THE UNIVERSITY OF
MEMPHIS
Center for Earthquake Research and Information

Thomas H. W. Goebel

http://www.ceri.memphis.edu/~thgoebel/
thgoebel@memphis.edu ❖ (001)-901-678-4885

Professional appointments

UMRF Professorship, University of Memphis Research Foundation
University of Memphis, Tennessee, USA, August 2022 – present
Assistant Professor, Center for Earthquake Research and Information
University of Memphis, Tennessee, USA, September 2019 – present
Researcher & Lecturer, Seismological Laboratory
University of California, Santa Cruz, USA, September 2018 – September 2019
Postdoctoral Scholar, Seismological Laboratory
University of California, Santa Cruz, USA, September 2015 – August 2018
Postdoctoral Scholar, Seismological Laboratory
California Institute of Technology, USA, August 2013 – August 2015
Consultant and Technical Advisory Board Member, Induced seismicity consortium (ISC)
*University of Southern Californi*a, USA, June 2013 – December 2015

Visiting positions

DAAD Fellow, *German Research Centre for Geoscience (GFZ)*, Potsdam, May-July, 2022
Humboldt Fellow, *Karlsruhe Institute of Technology (KIT)*, Germany, June – December 2016
Visiting Scholar, *Swiss Federal Institute of Technology (ETH)*, Zürich, May - July 2012
Visiting Scholar, *German Research Centre for Geoscience (GFZ)*, Potsdam, Sept. – Dec. 2010

Education

August 2008 – 2013
Ph.D. Geophysics, *University of Southern California*
April 2005 - September 2007
B.Sc. Geological Sciences, *Freie Universität Berlin*, Germany
October 2004 - March 2005
Applied Geophysics, *Technical University – Bergakademie Freiberg*, Germany (transferred, course work applied)

Teaching experience

Lecturer, *University of Memphis*
Honors Forum: Earthquakes in Hollywood, UNHP 1100 (Fall 2022)
Seminar in Machine Learning, CERI 8701 (Fall 2021)
Crustal Dynamics, CERI 8275 (Spring 2021, Spring 2023)
Data Analysis in Geophysics, CERI/CIVL 8104, (Fall 2020, Fall 2021, Fall 2022)
Programming Tools, CERI/CIVL 8002 (Spring 2020, Spring 2022)

Lecturer, *University of California, Santa Cruz*
Earthquakes, EART11 (online), (Spring, Summer 2019)
Introduction to Scientific Computing, EART119, (Fall 2018)

Lecturer, Fall 2018 (two weeks)
'Fricción y la física de terremotos' (friction and earthquake mechanics), two weeks intensive course in Spanish, *Universidad National de El Salvador, Santa Ana, El Salvador*

Lecturer, Winter 2016, Summer 2017
Geomechanics and advanced seismicity analysis: Application to reservoir characterization
two-day intensive course, *University of Southern California,* Los Angeles, California
one-day intensive course, *Society of Petroleum Engineers,* Bakersfield, California

Awards and fellowships

Eos Research Spotlight
GRL article: "Fault roughness promotes aftershock-like clustering in the lab" selected as AGU Research Spotlight
DAAD Fellowship
GFZ-Potsdam, Germany, May - July 2022
NSF Early Career Award
National Science Foundation, 2022-2026
Editor's Citation for Excellence in Refereeing
Journal of Geophysical Research, American Geophysical Union 2017
Humboldt Research Fellowship
Karlsruhe Institute of Technology, Germany, June - December 2016
Think-Swiss Research Fellowship
*Swiss Federal Institute of Technology (ETH-*Zürich*),* May - July 2012 (2 months)
Best Student Presentation Award
Seismological Society of America, Annual Meeting, April, 2011
Outstanding Teaching Assistant Award
Department of Earth Sciences, University of Southern California, Spring 2010

Publications

Since 2012, I have published 34 peer-reviewed articles and 3 extended abstracts

Selected publications

2023

Patton, Goebel, Kwiatek, Davidsen, "What controls the characteristics of compressive failure and accelerated seismic release?", *PRL-E*, (subm.)

