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Academic Appointments

2017-present: Chair of Earth and Environmental Science, Temple University, Philadelphia, PA, USA
2014-present: Associate Professor of Earth and Environmental Science, Temple University, Philadelphia, PA, USA
2008-2014: Assistant Professor of Earth and Environmental Science, Temple University, Philadelphia, PA, USA
Summers 2008, 2009, 2010: Invited Visiting Professor, RES School of Renewable Energy Science, Akureyri, Iceland:
- Taught 1 week condensed Geothermal Drilling and Logging (GEO605) as part of the International M.Sc. degree program in Geothermal Energy Science
- Advised M.Sc. research projects

Education

2004-2007: Mendenhall Postdoctoral Fellow, U.S. Geological Survey, Earthquake Hazards Team, Menlo Park, CA; Advisors: Steve Hickman and Colin Williams, Earthquake Hazards Center
2003-2004: Postdoctoral Fellow, Stanford University, Rock Fracture Project
1998-2003: Ph.D. Stanford University, Stanford California, Geology, (Advisor: Dr. Atilla Aydin)
1994-1998: B.A. Bucknell University, Lewisburg, Pennsylvania; Majors: Geology (with Honors) and Philosophy

Dissertation

Fault architecture as a function of deformation mechanism in clastic rocks with an emphasis on sandstone (2003). Combined field analysis of structures comprising faults, fault kinematics, and 3-D model construction with mechanical simulations using linear elastic fracture mechanics and boundary element methods, 185 pp.

Research Publications

(Note: Student or PostDoc presentations and manuscripts are starred.)

Links to articles, and most conference proceedings and abstracts are available via Google Scholar at:
http://scholar.google.com/citations?user=FWfJM1EAAAAJ&hl=en

In Preparation

Davatzes, N.C., M. Swyer, D. Lockner, S.J. Solum, (*in prep*) Mechanisms of fault gouge evolution and physical properties: Moab Fault, Utah. For submission to *Journal of Structural Geology*.
Swyer, M.W. and **N.C. Davatzes** (*in prep.*) Robust investigations of structural uncertainty: The role of faulting in the Desert Peak Geothermal System, For submission to *Geothermics*.
Blake, K. and **N.C. Davatzes** (*in prep*) Stress Heterogeneity in the vicinity of the Coso Geothermal Field. For submission to *Tectonophysics*.

In Review

none

Refereed Articles

H Sakuma, DA Lockner, J Solum, **N Davatzes** (2022) Effect of cationic species on the friction of clay-bearing faults. Nature, Communications earth and environment. 116 (2022). https://doi.org/10.1038/s43247-022-00444-3

* CS Choi, S Ravi, IZ Siregar, FG Dwiyanti, J Macknick, M Elchinger, **N Davatzes** (2021) Combined land use of solar infrastructure and agriculture for socioeconomic and environmental co-benefits in the tropics. Renewable and Sustainable Energy Reviews, v 151, 12 p. https://doi.org/10.1016/j.rser.2021.111610

* OA Callahan, P Eichhubl, JE Olson, **NC Davatzes**, (2020) Experimental investigation of chemically aided fracture growth in silicified fault rocks, Geothermics, v 83, https://doi.org/10.1016/j.geothermics.2019.101724

* OA Callahan, P Eichhubl, **NC Davatzes** (2020) Mineral precipitation as a mechanism of fault core growth, Journal of Structural Geology, v (2020/8/16) https://doi.org/10.1016/j.jsg.2020.104156

* OA Callahan, P Eichhubl, JE Olson, **NC Davatzes** (2019) Fracture mechanical properties of damaged and hydrothermally altered rocks, dixie valley-stillwater fault zone, Nevada, USA, Journal of Geophysical Research: Solid Earth, V 104, p. 4069-4090. https://doi.org/10.1029/2018JB016708

* Ali, S.T., E.C. Reinisch, J. Moore, M. Plummer, I. Warren, **N.C. Davatzes**, and K.L. Feigl, (2018) Geodetic Measurements and Numerical Models of Transient Deformation at Raft River Geothermal Field, Idaho, USA, *Geothermics*, v. 74 p 106-111.

M. Cardiff, D.D. Lim, J.R. Patterson, J. Akerley, Paul Spielman, J. Lopeman; P. Walsh; A. Singh; W. Foxall; Herbert F Wang, N.E. Lord, C.H. Thurber, Dante Fratta, R.J. Mellors, **N.C. Davatzes**, K.L. Feigl (2018) Geothermal production and reduced seismicity: Correlation and proposed mechanism. Earth and Planetary Science Letters, v 482, p. 470-477.

* Schoenball, M. and **N.C. Davatzes** (*2017*) Quantifying the heterogeneity of the stress field derived from local and global borehole data. For submitted to Journal of Geophysical Research. V 112. DOI: 10.1002/2017JB014370

* Lindsey, N.J., Kaven, J.O., **Davatzes, N.C.**, Newman, G.A. (2016) Compartmentalization of Coso East Flank Geothermal Field Imaged by 3-D Full-tensor Magnetotelluric Inversion, *Geophysical Journal International*. (2017) 208, 652–662.

* Ali, S.T., J. Akerley, A. Baluyut, E.M. Cardiff, **N.C. Davatzes**, K.L. Feigl, W. Foxall, D. Fratta, R.J. Mellors , P. Spielman , H.F. Wang, E .Zemach (2016) Time-series analysis of surface deformation at Brady Hot Springs geothermal field (Nevada) using Interferometric Synthetic Aperture Radar, *Geothermics.* V. 61, p. 114-120.

* Shoenball, M., **N.C. Davatzes**, J.M. Glen (*2015*) Differentiating Induced and Natural Siesmicity Using Space-Time-Magnitude Statistics Applied to Coso Geothermal Field, *Geophysical Research Letters*, v. 42, p. 6221-6228, *doi:10.1002/2015GL064772.*

* Dempsey, D., S. Kelkar, **N.C. Davatzes**, S. Hickman, D. Moos (2015) Numerical modeling of injection, stress and permeability enhancement during shear stimulation at the Desert Peak Enhanced Geothermal System, *International Journal of Rock Mechanics and Mining Sciences*, v 78, p. 190-206.

* Benato, S., S. Hickman, **N.C. Davatzes, J.** Taron, S. Spielman, D. Elsworth, E.L. Majer, and K. Boyle (2015) Conceptual model and numerical analysis of the Desert Peak EGS project: Reservoir response to the shallow medium flow-rate hydraulic stimulation phase, *Geothermics*, v 63, 18 p.

* Geng, X., **N.C. Davatzes**; D.J. Soeder; J. Torlapati4 ; R.S. Rodriguez5 ; and M.C. Boufadel, (2014) Migration of High-Pressure Air during Gas Well Drilling in the Appalachian Basin, Journal of Environmental Engineering, v. 140, 10 p.

* Kaven, O., S. Hickman, **N.C. Davatzes**, O. Mutlu (2012). Linear complimentarity solver for 3D frictional sliding problems. Computational Geosciences, v. 15, 12 p.

Solum, J., **N.C. Davatzes,** D. Lockner (2010). Structural and Diagenetic Control of Fluid Migration and Cementation Along the Moab Fault, Utah. *invited* and to Journal of Structural Geology, v. 32, p. 1899-1911. *(Special Issue on Chemical and Mechanical Interactions*)

Davatzes, N.C., and S.H. Hickman (2010), Stress, fracture, and fluid-flow analysis using acoustic and electrical image logs in hot fractured granites of the Coso geothermal field, California, U.S.A., in M. Poppelreiter, C. Garcıa-Carballido, and M. Kraaijveld, eds., Dipmeter and borehole image log technology: AAPG Memoir 92, Ch 24., p. 1 – 35.

Eichhubl, P. and **N.C. Davatzes,** S.P. Becker (2009). Structural and Diagenetic Control of Fluid Migration and Cementation Along the Moab Fault, Utah. American Association of Petroleum Geologists Bulletin, 93 (5), 653-681.

Davatzes, N.C., A. Aydin, R. Sorkhabi, and Y. Tsuji. (2005). Distribution and nature of fault architecture in a layered sandstone and shale sequence: An example from the Moab fault, Utah. *In* R. Sorkhabi and Y. Tsuji, eds., Faults, fluid flow, and petroleum traps: AAPG Memoir 85, p. 153-180

Davatzes, N.C., P. Eichhubl, and A. Aydin. (2005). Structural evolution of fault zones in sandstone by multiple deformation mechanisms: Moab fault, SE Utah. Geological Society of America Bulletin, v. 117, no. 1/2, p. 135-

148.

Davatzes, N.C., A. Aydin, & P. Eichhubl (2003). Overprinting faulting mechanisms during the development of multiple fault sets in sandstone. Tectonophysics, v. 363, p. 1-18.

Davatzes, N.C. and A. Aydin. (2003). The formation of conjugate normal fault systems in folded sandstone by sequential jointing and shearing. Journal of Geophysical Research, v. 108, no. 10, p. 2156-2202. DOI 10.1029/2002JB002289

Davatzes, N.C. and A. Aydin. (2003). Overprinting faulting mechanisms in high porosity sandstone of SE Utah. Journal of Structural Geology, v. 25, no. 11, p. 1795-1813.

Peer Reviewed Proceedings Papers

* Stowe, B, D Spake, TT Cladouhos, AN Steely, and **NC Davatzes**. (2021) Combined Structural Analysis of Core and Image Log of TGH MB76-31 East of Mt Baker, Washington State. Geothermal Resources Council Transactions. v 45, p. 1235-1259. (Geothermal Rising, San Diego, CA October 03, 2011) https://www.geothermal-library.org/index.php?mode=pubs&action=view&record=1034449

* D. Spake, AN Steely, TT Cladouhos, MW Swyer, C Forson, **NC Davatzes**, 2019, Geothermal Exploration North of Mount St. Helens: Washington State Play-Fairway Project, Workshop on Geothermal Reservoir Engineering 44, 19 p.

