund, and international agencies.
2007–2008	Proprietary technical reports for Shell International Exploration and Production Company, Houston, Texas
2005	"Review of *The Initiation, Propagation, and Arrest of Joints and Other Fractures* by John W. Cosgrove and Terry Engelder, editors," *Eos (Transactions, American Geophysical Union)*, **86**, 526–527 (INVITED).
1999	Review of *Engineering Rock Mechanics: An Introduction to the Principles* by John A. Hudson and John P. Harrison," *Journal of Structural Geology*, **21**, 248–250 (INVITED).
1997	2D microtopography of ramps and graben terminations at Canyonlands National Park, Chevron Petroleum Technology Company, San Ramon, California.
1995, 1997	Editor (1997), *Geomechanics Trends*, **3**, 11 p., University of Nevada, Reno. Editor (1995), *Research in Geomechanics and Rock Fracture: Accomplishments and Annual Report of the Geomechanics–Rock Fracture Group*, **1**, 53 p., University of Nevada, Reno. Progress in rock mechanics during 1995, in *Research in Geomechanics and Rock Fracture: Accomplishments and Annual Report of the Geomechanics–Rock Fracture Group*, **1**, 5–16, University of Nevada, Reno.
1991–1993	Multiple proprietary technical reports for precious-metals mining companies including Newmont Gold Company, Noranda Exploration, Inc., Kennecott Exploration Company (all in Nevada).