Zaliapin, Ben-Zion, Dresen, Goebel, "Heterogeneity effects on damage localization prior to dynamic fault formation in the laboratory" (in prep, preprint available)

Pandey, Taira, Dresen, Goebel, "Inferring fault damage state and evolution from coda wave velocity changes in faulted and intact granite samples at varying stress" *Geophys. J. Int.* (submitted, preprint available)

Goebel, Brodsky & Dresen, "Fault roughness promotes aftershock-like clustering in the lab", 50(8),
(featured as an AGU research spotlight on Eos.org from among the best accepted articles)

2022

35 Nadav Wetzler, Emily E. Brodsky, Esteban J. Chaves, Thomas Goebel, Thorne Lay; "Regional Characteristics of Observable Foreshocks." *SRL*, doi: 10.1785/0220220122

34 Dell'Aira, Chy, Goebel, Meier. "Inferring hydrological properties of the rainfall-runoff conversion process through artificial neural networks modelling", World Environmental & Water Resources Congress, Conference Paper, Atlanta 06/2022, 1264-1278

2021

33 J. Davidsen, T.H.W. Goebel, G. Kwiatek, S. Stanchits, J. Baro and G. Dresen, "What controls the presence and charateristics of aftershocks in rock fracture in the lab" *J. Geophs. Res*., 126 (10)

32 Mueller, Doan, Goebel, Liu, Martinez-Garcon, Mitchell, Zaliapin. "Understanding and Anticipating Induced Seismicity", *EOS*, (*in press*)

31 Guo, H., Brodsky, E. E., Goebel, T. H. W., & Cladouhos, T. T. "Measuring Fault Zone and Host Rock Hydraulic Properties Using Tidal Responses." *GRL*, 48 (13).

30 Abercrombie, Trugmann, Shearer, Chen, Zhang, Pennington, Hardebeck, Goebel, Ruhl, "Does earthquake stress drop increase with depth in the crust?", *J.Geoph.Res.* 126(10)

2020

29 Jordan, Teresa, Patrick Fulton, Jefferson Tester, David Bruhn, Hiroshi Asanuma, Ulrich Harms, Chaoyi Wang et al. "Borehole research in New York State can advance utilization of low-enthalpy geothermal energy, management of potential risks, and understanding of deep sedimentary and crystalline geologic systems." *Scientific Drilling* 28 (2020): 75-91.

28 Goebel, T.H.W., Shirzaei, M., "More than 40 years of potentially induced seismicity close to the San Andreas fault in San Ardo, central California" *Seis. Res. Letts.* https://doi.org/10.1785/0220200276

27 Blanke, Kwiatek, Goebel, Dresen, "Stress drop – magnitude-dependence of acoustic emission events during stick-slip experiments", *Geophys. J. Int.* 224 (2), 1371-1380

26 G. Dresen, G. Kwiatek and T.H.W. Goebel, "Preparatory processes before stick-slip failure on smooth and rough laboratory fault surfaces" *PAAG*., 177, pages5741–5760

25 Dascher-Cosineau, K., Brodsky, E., Lay, T., Goebel T., "What controls variations in aftershock productivity?", *J. Geophys Res*., 125(2)

24 Tal, Y., Goebel, T.H.W., Avouac, J.-P., "Experimental and modeling constraints of the effect of fault roughness on dynamic frictional sliding", *EPSL*, 536,116-133

2019

23 Goebel, T.H.W., Rosson, Z., Brodsky, E.E., and Walter, J.I., "Aftershock deficiency of induced earthquake sequences during rapid mitigation efforts in Oklahoma" *Earth and Planetary Science Letters*, v. 522, p. 135–143, doi: 10.1016/j.epsl.2019.06.036.

22 Wetzler, N., Shalev, E., Göbel, T.H.W., Amelung, F., Kurzon, I., Lyakhovsky, V., Brodsky, E.E., "Earthquake swarms triggered by groundwater extraction near the Dead Sea Fault", *Geophys Res. Letts.* 46(14), 8056-8063

21 Rosson, R., Walter, J.I., Goebel, T.H.W., Chen, X., "Narrow spatial aftershock zones for induced earthquake sequences in Oklahoma", *GRL*, doi:10.1029/2019GL083562.