Michael W Swyer, TT Cladouhos, C Forson, AN Steely, **NC Davatzes**, 2018, Simulating Local Sources of Crustal Deformation for Washington State Geothermal Prospects using Geomechanical Models, ARMA,52nd US Rock Mechanics/Geomechanics Symposium and 2nd DFNE Conference 18–464, Seattle, WA, June 17-22, 2018. 9 p.

Michael W Swyer, TT Cladouhos, C Forson, AN Steely, **NC Davatzes** (2018) Preliminary Geothermal Resource Assessment of the St. Helens Seismic Zone Using the Results from the Geothermal Play-Fairway Analysis of Washington State Prospects. ARMA 18–464, ARMA,52nd US Rock Mechanics/Geomechanics Symposium and 2nd DFNE Conference 18–464, Seattle, WA, June 17-22, 2018. 9 p.

Forson, C., A.N. Steely, T. Cladouhos, M. Swyer, **N.C. Davatzes**, M. Anderson, B. Ritzinger, J. Glen, J. Peacock, W. Schermerhorn, E. Burns, P. Stelling **(2018)** GEOTHERMAL PLAY-FAIRWAY ANALYSIS OF WASHINGTON STATE PROSPECTS: PHASE 2. Geothermal Resources Council Transactions, 41.

* Callahan, O.A., P. Eichhubl, J. Olson, N.C. Davatzes (2017) Fracture Mechanical Properties of Damaged and Hydrothermally Altered Rocks, Dixie Valley, NV: Implications for Fault Conduit Development in Geothermal Systems. PROCEEDINGS, 41st Workshop on Geothermal Reservoir Engineering. Stanford University, Stanford, California, February 13-15, 2017 SGP-TR-212, 8 p.

Feigl, K.L., The PoroTomo Team, including M.A. Cardiff, X. Zeng, N.E. Lord, C. Lancelle, D.D. Lim, L. Parker, E.C. Reinisch, S.T. Ali, D. Fratta, C.H. Thurber, H.F. Wang, M. Robertson, T. Coleman, D.E. Miller, J. Lopeman, P. Spielman, J. Akerley, C. Kreemer, C. Morency, E. Matzel, W. Trainor-Guitton, S. Jreij, **N.C. Davatzes** (2016) Overview and Preliminary Results from the PoroTomo project at Brady Hot Springs, Nevada: Poroelastic Tomography by Adjoint Inverse Modeling of Data from Seismology, Geodesy, and Hydrology. PROCEEDINGS, 42nd Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, February 13-15, 2017 SGP-TR-212. 15 p.

Forson, Corina; Czajkowski, Jessica L.; Norman, David K.; Swyer, Michael W.; Cladouhos, Trenton T.; Davatzes, Nicholas (2016) Summary of Phase 1 and Plans for Phase 2 of the Washington State Geothermal Play-Fairway Analysis, Geothermal Resources Council Transactions, 40.

Swyer, M.W., T.T. Cladouhos, C. Forson, J.L. Czajkowski, **N.C. Davatzes, N.C.**, G.M. Schmalzle. (2016) Permeability potential modeling of geothermal prospects combining regional crustal strain rates with geomechanical simulation of fault slip and volcanic center deformation: A case study for Washington State geothermal play fairways, 50th Annual Rock Mechanics / Geomechanics Symposium, Houston, TX, USA 26-29 June 2016. ARMA 16-828, 14 p.

* Schoenball, M., J.M.G. Glen, and **N.C. Davatzes** (2016), Analysis and Interpretation of Stress Indicators in Deviated Wells of the Coso Geothermal Field , Proceedings, 41st Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 22-24, 12 p.

* Laboso, R.C., **N.C. Davatzes** (2016), Fault-Controlled Damage and Permeability at the Brady Geothermal System, Nevada, USA, Proceedings, 41st Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 22-24, 16p.

* Ali, S.T., J. Akerley, E.C. Baluyut, **N.C. Davatzes**, J. Lopeman, J Moore, M. Plummer, P. Spielman, I. Warren, and K.L. Feigl (2016), Geodetic Measurements and Numerical Models of Deformation: Examples from Geothermal Fields in the Western United States Proceedings, 41st Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 22-24, 7 p.

Allis, R., J. Moore, **N.C. Davatzes**, M. Gwynn, C. Hardwick, S. Kirby, J. McClennan, K. Pankow, S. Potter, S. Simmons (2016), EGS Concept Testing and Development at the Milford, Utah FORGE Site , Proceedings, 41st Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 22-24, 13 p.

Forson, C. Swyer, M.W. , Schmalzle, G.M. , Czajkowski, J.L., Cladouhos, T.T. , **Davatzes, N.C.**, Norman, D.K. and Cole, R.A. (2015) Geothermal Play-Fairway Analysis of Washington State Prospects, Geothermal Resources Council, 39th Geothermal Resources Council Annual Meeting, Reno, NV, September 20-September 23, 2015. 16 p.

* Ali, S. T., **N.C. Davatzes**, K. L. Feigl, H. F. Wang, W. Foxall, R. J. Mellors, J. Akerley, E. Zemach, and P. Spielman (2015), Deformation at Brady Hot Springs geothermal field measured by time series analysis of InSAR data [SGP-TR-204], paper presented at Proceedings, Fortieth Workshop on Geothermal Reservoir Engineering, Stanford University, January 26-28, 2015. 5 p. https://pangea.stanford.edu/ERE/db/GeoConf/papers/SGW/2015/Ali.pdf

* Wells, O.L. and **Davatzes, N.C.** (2015) The history of dilation across natural fractures due to evolving surface roughness, Proceedings, Fortieth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, January 28-28, 2015, 12 p.

* Shoenball, M., Kaven, J.O., Glen, J.M.G., **Davatzes, N.C.** (2015) **Natural or Induced: Identifying Natural and Induced Swarms from Pre-production and Co-production Microseismic Catalogs at the Coso Geothermal Field,** Proceedings, Fortieth Workshop on Geothermal Reservoir Engineering, Stanford University, January 26-28, 2015. 11 p.

* Geng, X., **N.C. Davatzes,** M.C. Boufadel, D.J. Soeder, (2013). A modeling study of air migration from a drilling well to the surrounding aquifer in Appalachia. Journal of Environmental Engineering, American Society of Civil Engineers.

* Ali, T., **Davatzes, N.C.**, Drakos, P., Feigl, K., Foxall, W., Kreemer, C., Mellors, R., Wang,H., Zemach, E., (2014 SGW) InSAR measurements and numerical models of deformation at Brady Hot Springs geothermal field (Nevada), 1995-2012. Proceedings, Thirty-Ninth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 2-5, 2014, 14 p.

* Kaven, J.O., Hickman, S., and **Davatzes, N.C.** (2014) Micro-seismicity and seismic moment release within the Coso Geothermal Field, California. Proceedings, Thirty-Ninth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 2-26, 2014, 10 p.

* Dempsey, D., Kelkar, S., **Davatzes, N.C.**, Hickman, S., Moos, D., Zemach, E. (2014) Evaluating the Roles of Thermoelastic and Poroelastic Stress Changes in the Desert Peak EGS Stimulation. Proceedings, Thirty-Ninth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 2-26, 2014, 14 p.

* Roth, J., **Davatzes, N.C.**, Davatzes, A.E.K. (2013) Investigating the volume and structure of porosity in fractured and unfractured rock from the Newberry volcano, Oregon, USA: Evaluation of two- and three-dimensional methods. Geothermal Resources Council Annual Meeting, Las Vegas, NV, September 29-October 2, 2013. 10 p.

* Benato, S., Reeves, D.M., Parashar, R., **Davatzes, N.C.**, Hickman, S., Elsworth, D., Spielman, P., Taron, J. (2013) Computational Investigation of Hydro-Mechanical Effects on Transmissivity Evolution During the Initial Injection Phases at the Desert Peak EGS Project, NV. PROCEEDINGS, Thirty-Eighth Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, February 11-13, 2013SGP-TR-198, 14 p.
  an updated version was also presented at: European Geothermal Conference, 7 Petrothermal Systems (PS1-3), June 3-7, 2013 Palazzo dei Congressi – Pisa, Italy.

Davatzes, N.C., Feigl, K.L., Mellors, R.J., Foxall, W., Wang. H.F., and Drakos, P. (2013) Preliminary investigation of reservoir dynamics monitored through combined surface deformation and micro-earthquake activity: Brady's Geothermal Field, Nevada, PROCEEDINGS, Thirty-Eight Workshop on Geothermal Reservoir Engineering, Stanford, California, February 11-13, SGP-TR-194, 20 p.

* Dempsey, D., Kelkar, S., Lewis, K., Hickman, S., **Davatzes, N.C.**, Moos, D., Zemach, E. (2013) Modeling Shear Stimulation of the EGS Well 27-15 Using a Coupled Thermal-Hydrological-Mechanical Simulator. ARMA 13-608, San Francisco, CA June 23-26, 2013, 13 p.

* Kaven, J.O., Hickman, S., **Davatzes, N.C.** (2013) Micro-Seismicity within the Coso Geothermal Field, California, From 1996-2012, PROCEEDINGS, Thirty-Eighth Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, February 11-13, 2013SGP-TR-198, 9 p.

***** Swyer, M.W. and **Davatzes, N.C.** (2013) Evaluating the role of the Rhyolite Ridge fault system in the Desert Peak Geothermal Field with robust sensitivity testing through boundary element modeling and likelihood analysis, PROCEEDINGS, Thirty-Eight Workshop on Geothermal Reservoir Engineering, Stanford, California, February 11-February 13, SGP-TR-194, 16 p.

* Batir, J., **Davatzes, N.C.**, and Asmundsson, R. (2012) Preliminary State of Stress of the Hellisheidi Geothermal Field, Hengill Volcanic Zone, Iceland, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering, Stanford, California, January 30-February 1, SGP-TR-194, 17 p.

* Blake, K. and **Davatzes, N.C.** (2012) Borehole Image Log and Statistical Analysis of FOH-3D, Fallon Naval Air Station, NV, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering, Stanford, California, January 30-February 1, SGP-TR-194, 14 p.