2018

20 T.H.W. Goebel & E.E. Brodsky, "The spatial footprint of injection wells in a global compilation of induced earthquake sequences", *Science*, 361 (6405), 899-904

19 S.M. Hosseini, T.H.W. Goebel, B. Jha, F. Aminzadeh "A probabilistic approach to injection-induced seismicity assessment for different reservoir types and pressure-diffusion models", *Geophys. Res. Letts.*, doi: 10.1029/2018GL07552

18 X. Chen, J. Haffener, T.H.W. Goebel, X. Meng, Z. Peng, J.C. Peng, "Temporal correlations between seismic moment and injection volume for an induced earthquake sequence in Central Oklahoma", *J. Geophs. Res.*, doi:10.1002/2017JB014694

2017

17 T.H.W. Goebel, J. Walter, K. Murray & E.E. Brodsky. "Comment on: How will induced seismicity in Oklahoma respond to decreased saltwater injection rates", *Science Advances* doi:10.1126/sciadv.1700441.

16 J. Davidsen, G. Kwiatek, E.-M. Charalampidou, T.H.W. Goebel, S. Stanchits, M. Rueck & G. Dresen. "Triggering processes in rock fracture: On the importance of large-scale heterogeneities", *Physical Review Letts.,* 119.

15 T.H.W. Goebel, G. Kwiatek, T.W. Becker, E.E. Brodsky & G. Dresen, "What allows seismic events to grow big?: Insights from *b*-value and fault roughness analysis in laboratory stick-slip experiments", *Geology*, doi:10.1130/G39147.1
(Commentary by Ian Main: "Scale-model seismicity – Taking the rough with the smooth")

14 T.H.W. Goebel, M. Weingarten, J. Haffener, X. Chen & E.E. Brodsky. "The 2016 Mw5.1 Fairview, Oklahoma earthquakes: Evidence for long-range poroelastic triggering at >40 km from fluid disposal wells", *Earth Planetary Science Letts.,* 472, 50-61.

2016

13 N. van der Elst, M. Page, D.A. Weiser, T. Goebel & S.M. Hosseini. "Induced earthquake magnitudes are as large as (statistically) expected", *J. Geophys. Res.*, 121 (6), 4575-4590.

12 T.H.W. Goebel, E. Hauksson, A. Plesch & J. Shaw, "Detecting significant stress drop variations in large micro-earthquake datasets: A comparison between a convergent step-over in the San Andreas Fault and the Ventura thrust fault system, southern California", *Pure Appl. Geophys.* doi:10.1007/s00024-016-1326-8

11 T.H.W. Goebel, S.M. Hosseini, F. Cappa, E. Hauksson, J.-P. Ampuero, F. Aminzadeh & J.B. Saleeby. "Wastewater disposal and earthquake swarm activity at the southern end of the Central Valley, California", *Geophys. Res. Letts.*, 43, 1-8, doi:10.1002/2015GL066948.
(Nature Research Highlights: "Unnatural shaking in California", (2016), v. 530, 2/4/16)

2015

10 T.H.W. Goebel, E. Hauksson, F. Aminzadeh & J.-P. Ampuero. "An objective method for the assessment of fluid injection induced seismicity and application to tectonically active regions in central California", *J. Geophys. Res.*, 120, 1-20, doi:10.1002/2015JB011895.

9 T.H.W. Goebel, E. Hauksson, P. M. Shearer & J.P. Ampuero. "Stress drop heterogeneity within tectonically complex regions: A case study of San Gorgonio pass, Southern California", *Geophys. J. Int.,* 202(1), 514-528, doi: 10.1093/gji/ggv160.

8 T.H.W. Goebel. "Comparing seismicity rates and fluid injection operations in Oklahoma and California: Implications for upper crustal stresses", *The Leading Edge, Special Volume: Injection-induced seismicity, eds. Robert Habiger, Gregory Beroza*, 34(6), 640-648.