Chabora, E., Zemach, E., Spielman, P., Drakos, P., Hickman, S., Lutz, S., Boyle, K., Falconer, A., Robertson-Tait, A., **Davatzes, N.C.**, Rose, P., and Majer, E., and Jarpe, S. (2012) Hydraulic Stimulation of Well 27-15, Desert Peak Geothermal Field, Nevada, USA, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering, Stanford, California, January 30-February 1, SGP-TR-194, 12 p.

* Kaven, J.O., Hickman, S.H., and **Davatzes, N.C.** (2012) Using Micro-Seismicity and Seismic Velocities to Map Subsurface Geologic and Hydrologic Structure Within the Coso Geothermal Field, California, Proceedings,Thirty-Seventh Workshop on Geothermal Reservoir Engineering, Stanford, California, January 30-February 1, SGP-TR-194, 8 p.

Kelkar, S., Lewis, K., Hickman, S., **Davatzes, N.C.**, Moos, D., and Zyvoloski, G. (2012) Modeling Coupled Thermal-Hydrological-Mechanical Processes During Shear Stimulation of an EGS Well, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering, Stanford, California, January 30-February 1, SGP-TR-194, 8 p.

* Swyer, M.W. and **Davatzes, N.C.** (2012) Using Boundary Element Modeling of Fault Slip to Predict Patterns of stress Perturbation and Related Fractures in Geothermal Reservoirs and Explore Parameter Uncertainty, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering, Stanford, California, January 30-February 1, SGP-TR-194, 14 p.

Davatzes, N.C. and Hickman, S. (2011) Preliminary analysis of Fractures, Strength and Stress Directions in the Newberry EGS well 55-29. Geothermal Resources Council Annual Meeting, San Diego, CA. 12 p.

* Fetterman, J.D. and **Davatzes, N.C.** (2011) Evolution of Fracture Porosity in the Newberry Volcano Geothermal System, Oregon, USA: Feedback between deformation and alteration. Geothermal Resources Council Annual Meeting, San Diego, CA. 7 p.

Davatzes, N.C. and Hickman, S. (2011) Natural Fractures, Mechanical Properties, and *In Situ*, Stress in the Planning and Execution of the Desert Peak EGS Experiment. AAPG/SPE/SEG Hedberg Conference on "Enhanced Geothermal Systems." March 14-18, 2011 – Napa, California. 2 p.

* Runyon, K., Davatzes, A. and **Davatzes, N.C.**, (2011) Structural Characterization of the Cerberus Fossae at the Athabasca Valles Source Region, Mars. Lunar and Planetary Sciences Annual Meeting Extended Abstracts. 2 p.

* Blake, K. and **Davatzes, N.C.** (2011) Stress Heterogeneity in the Vicinity of the Coso Geothermal Field. Proceedings Thirty-Fifth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California. 11 p.

* Kaven, O., Hickman, S., and **Davatzes, N.C.** (2011) Micro-seismicity, fault structure, and hydrologic compartmentalization within the Coso Geothermal Field, California. Proceedings Thirty-Fifth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California. 8 p.

Cladouhos, T., Petty, S., Osborn, W., Hickman, S. and **Davatzes, N.C.** (2011) The role of stress in stimulation planning at the Newberry EGS Demonstration Project. Proceedings Thirty-Fifth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California. 8 p.

Lutz, S.J., Hickman, S., **Davatzes, N.C.**, Zemach, E., Drakos, P., and Robertson-Tait, A. (2010) Rock Mechanical Testing in Support of Well Stimulation Activities at the Desert Peak Geothermal Field, Nevada. Geothermal Resources Council Annual Meeting Proceedings

* Garza-Cruz, T. & **Davatzes, N.C.** (2010): Numerical Modeling of the nucleation conditions of drilling-induced Petal Centerline Fracture. Geothermal Resources Council.
Best Paper Award!

Davatzes, N.C. & Hickman, S. (2010) The feedback between stress, faulting, and fluid flow: Lessons from the Coso Geothermal Field, CA, USA, World Geothermal Congress, paper #1267. Nusa Dua-Bali, Indonesia, April 25-30, 2010, 12 p. (meets every 5 years)

Hickman, S. & **Davatzes, N.C.** (2010). In-situ stress and fracture characterization for planning of an EGS stimulation in the Desert Peak Geothermal Field, NV. Proceedings Thirty-Fourth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 1-3, 2010. SGP-TR-187. 11 p.

Lutz, S. J., Hickman, S., **Davatzes, N. C.**, Zemach, E., Drakos, P., Ann Robertson-Tait, (2010). Rock mechanical and petrologic testing in support of well stimulation activities at the Desert Peak Geothermal Field, Nevada. Proceedings Thirty-Fourth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 1-3, 2010. SGP-TR-187.

Davatzes, N.C. and Hickman, S. (2009). Fractures, stress and fluid flow prior to stimulation of well 27-15, Desert

Peak, Nevada, EGS project. Workshop on Geothermal Reservoir Engineering, 2009, Stanford Geothermal Workshop.

Davatzes, N.C. and Hickman, S., (2006), Stress and Faulting in the Coso Geothermal Field: Update and Recent Results from the East Flank and Coso Wash. 31st Stanford University Workshop on Geothermal Engineering, January 30-February 1, SGP-TR-179, pp. 12.

Davatzes, N.C. and Hickman, S., (2005) Controls on fault-hosted fluid flow: Preliminary results from the Coso Geothermal Field, California. Geothermal Resources Council Transactions, v. 19, p. 343-348.

Davatzes, N.C. and Hickman, S., (2005) Interpretation and comparison of Electrical and Acoustic image logs from a well in the Coso Geothermal Field, CA, 30th Stanford University Workshop on Geothermal Reservoir Engineering, January 31 – February 2, 2005, SGP-TR-176, pp. 11.

Eichhubl, P., **Davatzes, N.C.,** and Aydin, A., (2003) Fault architecture fluid flow and cementation: The Moab Fault, Utah, USA. in Geofluids IV, Extended Abstract, 13 p.

Abstracts

* Sawyer, M, J Glen, **NC Davatzes** (2021) Potential role of dikes in damaging rock to support hydrothermal fluid flow, Surprise. *AAPG Eastern Section Meeting, October 2-5, 2021, Pittsburg, PA*

* B Stowe, **NC Davatzes**, D Spake, TT Cladouhos, AN Steely (2020) Combined Structural Analysis of Core and Image Log of Borehole MB76-31 East of Mount Baker, Washington State. Geothermal Resources Council Transactions. v 44, p. 1343.

T Cladouhos; A Steely; **NC Davatzes** (2020) Washington State Geothermal Play-Fairway Analysis: Preliminary TCH Drilling Results. Geothermal Resources Council Transactions. v 44, p. 1296

* OA Callahan, P Eichhubl, **NC Davatzes** (2019) The impact of precipitation-strengthening on fault zone evolution in mineralizing epithermal environments GSA Annual Meeting in Phoenix, Arizona, USA-2019, 2019

* OA Callahan, P Eichhubl, **NC Davatzes**, 2018, Precipitation-Strengthening and Fault Zone Evolution, Dixie Comstock Epithermal Deposit, Dixie Valley, Nevada, USA, AGU Fall Meeting Abstracts, 2018, Washington DC. 10-14 Dec.

HF Wang, KL Feigl, J Patterson, L Parker, EC Reinisch, X Zeng, MA Cardiff, D Fratta, NE Lord, CH Thurber, M Robertson, Douglas E Miller, John Akerley, Corné Kreemer, Christina Morency, **NC Davatzes** (2017) Characterization of Material Properties at Brady Hot Springs, Nevada by Inverse Modeling of Data from Seismology, Geodesy, and Hydrology. American Geophysical Union, Fall Meeting 2017, abstract #H41O-01. New Orleans, LA, 11-15 Dec.

Davatzes, NC, RC Laboso, CE Layland-Bachmann, KL Feigl, W Foxall, AR Tabrez, RJ Mellors, DC Templeton, J Akerley (2017) Are geothermal Systems stressed out? American Geophysical Union, Fall Meeting 2017, abstract #H41O-01. New Orleans, LA, 11-15 Dec.

Forson, Corina, Steely, Alexander N., Cladouhos, Trenton T., Swyer, M W., **NC Davatzes**, M Anderson, B RITZINGER, J PEACOCK, J GLEN, W SCHERMERHORN, and P STELLING, (2017) Geothermal exploration using play-fairway analysis in Washington state. Geological Society of America *Abstracts with Programs.* Vol. 49, No. 6. GSA Annual Meeting, Seattle, WA, October 22-26, 2017

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Selected Research Reports

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2. PoroTomo: Poroelastic Tomography by Adjoint Inverse Modeling of Data from Seismology, Geodesy, and Hydrology: Kurt L. Feigl, Michael Cardiff,Dante Fratta, Clifford Thurber, Herbert F. Wang, S. Tabrez Ali,Neal E. Lord, Peter E. Sobol, Robert J. Mellors, Whitney J. Trainor-Guitton, Eric M. Matzel, **Nicholas C. Davatzes**, Corné Kreemer, William Foxall, John Akerley, Athena Chalari, Thomas Coleman
3. Geothermal Play-Fairway Analysis of Washington State Prospects: David K. Norman, Jessica L. Czajkowski, Corina Forson, Trenton T. Cladouhos, Michael W. Swyer, Gina M. Schmalzle, **Nicholas Davatzes**, and Ryan A. Cole
4. Geomechanical Framework for the Analysis of MEQ in EGS Experiments: Ahmad Ghassemi, **Nicholas C. Davatzes**
5. Bradys EGS Project: John Akerley, Ezra Zemach, Ann Robertson-Tait, Daniel Moos, Ernest Majer, Peter Rose, Sue Lutz, Steve Hickman, Jim Faulds, **Nick Davatzes**, Inga Moeck

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Davatzes, N.C., (2004) Coso surface mapping and laboratory analysis work plan: Revision after June 2004.

Davatzes, N.C., (2004) Fault linkage and evolution of the fault core in sandstone, Valley of Fire State Park.

Invited Lecture/Speaker (those with papers listed in sections above)

2021: **Davatzes, N.C.**, Power from Earth's Heat: How geothermal energy systems could improve our energy outlook? Featured Speaker in the Second Anniversary PEP Bandung international webinar series INSIGHT, *Where does Indonesia's Enormous Geothermal Potential has to be Directed?* Bandung, Indonesia, September 8, 2021, https://www.youtube.com/watch?v=ncwVsD0iOoM

2020: **Davatzes, N.C.**, Invited participate: ICDP Scientific Drilling Workshop: Deep Geothermal Test Borehole, Cornell Campus: 8-10 January, 2020

2019: **Davatzes, N.C.** Geothermal Energy Systems, IPB Agricultural University, Bodor, Indonesia, May 13, 2019.

2019: **Davatzes, N.C.** Geothermal Energy Systems, ITB Technical University, Bandung, Indonesia, May 16, 2019.

2018: **Davatzes, N.C.** What can heterogeneity of stress in the brittle crust tell us?, Gordon Research Conference on Rock Deformation, Andover, NH. August 19-24, 2018,

2018: **Davatzes, N.C.**, Are Geothermal Systems Stressed Out? Recruiting Seminar at Bucknell University, Bucknell University Seminar Talk, Lewsburg, PA, October 12, 2018.

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2016: **Davatzes, N.C.**, Geomechanics of Geothermal Systems: Lessons from the Basin and Range of Nevada and California, Dept. of Geosciences, University of Massachusetts, Madison, MA, February 5, 2016.

2015: **Davatzes, N.C.**, Geothermal Feedback: Stress, active faulting, and fluid flow, USC Distinguished Lecture Series, http://cgs.usc.edu/distinguished-speaker-programs/, June 11, 2015.

2013: **Davatzes, N.C.**, Hickman, S., Zemach, E., Chabora, E., Lutz, S., Rose, P., Majer, E., Robertson-Tait, A., Dempsey, D., Kelkar, S., Structural and geomechanical constraints in designing an EGS: Example at the Desert Peak Geothermal Field, Nevada, USA. Cornell University, Ithaca, NY, December 4, 2013.

2013: **Davatzes, N.C.**, Hickman, S., Zemach, E., Chabora, E., Lutz, S., Rose, P., Majer, E., Robertson-Tait, A., Dempsey, D., Kelkar, S., Structural and geomechanical constraints in designing an EGS: Example at the Desert Peak Geothermal Field, Nevada, USA. China EGS Workshop, Jilin University, Changchun, China, July 9-10, 2013.

2013: **Davatzes, N.C.**, Feigl, K.L., Mellors, R.J., Foxall, W., Wang. H.F., and Drakos, P. (2013) Contrasts between deformation accommodated by induced seismic and aseismic processes revealed by combined monitoring of seismicity and surface deformations: Brady's Geothermal Field, Nevada. Geothermal Engineering Integrating

Mitigation of Induced Seismicity in Reservoirs (GEISER). *Sala del Capitolo, Convento di San Domenico Maggiore, Napoli*, May 30-31, 2013.

2013: *Lecture*: **Davatzes, N.C**., Solum, S., Lockner, D., * Anyamele, N. Development of Damage, Fault Rock, and Fault Zone Properties; Moab Fault, Utah, USA; *Seminar*: **Davatzes, N.C.** and Hickman, S. Structural and Geomechanical Constraints in Designing an EGS: Example at Desert Peak Geothermal Field. Rochester, NY, February, 22.

2012: *Invited Lecture Series*: **Davatzes, N.C.**: Geological and Nuclear Sciences of New Zealand Talk Series (three invited lectures in four days). (1) Structural and Geomechanical Constraints in Designing an EGS: Example at Desert Peak Geothermal Field, Nevada, USA; (2) Petal Centerline Fractures in Image Logs: Numerical Modeling of Nucleation Conditions Below a Borehole Floor; (3) Development of Damage, Fault Rock, and Fault Zone Properties: Moab Fault, Utah, USA. GNS, Taupo, New Zealand, August 28-31, 2012.

2012: **Davatzes, N.C.**, Hickman, S., * Fetterman, J.A., Cladouhos, T.: Newberry EGS Demonstration, USA: Overview and Structural Analysis. International Geothermal Congress, Freiburg, Germany, May 23, 2012.

2012: *Keynote***: Davatzes, N.C.**, Hickman, S., EGS Team: Structural and Geomechanical Constraints in Designing an EGS: Example at Desert Peak Geothermal Field, Nevada, USA. International Congress on Enhanced Geothermal Systems, Freiburg, Germany, May 25, 2012.

2012: Boufadel, M. and **Davatzes, N.C.:** Risks, Benefits, Myths, and Realities of Hydraulic Fracturing Talk Session. Ohio Environment, Energy and Resources Law Seminar, Cherry Valley Lodge, Newark, Ohio, April 19-21.

2011: * Blake, K and **Davatzes, N.C.**: Crustal Stress Heterogeneity in the Vicinity of a Geothermal Field: Coso Geothermal Field, CA. HADES Workshop: Hotter and Deeper Exploration Science, Taupo, New Zeland. May 25, 2011.

2011: **Davatzes, N.C.**, Colorado School of Mines, CO: Advanced Formation Evaluation Seminar: “Applications of Formation Evaluation to Geothermal Systems,” February 15, 2011.

2011: **Davatzes, N.C.**, Alternative Stress Observations from Boreholes, etc., at Southern California Earthquake Center (SCEC) 2011 Annual Meeting: Workshop on Strategies for Implementing a Community Stress Model, September 10. Palm Springs, CA, USA.

2009: **Davatzes, N.C.**, University of Pennsylvania, Department of Earth and Environmental Science, Seminar Series (Philadelphia, PA): Geothermal Energy: Active faulting, stress, and fluid flow at the Coso Geothermal Field, CA.

2007: **Davatzes, N.C.**, Geothermal Resources Council, Borehole Geophysical Methods in the development of geothermal reservoirs. Reno, Nevada.

2007: **Davatzes, N.C.**, Chevron Corporation: Stress, faulting, and fluid flow in the Coso Geothermal Field.

2006: **Davatzes, N.C.**, USGS Headquarters Office, Stress, Fault Rocks, and Fluid Flow: A complete system in the East Flank of the Coso Geothermal Field.

2006: **Davatzes, N.C.** and Solum, J.G., Shell Petroleum Company: The distribution and generation of fault rocks and fault properties along Moab fault.

2006: **Davatzes, N.C.**, Energy Team, U.S. Geological Survey, Two seminars: 1. The distribution and generation of fault rocks and fault properties along the Moab fault 2. Stress, Fault Rocks, and Fluid flow.

2006: **Davatzes, N.C.**, Exploration Techniques Short Course: Geothermal Resources Council (GRC) Annual Meeting 2006, Presented invited lecture on Structural Controls of Geothermal Systems.

2006: **Davatzes, N.C.**, UC Davis Lecture Series, Controls on Geothermal System Permeability at the Coso Geothermal Field.

2005: **Davatzes, N.C.**, Temple University Geology Department, Impact of deformation mechanisms on faulting and fault zone hydrology.

2005: **Davatzes, N.C.**, Coso Enhanced Geothermal System Workshop, Investigation of fracture and fault characteristics in the EGS area.

2005: **Davatzes, N.C.**, Volcano Hazards Team, U.S. Geological Survey, Insights into fracture controlled fluid flow above a magmatically heated geothermal system.

2005: **Davatzes, N.C.**, Society for Petrophysicists and Well Log Analysts, Comparison of Acoustic and Electrical Image Logs from Coso Geothermal Field.

2004: **Davatzes, N.C.**, Energy and Geoscience Institute, Impact of deformation mechanisms on fault zone architecture and hydrology in sedimentary rocks.

2004: **Davatzes, N.C.**, Earthquake Hazards Team, Impact of deformation mechanisms on fault zone architecture and hydrology in sedimentary rocks.

2002: **Davatzes, N.C.**, Phillips Petroleum Company, Detailed anatomy of deformation in sandstone units along the Moab Fault.

2002: **Davatzes, N.C.**, ConocoPhillips Petroleum Company, Geological modeling of fault architecture.

2002: **Davatzes, N.C.**, ChevronTexaco Petroleum Company, Fault seal and conduit dichotomy.

Workshops, Short Courses, Fieldtrips Organizer/Leader

2014: **Davatzes, N.C.,** collaborators: Dr. John Ziagos, Nathanial Lindsay. Invited by *Winter School* PI Tea Godoladze to collaboratively develop a 5-day Geothermal Training Course, Ilya State University, Earth Sciences Institute, Field Station, Stepantsminda, Country of Georgia. March 3-7, 2014. Participants included students, professors, and professionals from Georgia, Armenia, Azerbaijan, and Turkey.
Topics Covered by **N.C. Davatzes**: (1) Reservoir Geomechanics; (2) Geophysical Well Characterization; (3) Site Screening: Best Practices to Locate Geothermal Sites: Part 1: Geothermal Geochemistry; (4) Site Screening: Best Practices to Locate Geothermal Sites: Part 2: Assessment; (5) Reservoir Characterization and Management; (6) Geothermal Geology; (7) Case Study: The Coso Geothermal System, CA, USA: Part 1: Discovery; (8) Case Study: The Coso Geothermal System, CA, USA: Part 2: Construction and Use of Geomechanical Models.

2007: **Davatzes, N.C.** (2007) Geothermal Research Council: Invited Lecturer on Borehole Geophysical Methods in the development of geothermal reservoirs.

2006: **Davatzes, N.C.** (2006) Exploration Techniques Short Course: Geothermal Resources Council (GRC) Annual Meeting 2006: *Structural Controls of Geothermal Systems*. Davatzes, N.C.

2004: **Davatzes, N.C.** (2004) Stanford Sedimentology Research Group fieldtrip to Southern Nevada: Designed and lead field trip to Buffington Pockets and Valley of Fire State Park

2002: **Davatzes, N.C.** & Aydin, A. Gordon Research Conference: Rock Deformation (Il Ciocco, Italy): Sequence and distribution of two distinct deformation mechanisms along a slipping normal fault in sandstone

2001: Aydin, A., **Davatzes, N.C.**, Eichhubl, E. (June, 2001) Rock Fracture Project Field Workshop: (Moab Fault & Arches National Park, UT) Developed fieldtrip demonstrating how the formation and properties of fault zones in clastic rocks, in concert with localized diagenesis, control subsurface fluid flow and the migration of petroleum for a group of 14 industry affiliates. *Field Guide: Rock Fracture Field Workshop 12 Field Guide: Fractures and faults in sandstone-Moab Revisited* (71 p.)