7 E. Hauksson, T.H.W. Goebel, J.-P. Ampuero & Elizabeth Cochran. "A century of oilfield operations and earthquakes in the greater Los Angeles basin, southern California", *The Leading Edge,* 34(6), 650-656, doi: 10.1190/tle34060650.1.

2014

6 G. Kwiatek, T.H.W. Goebel, & G. Dresen. "Seismic moment tensor and *b*-value variations over successive seismic cycle in laboratory stick-slip experiments", *Geophys. Res. Letts.*, 41 (16), doi:10.1002/2014/GL060159.

5 T.H.W. Goebel, T. W. Becker, C. G. Sammis, G. Dresen, & D. Schorlemmer. "Off-fault damage and acoustic emission distributions during the evolution of structurally-complex faults over series of stick-slip events", *Geophys. J. Int.*, 197 (3), doi: 10.1093/gji/ggu074.

4 T.H.W. Goebel, T. Candela, C. G. Sammis, T. W. Becker, & G. Dresen. "Seismic event distributions and off-fault damage during frictional sliding of saw-cut surfaces with predefined roughness", *Geophys. J. Int.*, 196 (1), 612-625.

2013

Thesis T.H.W. Goebel. "Microseismicity, fault structure & the seismic cycle. Insights from laboratory stick-slip experiments", *Thesis (Ph.D.), University of Southern California. (2013)* 204 p, ISBN: 9781303467219, http://gradworks.umi.com/35/98/3598217.html

3 T.H.W. Goebel, D. Schorlemmer, T. W. Becker, G. Dresen, & C. G. Sammis. "Acoustic emissions document stress changes over many seismic cycles in analog experiments", *Geophys. Res. Letts.*, 40 (10), doi:10.1002/grl.50507.

2 T.H.W. Goebel, C. G. Sammis, T. W. Becker, G. Dresen, & D. Schorlemmer. "A comparison of seismicity characteristics and fault structure in stick-slip experiments and nature", *Pure Appl. Geophys.*, doi:10.1007/s00024-013-0713-7.

2012

1 T.H.W. Goebel, T. W. Becker, D. Schorlemmer, S. Stanchits, C. G. Sammis. E. Rybacki & G. Dresen, "Identifying fault heterogeneity through mapping spatial anomalies in acoustic emission statistics", *J. Geophys. Res.*, 117 (B3), doi:10.1029/2011JB008763.

Extended abstracts

Y.-X. Zhang, T.H.W. Goebel, Z. Peng, C. Williams, M. Yoder, J. Rundle (2017), "Earthquakes and Multi-hazards around the Pacific Rim, Vol. 1: Introduction", *Pure Appl. Geophs.*, 174, 2195-2198

T.H.W. Goebel, F. Aminzadeh, J. Haffener & X. Chen. "Statistical seismicity analysis methods for the detection of fault activation during fluid injection", *Society of Exploration Geophysicists*, annual meeting 2016, Dallas Texas

Conference presentations and invited talks

Since 2008, I have given more than 60 presentations (>20 invited and 3 keynote presentations).

Keynotes and invited talks

- Goebel, Kwiatek, Davidsen, Dresen, "Micro-seismicity clustering aftershock decay and b-values during laboratory fracture and stick-slip experiments", SSA Puerto Rico, April 2023 (invited talk)
- Goebel, Brodsky & Dresen, "Fault roughness promotes aftershock-like clustering in the lab", AGU Chicago, December 2022 (invited talk)
- Goebel, Kwiatek, Ben-Zion, Dresen, "Seismic and aseismic preparatory processes before stick-slip failure: The role of heterogeneity" European-Research-Council workshop on Machine learning and earthquake precursory activity, Rome, September 2021, (invited talk)
- Goebel, Brodsky, Guo, Weingarten, Scibek, Chen, Haffener, Wetzler, Shriaei, Walter.