1999: Aydin A., **Davatzes, N.C.**, Flodin, E., Girbacea, R., Krantz, R., Maerten, L., and Pollard, D. (June 1999) Rock Fracture Project Field Workshop: (Capital Reef, UT) Co-developed and Co-lead of fieldtrip focusing on small structures accommodating deformation during formation of a Monocline. Included producing a fieldtrip guidebook presenting original research and field trip lectures to a group of affiliates representing 18 energy industry corporations. Field Guide: *Rock Fracture Field Workshop 10 Field Guide: Fractures and faults in folded rocks: the Waterpocket Monocline and the San Rafael Anticline (Utah)* (78 p.)

Research Grants

Grants In Review (PI) (not counted in totals above)

2022-2025*:* PI: S Ravi (Temple U); Co-I (Temple U): J Caplan, **N Davatzes**; Co-I (Penn State U): L McPhillips, C Raj, S Duiker, M Hoffman, S Fathel, K Spengler ; Co-I (NREL): J Macknick; Co-I (U Delaware): K Davis. FOA: DE-FOA-002605, Contrl # 2605-1562: Holistic evaluation of soil, water, and vegetation-related ecosystem services at utility-scale solar installations. Budget: $1,996,730, Start Date: 01/01/2023, End Date: 12/31/2026

Pre-proposals in Review:

None

Grants Approved Pending Release of Funds (PI) (counted toward funding total)

None

Fully Funded Grants (PI) (counted toward funding total)

2017-2021: PI: Forson, C., CO-I: A.N. Steely, T. Cladouhos, M. Swyer, **N.C. Davatzes**, M. Anderson, B. Ritzinger, J. Glen, J. Peacock, W. Schermerhorn, E. Burns, P. Stelling. Washington State Phase 3. (Phase 1 and Phase 2 previously completed: total project: ; sub-award:).

Previously Funded Grants (now inactive)

2013-2020: **Davatzes, N.C.** (PI), USGS-Temple cooperative research on tectonic and geothermal systems. United States Geological Survey (USGS), Geothermal Energy Program, ($499,835). Renewed yearly.

2016-2017: PI: David K. Norman (PI); Co-I: Jessica L. Czajkowski, Daniel Eungard, Trenton T. Cladouhos, Michael W. Swyer, Gina M. Schmalzle, **Nicholas Davatzes**, and Ryan A. Cole, Geothermal Play-Fairway Analysis of

Washington State Prospects: Summary (Phase 2: total project: $715,909; sub-award to Temple: $19,976.81).

2014-2017: **Davatzes, N.C.** (PI) Collaborative agreement Lawrence Berkeley National Laboratory. Geomechanical Analysis of Geothermal Systems. ($32,000). Fellowship for Graduate Student Support.

2014-2017: Feigl, K.L. (PI), Wang, H.F. (Co-Is): Fratta, D., Cardiff, M., Thurber, C., Ali, T., Morency, C., Mellors, R.J., **Davatzes, N.C.**, Kreemer, C., Foxall, W. (Co-PI), Zemach, E., Drakos, P. (Co-PI), Spielman, P., Akerley, J., Chalari, A., Mondanos, M., Poroelastic Tomography by Adjoint Inverse Modeling of Data from Seismology, Geodesy, and Hydrology. DOE Geothermal Technologies Program. (Sub-Award to PI Davatzes: $101,145)

2013-2017: Feigl, K.L. (PI), **Davatzes.N.C.**, Kreemer, C.W., Hager, B., Mellors, R.J. Interferometric analysis of JERS-1, ALOS and ALOS-2 SAR data over geothermal areas for constraining rheological models, Japanese Aerospace Exploration Agency (JAXA) - Hydrology. (Purpose: access to task satellite radar imaging)

2012-2017: **Davatzes, N.C. (PI)**, Hickman, S., Brady's Enhanced Geothermal Systems Demonstration: Phase II ($65,194) ORMAT, Nevada

2011-2017: **Davatzes, N.C.** (PI), Feigl, K., Wang, H., Mellors, R., Foxall, W., and Drakos, P., Development of tools for coupled InSAR and Seismicity monitoring ($1,552,446.65), Department of Energy, Geothermal Technologies Program (FOA DE-FOA-0000522; award number DE –EE0005510)

2015-2016: Frontier Observatory for Research in Geothermal Energy (FORGE) – Milford Site, Utah Renewable upon competitive Phase II and III proposal **DE-FOA-0000890,** Phase 1; Member of research team as Co-I through subcontract from the Utah Geological Survey (sub-Ward to PI Davatzes: $10,000).

2014-2015: PI: David K. Norman (PI); Co-I: Jessica L. Czajkowski, Daniel Eungard, Trenton T. Cladouhos, Michael W. Swyer, Gina M. Schmalzle, **Nicholas Davatzes**, and Ryan A. Cole, Geothermal Play-Fairway Analysis of Washington State Prospects: Summary (Phase 1: total project: $274,810; sub-award to Temple: $22,847).

2013-2015: Feigl, K.L. (PI), **Davatzes.N.C.**, Kreemer, C.W., Hager, B., Mellors, R.J. Interferometric analysis of SAR data over geothermal areas for constraining rheological models, German Space Agency, TerraSAR-X satellite mission. (Purpose: access to task satellite radar imaging)

2011-2014: Feigl, K. (PI) and **Davatzes, N.C.** (Co-PI), Constraining the rheology of the earth's crust by interferometric radar measurements and numerical models at geothermal areas (proposal to join science team with access to task satellite acquisition of Synthetic Aperture Radar scenes), TerraSAR-X Science Service, German Aerospace Centre (DLR). (Purpose: access to task satellite radar imaging)

2010-2016: Ghassemi, A. & **Davatzes, N.C.**, Development of a Geological and Geomechanical Framework for the Analysis of MEQ in EGS Experiments (Geysers) ($195,523 – represents portion to Temple only: total project budget is 1,607,442 related to developing a new rock mechanics lab), GOV-Department of Energy (DOE).

2010-2014: **Davatzes, N.C.** & Hickman, S., Newberry Volcano EGS Demonstration, ($670,000), AltaRock Energy as part of a GOV-Department of Energy (DOE) grant.

2012-2013: Hutapea, P. (PI), Xi, X. (Co-PI), **Davatzes, N.C.** (Co-PI), Neretina, S. (Co-PI), Acquisition of a Scanning Electron Microscope for Multidisciplinary Research ($475,000), Department of Defense DURIP.

2012: **Davatzes, N.C. (PI)**, Blue Mountain BHTV Log Analysis for Nevada Geothermal Power ($13,400), Nevada Geothermal Power.

2011-2012: **Davatzes, N.C.** & Hickman, S., Development of an Enhanced Geothermal System at Desert Peak, NV, GOV-Department of Energy ($210,000), Ormat Energy.

2011-2012: **Davatzes, N.C.**, Fractures and Stress in the Fallon FOH-3D Geothermal Well: Resource Evaluation (20,845.80), Epsilon System Solutions.

2011-2011: **Davatzes, N.C.**, Evolution of Fault Zone Permeability and Strength, Moab Fault, Utah ($25,000), Shell Petroleum Company.

2011-2012: Boufadel, M.C. (PI) and **Davatzes, N.C.** (Co-PI), Masucci (Co-PI), Evaluation of the upwelling of natural gas and liquids during hydrofracking of Shale formations, William Penn Foundation ($66,000)

2010-2012: **Davatzes, N.C.** & Hickman, S., Brady's Geothermal Field EGS Project Mechanical Analysis ($75,000), Ormat Energy.

2010-2012: Dr. J. Ole Kaven, **Davatzes, N.C.**, Fault Geometry and Mechanics in the Coso Geothermal Field ($123,599/year, 4 years, total: $494,396), U.S. Geological Survey.

2008-2010 - **Davatzes, N.C.**, Evolution of hydraulic and mechanical properties of clay-rich fault rocks ($145,265), Shell Petroleum Company, Technologies Research Group.

2009 - **Davatzes, N.C.**, Use of multiple stimulations to improve economics of Engineered Geothermal Systems in shallow high temperature intrusives ($215,000), AltaRock Energy, FOA: DE-PS36-08GO98008 Department of Energy (DOE).

2008: **Davatzes, N.C.**, Visiting Scientist ($6,180), U.S. Geological Survey (direct travel reimbursement).

2008: Faulds, J., Coolbaugh, M., **Davatzes, N.C.**, & Oppliger, G., Characterizing Structural Controls on Geothermal Systems in the Northern Great Basin through Integrated Structural Analysis and Modeling ($10,690), Great Basin Center for Geothermal Research.

Previously Funded Grants prior to start at Temple (now inactive)

2006-2007 - **Davatzes, N.C.**, Creation of an Enhanced Geothermal System through Hydraulic and Thermal Stimulation: Co-PI on proposal to DOE Enhanced Geothermal Systems Program ($175,000), FOA: DE-FC07-01ID14186, GOV-Department of Energy (DOE).

2004-2006 - **Davatzes, N.C.**, Investigating host rock mineralogical and petrophysical controls on fracture ($160,000), U.S. Geological Survey, Mendenhall Postdoctoral Fellow program.

Professional Experience & Consulting

2004: Consultant Greystone Pictures production of the documentary Countdown to Armageddon, Expert consultant on plate tectonics and geology of Earth's evolution

2004: Consultant Personnel Protection Technologies LLC, Developed Matlab scripts to analyze radar from a new tool being developed to detect suicide bombers

2002: Internship, ConocoPhillips Petroleum Company

1998, 2000: Southwest Research Institute, Center for Nuclear Waste Regulatory Assessment, Internships: (1) Conducted structural analysis of faults in Owens Valley, CA, using inferences of past fault activity to assess seismic risk. (2) Conducted magnetic study of dikes in San Raphael volcanic field, UT, as an analogue to asses the risk of lateral dike propagation into the proposed Nuclear Waste Repository at Yucca Mtn., NV.

Honors/Awards

2014: Geothermics 2013 Certificate of Excellence in Reviewing.
2013: College of Science and Technology, Temple U, Dean's Mentoring Award Recipient.
2010: Invited Visiting Professor: RES School of Renewable Energy Science, Iceland.
2009: Invited Visiting Professor: RES School of Renewable Energy Science, Iceland.
2008: Invited Visiting Professor: RES School of Renewable Energy Science, Iceland.
2003: USGS Mendenhall Postdoctoral Research Fellow.
2002: Shell Grant, Stanford University.
1998: Dr. and Mrs. Thomas Davies Barrow Fellowship, Stanford University.
1998: McGee Grant, Stanford University.
1998: Phi Beta Kappa/Sigma Xi.
1998: Harold W. Miller Prize (best University Honors Thesis), Bucknell University.
1998: Richard P. Nickelsen Prize (excellence in geology), Bucknell University.
1994-1998: Dean's List, Bucknell University.
1993: Norwalk Jazz Festival, CT, Best Soloist.
1993: National Merit Scholar Finalist, Wilton High School, CT.

Teaching

Courses Taught (Temple University)

SCTC 1001 – CST 1st Year Seminar

SCTC 1003 – Fragile Future to Sustainable Society: Seminar introduces new EES students to major themes in departmental research and careers

EES 0836 - *Teacher:* Disasters: Geology vs. Hollywood: General Education: Course teaching the basics of natural disasters by drawing contrasts and revealing misconceptions embedded in Hollywood disaster films.

SCTC 2001 - *Developer/Teacher*: Science of Energy Resource Consumption: Covers key energy resources, their limitations, impacts, and benefits. Also addresses how science related to controversial issues is portrayed to public to shape opinion. (Created 2015 Autumn, now EES 2002 Energy and Environment lead by Dr. Sujith Ravi)

EES 2051 - *Developer/Teacher*: Introduction to Data Visualization and Analysis for Earth and Environmental Science: Covers introduction to the management, visualization, and analysis of data sets common to Earth and Environmental Science using Excel and Matlab in support of calculus and physics concepts applied to example data sets. Includes specially developed text and problem sets.

EES 4082 - Independent Undergraduate Research

EES 4096/4101 - *Developer/Teacher*: Introduction to Structural Geology: Covers basic concepts of structural geology, including the geometry of structures, continuum definitions of deformation, deformation mechanisms, stress, and rheology. Writing intensive (4096) and non-writing intensive (4101) versions (Created 2008 Spring)

EES 5101 - *Developer/Teacher*: Introduction to Structural Geology (for graduate students). (Created 2012 Spring)

EES 5802 - *Developer/Teacher*: Quantitative Structural Geology: Covers basics of continuum mechanics including strain and deformation as applied to brittle deformation of rock, and programming in Matlab. (Created 2008 Autumn)
EES 9994/9996/9998 - *Developer/Teacher*: Individual Study Program Masters Res + Thesis Structural Geology Tectonics

Courses Taught (RES School of Renewable Energy Technology)
2009, 2010 - Drilling Techniques and Logging Methods: Invited Visiting Professor Res School of Renewable Energy Technology, Iceland: 5 day short course
2008 - Drilling Techniques and Logging Methods: Invited Visiting Professor Res School of Renewable Energy Technology, Iceland: 3 day short course on Borehole Geophysics.

Course Development Activities
2022: Fragile Future to Sustainable Society
2021-2022: CST 1st Year Seminar
2015-2017 - Introduction to Data Visualization and Analysis for Earth and Environmental Science (CST/EES 2051); Flipped classroom format; project driven class to develop quantitative analysis skills of EES data sets in MS Excel and Matlab®.
2015 - Science of Energy Resource Consumption: Earth systems constraints on energy resource types.
2014 - Created a short course on Geothermal Resource Characterization (conducted as the Winter School at Ilya State University, Georgia) in collaboration with John Ziagos and Nathaniel Lindsey.
2009 - Created 5-day graduate course on Borehole Geophysical Logging (taught at the RES School for Renewable Energy Science)
2008 - Created undergraduate course 4096: Introduction to Structural Geology (Temple University); graduate co-listed developed in 2015
2008 - Created graduate course 5802: Quantitative Structural Geology (Temple University) based on Continuum Mechanics
2008, 2009 - Created 3-day graduate course on Borehole Geophysical Logging (taught at the RES School for Renewable Energy Science)

PostDoctoral Research Advisor (Temple University)
2014-2017: Postdoctoral Research Advisor: Martin Shoenball: Research on tectonic and geothermal systems integrating Geomechanics and Potential Fields Geophysics. (Jointly Advised by Davatzes and Jonathan Glen, U.S. Geological Survey)
2013-2016: Postdoctoral Research Advisor: Dr. Tabrez Ali: Poroelastic Modeling of Impulse and Response in Geothermal Systems. (Jointly Advised with Dr. Kurt Feigl)
2009-2012: Postdoctoral Research Advisor: Dr. J. Ole Kaven; Project: Fault geometry and mechanics in the Coso geothermal field. (Jointly Advised by Davatzes and Steven H. Hickman of the U.S. Geological Survey)

Ph.D. Dissertation External Reviewer
2017: Cecile Massiot (Victoria University of Wellington): Fracture system characterization and implications for fluid flow in volcanic and metamorphic rocks. 198 p.
2014: Ing. Branislav Fričovský (Technical University of KOŠICE, Faculty of Mining, Ecology, Process Control and Geotechnologies): Composite conceptual model and hydrogeothermal evaluation of the Bešeňová elevation hydrogeothermal structure, Liptov, 300 p.

PhD Research Committee Member (Temple University)
2019-present: Chong Seok Choi: Environmental impacts of renewable energy development and opportunities to colocate solar-energy and agriculture in tropical areas.
2019-present: Louise Borthwick: Geophysical imaging of subglacial geology beneath Thwaites Glacier
2013-2018: Owen Callahan (University of Texas, Austin): Interactions between chemical alteration, fracture mechanics, and fluid flow in hydrothermal systems (Ph.D. Candidate, proposal defense completed)

Masters Research Advisor (Temple University)
2020-2022: Breeann Stowe: Combined Structural Analysis of Core and Image Log of TGH MB76-31 East of Mt Baker, Washington State (*graduated*) (http://dx.doi.org/10.34944/dspace/7708)
2019-2022: Morgan Sawyer: Geomechanics of Geothermal Systems in Surprise Valley, CA (*graduated*) (http://dx.doi.org/10.34944/dspace/7708)

2017-2019: Phillip Drew Spake: Geothermal Exploration North of Mount St. Helens. (graduated) (http://dx.doi.org/10.34944/dspace/2424)
2014-2016: Roselyne Laboso: Spatial Heterogeneity of Permeability as Influenced by Stress States and Fault Slip. (*graduated*) http://dx.doi.org/10.34944/dspace/3137
2013-2015: Olivia Wells: Investigation of the source and evolution of fracture surface topography and its dependence on slip. (*graduated*) (http://dx.doi.org/10.34944/dspace/4008)
2011-2013: Justin Roth: (Co-Advisor: Alexandra Davatzes): Quantifying the volume of porosity in fractured and un-fractured rocks from the Newberry Volcano: An evaluation and comparison of two- and three- dimensional methods. (*graduated*) (http://dx.doi.org/10.34944/dspace/3479)
2010-2012: Michael Swyer: Evaluating the role of the rhyolite ridge fault system in the desert peak geothermal field, NV: Boundary element modeling of fracture potential in proximity to fault slip. (*graduated*) (http://dx.doi.org/10.34944/dspace/2479)
2009-2011: Kelly Blake: Quantifying Length-Scale Dependence of Stress Heterogeneities in the Earth's Crust in the Vicinity of a Geothermal Field: Coso Geothermal Field, CA. (*graduated*) (http://dx.doi.org/10.34944/dspace/794)
2009-2011: Kirby Runyon (Co-Advisor, Primary advisor: Alexandra Davatzes): Tectonic pressurization of Athabasca Valles: Mapping and modeling of a graben-sourced outflow system on Mars. (*graduated*) (http://dx.doi.org/10.34944/dspace/2264)
2008-2009: Nwachukwu Anyamele: Characterizing mechanisms of clay gouge formation and implications for permeability, Moab fault, Utah. (*graduated*)

Masters Research Advisor (RES School of Renewable Energy Science, Iceland)

(Note: These students spent time as visiting researchers within the Davatzes Laboratory, with the project initiated during the summer session of the corresponding 1st year. Unless otherwise noted, Davatzes was the primary research advisor.)
2010-2011: Research Advisor (Co-Advisor Ragnar Asmundsson): Joseph Batir: Stress field Characterization of the Hellisheidi Geothermal field and possibilities to improve Injection Capabilities. (*graduated*)
2010-2011: Research Advisor: James Drew Fetterman, Thesis: Analysis of Porosity Generation in Geothermal Systems. (*graduated*)
2010-2011: Research Advisor: Amelia Letvin, Thesis: Cuttings and Geophysical Log Analysis a the Newberry Geothermal Field. (*graduated*)
2009-2010: Research Advisor: Tryana Garza-Cruz (student at RES School of Renewable Energy Sciences, Iceland) Thesis: Numerical Modeling of the nucleation conditions and geometry of petal-centerline fractures below a borehole, a sensitivity study and application to the Coso Geothermal Field. (*graduated, top-of-class*)

Masters Research Committee Member (Temple University)

2019-2021: JoAnna Marlow: Sources of Uncertainty in Remote Stratigraphic Observations
2018-2020: Nolan Barrette: Geophysical imaging of tunnel channels in central Wisconsin
2018-2020: Alex Rocarro: Geophysical mapping of sub-ice-shelf bathymetry in Amundsen Sea Embayment
2017-2019: Chong Seok Choi: Combined land use of solar infrastructure and agriculture for socioeconomic and environmental co-benefits in the tropics.
2013-2015: Haley Rodack: Using Fracture Flow Modeling to Understand Back Matrix Diffusion in Pump and Treat Remediation (*graduated*).
2013-2014: Stephen Peterson: The Geologic, Geomorphic and Geographic Controls on Lead and Other Heavy Metals in Philadelphia's Fairmount Park Soils (*graduated*)
2011-2013: Joseph Frederickson: Craniofacial Ontogeny in Centrosaurus apertus. (*graduated*)
2010-2012: Alyssa Finlay: A new method for CO2 sequestration: Indirect mineral carbonation of bone using a two-step aqueous phase process. (*graduated*)
2008-2010: Catherine Jedrzejczyk: Monitoring the effectiveness of stormwater infiltration trenches at the Pennypack Preserver, Montgomery County, Pennsylvania. (*graduated*)

Undergraduate Independent Studies and Laboratory Work

2022: Undergraduate Research Advisor: Jenna Lobasso: XRD and thin section analysis of core from TGH 76-3.
2021: Undergraduate Research Advisor: Lucy Archibald: XRD and thin section analysis of core from TGH 76-31.
2019: Undergraduate Research Advisor: Breeann Stowe: Structural analysis of core and image logs of TGH 76-31, Mount Baker, Washington
2019: Undergraduate Research Advisor: Breeann Stowe: Structural analysis of core and image logs of TGH 76-31, Mount Baker, Washington
2013: Undergraduate Research Advisor: Garret Bullard: Analysis of Deformation Bands in the North Sea:

Dependence of porosity reduction and structure on depth and vertical stress
2013: Undergraduate Research Advisor: Katey O'Mally: Variation in b-Value of earthquake populations due to EGS stimulation at the Desert Peak Geothermal Field, NV.
2013: Undergraduate Worker: Jacob Berman: Thin Section, XRF, and Separate preparation of glauconite-rich sands.
2012: Undergraduate Research Advisor: Shannon Guffey: City Soils Sample Acquisition and Processing and XRF analysis of elemental composition emphasizing heavy metal contamination.
2012: Undergraduate Research Advisor: Adam Elabd: Development of a Standard Operating Procedure for Laser Scans of Rock Samples and Analog Experiments.
2012: Undergraduate Worker: Marla Hart: Thin section preparation.
2012: Undergraduate Worker: Stephen Yuan: Thin section preparation.
2012: Undergraduate Research Advisor: Jacob Berman: Thin section preparation and XRF scans
2012: Undergraduate Research Advisor: Daniel N. Habecker: Thin section preparation and XRF scans
2012: Undergraduate Research Advisor: Hunter White: Mapping Sand Grain Coordination in Clay-Rich Gouges
2011: Undergraduate Research Co-Advisor: Stephanie Price: High Resolution Laser Scanning and Quantification of Bone Surface Textures
2011: Undergraduate Research Advisor: Luke Walsh: Comparison of Boundary Element Simulations of Borehole Stress Concentration to the dependence of Petal-Centerline Fractures on Borehole Deviation
2010: Undergraduate Research Co-Advisor (with Alexandra Davatzes): Chris Monshizadegan: XRF Study of PreCambrian Sediments (Conference Paper Presented at the Lunar and Planetary Science Meeting, March 2011)
2010: Undergraduate Research Advisor: Luke Walsh: Laboratory assistant including XRF, XRD, and programming techniques
2010: Michael Swyer: Triaxial testing of the permeability and friction of natural fault gouges
2009-2010: Undergraduate Research Advisor: Emily Morton: Analysis of Induced Seismicity at the Geysers Geothermal Field
2009-2010: Undergraduate Research Advisor: Stephen Peterson: XRD analysis of the mineralogical evolution of fault rock, Moab Fault, Utah
2009: Undergraduate Research Advisor: Kevin McGinn: XRF Anlaysis of faulted basalt along the Rhyolite Ridge Fault, Desert Peak Geothermal Field, Nevada
2008: Undergraduate Research Advisor: Christopher Hanratty: Core study of diagnetic alteration of fractures and evolution of permeability, Coso Geothermal Field

Laboratory Staff
2011-2013: Laboratory Manager: Steve Peterson: XRD and XRF Sample Preparation and Analysis and development of laboratory methods
2011: Research Staff: Steve Peterson: XRD and XRF Sample Preparation and Analysis and development of laboratory methods
2011: Adjunct Researcher: Madhavan Narayanan, Ph.D.: Mineral transformations in brittle fault zones hosting geothermal systems.
2010: Jesse Thornburg: XRD analysis and update to Temple University equipment

Other Teaching Activities
1998-2000 - GES 1: Introductory Geology GES 151: Depositional Systems GES 217: Characterization and Hydraulics of Rock Fractures GES 254: Diagenesis and Transfer Processes in Sedimentary Basins.
1996-1998 - GES 100: The Dynamic Earth (introductory physical geology); PHIL 103: Philosophy of Logic.

Service

Member: Committee/Task Force or Workshop
2015: U.S. Department of Energy, SubTER Roundtable Meeting (2015) Washington. Germantown, Maryland, May 22, 2015; Resulted published as DOE white paper: Controlling Subsurface Fractures and Fluid Flow: A Basic Research Agenda, DOE Roundtable Report (May 22, 2015) Chair: L.J Pyrak-Nolte and D.J. De Paolo. Members: **N.C. Davatzes**, J. Fredrich, B. Gilbert, P. Kelemen, K. Maher, J. Miller, J. Morris, C. Peters, S. Pride, K. Rosso, J.R. Rustad, A. Stack, M. Walck, W. Zhu.
2014: **Davatzes, N.C.**, "Constraining" State of Stress from Boreholes. Briefing on stress measurement techniques to the JASON Advisory Group [http://en.m.wikipedia.org/wiki/JASON_(advisory_group)], the JASON Advisory Group is a prestigious DOE/Defense/Intelligence funded group that externally reviews public and secret federally funded projects. General Atomics, La Jolla, CA, June 20, 2014.
2012: Use of Analog Experiments in the Classroom. Analog Experiments Workshop, University of Massachusetts,

Amherst, MA, June 12, 2012.
2011: *Invited Speaker*, **Davatzes, N.C.** and Hickman, S., Borehole televiewer logging and analysis. Brady's EGS Workshop, Ormat NV, Reno, NV, (August 31 – September 1, 2011)
2010: *Invited participant*. Joint DoE (U.S. Department of Energy) and European GEISER Consortium Workshop on Induced Seismicity [in geothermal reservoir development and Enhanced Geothermal Systems; Reykjavik, Iceland. October (4-5). (International)
2009: *Invited participant*. NREL Expert Panel, National Renewable Energy Lab (NREL) Expert Panel: Enhanced Geothermal Systems Reservoir Risk Analysis: Invited member working with the National Renewable Energy Laboratory (NREL) to develop a statistical module for assessing engineering and economic risk and potential growth of electricity produced from Enhanced Geothermal Systems. (National).
2008: Hedberg Conference (AAPG), Casper Wyoming: Faulting Panel discussion leader. Invitation only meeting limited to 75 Participants. (July 14-18, 2008)
2007: *Invited participant*. DOE Sponsored Working Group, DOE Sponsored Working Group: The Future of Geothermal Energy: Enhanced Geothermal Systems (EGS) Workshop Invited member of working group to plan future research directions in EGS technology. Washington, D.C. (National).
2007: *Invited participant*. DOE Expert Working Group, DOE Sponsored Working Group: Enhanced Geothermal Systems Reservoir Creation Workshop: Invited member of working group to identify key issues for enhancing geothermal systems where either permeability or fluid saturation is inadequate. Houston, TX. (National).
2006: *Invited participant*. DOE Sponsored Working Group, DOE Sponsored Working Group: Exploration Research Planning Meeting: Invited member of working group to identify key research needs for development of geothermal resource explorations technology (National).
2005-2007: USGS Geothermal Resources Assessment, Project to assess U.S. geothermal energy resources (National).

Chair: Conference / Track / Program
2006: **Davatzes, N.C.** (2006) Workshop on Geothermal Reservoir Engineering, Convener of a paired special session focused on the Enhanced Geothermal Systems project at Coso (International).
2005: **Davatzes, N.C.** (2005) American Geophysical Union Joint Assembly, Convener of special session: Geothermal Systems: Fantastic natural laboratories and valuable energy resources (International).

Journal Editor:
2013-now: Editorial Board of online journal *Geothermal Energy*, Springer Open Journal. http://www.springer.com/earth+sciences+and+geography/environmental+science+%26+engineering/journal/40517

Reviewer - Article / Manuscript
Geofluids (International) (2006)
Geological Society of America Bulletin (International) (2012)
Geophysical Research Letters (International) (2011)
GEOSPHERE (International) (2010)
Geothermics (International) (2006,2009,2009,2012,2013)
Geothermal Energy (International) (2014, 2016, 2017)
Journal of Geophysical Research (International) (2007,2012)
Journal of the Geological Society of London (International) (2005)
Journal of Structural Geology (International) (2004,2004,2012, 2015)
Tectonophysics (International) (2012)
U.S. Geological Survey (United States: internal reviewer 2004,2005,2006,2007)
Water Resources Reviews (International) (2006)

Reviewer - Grant Proposal Related to Expertise
2017: NSF EarthScope
2013: DOE SBIR program
2010, 2012: Petroleum Research Fund, American Chemical Society (National).
2009: DOE Basic Energy Science Proposal (National).
2009: Ad Hoc NSF Review Panelist, Ad Hoc Review Panel Member, Expert in Geothermal and Fractured Reservoirs: NSF: Engineering Research Centers Program, National Science Foundation, ERC Program Competition--NSF (09-545), Generation-3 ERC (National).

Temple University Committees

2021: EES Departmental Newsletter (Chair)
2018: EES Departmental Newsletter (Chair)
2017, 2018: EES Faculty Writing Retreat Leaader
2017-present: Graduate Student Recruiting Committee member
2017-2018: EES Graduate Student Orientation and TA Training Committee Organizer and Member
2016-2017: Geology Program Review Committee Chair (Lead Author: Earth and Environmental Science Periodic Program Review; Coordinator of External Review)
2015-2017: CST Merit Committee
2015-now: Certificates Development Program Committee
2010, 2012, 2015: Departmental Seminar Series Chair
2014-2015: Curriculum Committee: Co-Author Ph.D. Handbook (co-author with Laura Toran & reviewing group) (approved 2015)
2014-2015: Faculty Search Committee Chair (successful hire)
2014-2016: Science Library Committee
2013-now: Beury Hall Digital Signage Manager
2013: Faculty Search Committee
2009: Middle States Assessment
2008: Ph.D. Proposal Writing Committee
2008: Candidate Search: Positions in (1) Isotope Geochemistry, (2) Natural Hazards
2008: Proposal for Plasma Screen Display to advertise Department (to College of Science and Technology Dean's Office)

Education and Public Outreach

2022: Interview: EES Department Chair Dr. Nick Davatzes was interviewed by KYW Newsradio and discussed about catastrophic earthquakes. The interview is available as a podcast. Listen to it here. (https://www.audacy.com/kywnewsradio/podcasts/kyw-newsradio-in-depth-229/catastrophic-earthquakes-how-big-does-a-quake-really-need-to-be-doomsday-scenarios-ep-4-1267363530)
2016, 2017: Abington Friends School: Science Night, "The Earthquake Machine": Demonstration and lesson of earthquake physics and statistical analysis: Kindergarten through 5th grade.
2013-2015: AFS Outside Planning Committee: PHASE 2; Design Team; Case Statement Team.
2011-2012: Planning Committee Member of Abington Friends School Outdoor Learning Center: An effort to incorporate outdoor play and investigative learning into formal curriculum that includes independent observation and scientific analysis of the local campus geology, ecosystem, physics, chemistry, and sustainability through the harvest of local materials such as clay from streams and a "materials garden" for science/art/classroom learning.
2012: Abington Friends School: Science Night, "The Earthquake Machine": Demonstration and lesson of earthquake physics and statistical analysis: Kindergarten through 5th grade.
2011: Science Enrichment Activity: designed and taught "Earthquake Machine" activity to 3rd grade science at Abington Friends School, Jenkintown, PA.
2011: Science Enrichment Activity: designed and taught "Tree Ring Dating" to communicate scientific method, geologic time, and paleo-climate to kindergarteners at Abington Friends School, Jenkintown, PA.
2006: Reviewed submitted science textbooks and teaching aids to ensure scientific accuracy, standards, and teaching criteria for the state of California.
2006: Designed exhibit to introduce the public to Geothermal Energy and investigations of stress in the shallow Earth's crust.
2006: Panel member of subject matter experts to identify critical content knowledge of earth science concepts to aid in teacher and student training in Earth Science at K-8 level.

Collaborators

Internal Collaborators – Temple University

Alexandra E. Davatzes: Assistant Professor, Earth and Environmental Science
David Grandstaff: Professor, Temple University
Parsaoran Hutapea: Associate Profess, Mechanical Engineering
Michele Masucci: Associate Professor, Department of Geography and Urban Studies
Sujith Ravi: Associate Professor, Department of Earth and Environmental Science
Timothy Shipley: Associate Professor, Temple University
Dennis Terry: Associate Professor, Department of Earth and Environmental Science
Allison Tumarkin-Deratzian: Adjunct Professor, Department of Earth and Environmental Science

External Collaborators

Rachel Abercrombie: Boston University, Boston, MA
Tabriz Ali: University of Wisconsin, Madison, WI
Ragnar Asmundsson: Geophysicist, Isor, Reykjavik, Iceland
Atilla Aydin: Professor, Stanford University, CA
Bridget Ayling: Geoscience Australia.
Stefano Benato: University of Nevada, Reno
Kelly Blake: Navy Geothermal Program Office
Michel C. Boufadel: The New Jersey Institute of Technology, NJ
Ethan Chabora: Geothermex, Schlumberger
Matthew Cline: AltaRock Energy, Inc.
Steve Bjornstad: Navy Geothermal Program Office (ESC-25, Naval Air Weapons Station, China Lake, CA)
Trenton Cladohous: Geologist, AltaRock Energy, Seattle, WA
David Dempsey: Los Alamos National Laboratory, AZ
Peter Drakos: Geologist, Ormat, Reno, NV
Peter Eichhubl: Research Scientist, Bureau of Economic Geology, John A. and Katherine G. Jackson School of Geosciences, University of Texas at Austin
Mariana Eneva: Research Scientist and Owner, Imageair, Inc., San Diego, CA
Jim Faulds: Research Geologist/Graduate Faculty, Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno
Kurt Feigl: Professor, University of Wisconsin-Madison , WI
Michael Fehler: MIT, Boston, USA
Drew Fetterman: ThermaSource, Schlumberger
Eric Flodin: Research Scientist, Technology Research Group, Chevron Energy Technology Company
William Foxall: Lawrence Livermore National Laboratory
Ahmad Ghassemi: Associate Professor, University of Oklahoma, Norman
Jonathan Glenn: Research Geophysicist, GUMP, .S. Geological Survey
Thomas Graf: Leibniz Universität Hannover
Oli Guðmundsson, University of Uppsala
Bradford Hager: MIT, Boston, USA
Steve Hickman: Research Geophysicist, Earthquake Hazards Group, U.S. Geological Survey
Joern Ole Kaven: PostDoc: Temple University/U.S. Geological Survey
Sharad Kelkar: Los Alamos National Laboratory, AZ
Cornet Kremer: University of Nevada, Reno, NV
David Lockner: Research Geophysicist, Physics of Earthquakes Mega-Project Chief, Earthquake Hazards Team, U.S. Geological Survey
Susan Lutz: Geologist, TerraTek, Schlumberger, Salt Lake City, Utah
Ernie Majer: Lawrence Berkeley National Laboratory
David McNamarra: Research Geologist: GNS Science, New Zealand
Glenn Melosh: Senior Geologist, Nevada Geothermal Power, Vancouver, BC, Canada
Robert Mellors: Lawrence Livermore National Laboratory

Dan Moos – Research Fellow, Baker Hughes

Yini Nordin: AltaRock Energy, Inc.

William Osborn: AltaRock Energy, Inc.

Susan Petty: Chief Executive Officer, AltaRock Energy, Seattle, WA

Ann Robertson-Tait: Vice President, Business Development/Senior Geologist, Geothermex Inc., Richmond, CA

Peter Rose: Research Assistant Professor, Energy and Geoscience Institute (EGI), University of Utah, Salt Lake City, Utah

Daniel Soder: Department of Energy

John Solum: Research Geologist, Research Lab, Shell Petroleum Company, Houston, TX

Eric Sonnenthal, Lawrence Berkeley National Lab

Alex Steely, Department of Natural Resources, Washington State Geological Survey

Herb Wang: Professor, University of Wisconsin-Madison

Ezra Zemach: Geologist, Ormat, Reno, Nevada

Industry Collaborators

AltaRock Energy: Venture Capital company developing geothermal resources and resource enhancement technology.

ConocoPhillips Petroleum Company: Petroleum production and refining company (3rd largest in the United States).

Coso Operating Company: Operator of 2nd largest in place geothermal resource in the United States.

Navy Geothermal Program Office: Coordinates geothermal energy resource development on Navy lands.

Nevada Geothermal Power: New geothermal electricity production company developing blind geothermal systems in Nevada.

Ormat: International geothermal electricity producer.

Shell Petroleum Company: International Petroleum Company (5th largest international Energy Company).

Professional Profile

Research Interests: Geomechanics, Fault Zone Physics, and Stress

The future development of society in a world with a population exceeding 7 billion people depends on Earth's dynamic resources. The supply of accessible geothermal heat and future petroleum extraction are all controlled by the movement of fluids through faults and fractures in the Earth's crust. Extraction and injection of fluids also perturbs the stress in the earth, which can induce earthquakes, form new flow pathways, and cause surface deformation. My research investigates the mechanical and hydrological properties of fractures, the stresses that cause them to remain closed, slip, or open, and the geological processes that heal them by forming new minerals. Thus, I study the conditions necessary to enhance and maintain permeability. This same understanding of fracture properties is critical to petroleum systems, contaminant transport, the formation of ore deposits, and earthquake hazards.

My research incorporates geomechanical analysis with insight from analytical and numerical simulations applied in concert with direct field/borehole observations to investigate how the physical properties (friction, earthquake behavior, and permeability) of fault zones arise from the processes that deform rock. Geothermal systems with active energy production provide particularly good natural laboratories which can be well characterized and which are subjected to strong, well-measured impulses from injection, production, and stimulation. Thus my research is primarily focused within the fields of **geomechanics**, in combination with **borehole geophysics**, quantitative brittle **structural geology** and **geothermal systems**.

Teaching Interests

My teaching involves hands-on, open-ended projects that require students to make decisions about how to define their research goals, develop hypotheses, and to gather and organize data. Thus, the students conduct their own investigations using published data, analog experiments, fieldwork, and in class demonstrations. I emphasize quantitative analysis and require that the students independently develop methods to both gather their data and test relationships among experimental variables after preparing them through a combination of lecture and guided discussion in the classroom. I encourage students to extend their classroom work into independent study. Mentoring students toward scientific independence and informed, critical decision making is one of my primary goals.

In addition, I broaden the impact of my research and teaching through outreach to the community. As manipulation of fluid pressure deep in the earth becomes commonplace to supply a growing demand for energy, the public must have the information and understanding to make informed decisions. Such manipulations govern the behavior in a variety of critical systems that have been receiving increasing attention in the news and legislation including: (1) Hydrofracking, (2) Waste Water Injection, (3) Hydrocarbon Production and Enhanced Recovery, (4) “Hydroshearing” in Enhanced Geothermal Systems, and (5) CO_2 sequestration. Key concepts appear to be missing

or distorted in current discussions concerning human impacts inluding earthquakes, contaminant transport, and the availability and potential for recovery of resources such as: (1) basic concepts of the scientific methods applied to inverse problems; (2) basic understanding of the geologic and hydrologic context as well as stresses in the earth; (3) the meaning of scientific uncertainty; (4) the scales of pressure and volume change involved in stimulation and reservoir management through the basics of dimensional analysis. I am actively developing outreach that involves hands-on physical experiments with school children ranging in age from elementary through high school to teach these concepts.