"Why do induced events occur far from injections wells in California and Oklahoma" European-Research-Council Tectonic/Fear Seminar, 06/06/2021 (invited)

- Goebel, Chang, Brodsky, A mechanism for deep and distant induced earthquakes, 2020 International Forum on the Pohang Earthquake South Korea (invited)
- Goebel, Chen, Haffener, Walter, Rosson, Weingarten & Brodsky (2019), Examining the distance decay and effects of active mitigation on injection induced seismicity, 3rd Induced Seismicity Workshop, Schatzalp, Switzerland, 5-8th March 2019, (keynote)
- T.H.W. Goebel, M. Bohnhoff, E.E. Brodsky, and G. Dresen (2018), The influence of fault damage and fluids on seismic behavior during slip on laboratory faults, AGU –D.C.
- T.H.W. Goebel, G. Kwiatek, T.W. Becker, E.E. Brodsky, G. Dresen (2018), Fault roughness, stress and seismicity statistics in stick-slip experiments, *UC Berkeley Seismolab Seminar,* October 2nd, 2018.
- T.H.W. Goebel, E.E. Brodsky (2018), What is the maximum spatial reach of fluid-injection operations?: Examining seismicity decay and poroelastic effects around injection wells, *Caltech Seismo-Lab Seminar*, Pasadena, April 20th, 2018
- T.H.W. Goebel, G. Kwiatek, T.W. Becker, E.E. Brodsky, G. Dresen (2017), What allows seismic events to grow big? Insights from *b*-value and fault roughness analysis in stick-slip experiments, *USGS Earthquake Physics Seminar,* Menlo Park, USA, June 14th, 2017.
- T.H.W. Goebel, M. Weingarten, J. Haffener, X. Chen & E.E. Brodsky (2016b), The 2016 Mw5.1 Fairview, Oklahoma earthquakes: Evidence for long-range poroelastic triggering at >40 km from disposal wells, *Ecole Normale Superieur,* Paris, France, October 25th, 2016.
- T.H.W. Goebel, J. Haffener, X. Chen & E.E. Brodsky (2016a), Distant earthquake triggering by fluid injection operations in Colorado, Oklahoma and California, *German Center for Geosciences,* Potsdam, July 5th, 2016.
- T.H.W. Goebel, E. Hauksson, P. Shearer, J. Shaw, A. Plesch (2015c) Stress drop variations in San Gorgonio Pass and Ventura Basin, Hewett Club Seminar, *UC Riverside*, Dec. 1st,2015
- T.H.W. Goebel, J.-P. Ampuero, E. Hauksson, J. Saleeby , M. Hosseini, F. Aminzadeh and F. Cappa (2015b), Seismogenic response to fluid injection in California hydrocarbon basins: The role of permeability structure and implications for crustal stresses, *USGS Earthquake Physics Seminar,* Menlo Park, USA, September 9th, 2015.
- T.H.W. Goebel, E.Hauksson, J.-P.Ampuero, F.Aminzadeh (2015a), Differences in fluid injection induced seismicity in California and Oklahoma and implications for crustal stresses, *Earthquake Physics Seminar, University of Southern California*, January 21st, 2015.
- T.H.W. Goebel, E.Hauksson, J.-P.Ampuero, F.Aminzadeh (2014c), Waste water injection and induced seismicity in central California, *USEA Informational Briefing on subsurface technology, engineering challenges, R&D opportunities*, Washington D.C., October 30, 2014.
- T.H.W. Goebel, E.Hauksson, J.-P.Ampuero, F.Aminzadeh, F.Cappa, J.B.Saleeby (2014b), Waste water injection induced seismicity in naturally-active, seismogenic regions in central California, *Southern California Earthquake Center annual meeting*, Conference Proceedings, v03, p. 113 (plenary talk).
- T.H.W. Goebel, T. W. Becker, D. Schorlemmer, C. G. Sammis, G. Dresen (2012b), Properties of faults inferred from seismicity statistics during stick-slip experiments. Caltech, *Seismo-Lab Seminar,* Dec. 14, 2012, Pasadena, California.
- T.H.W. Goebel, T. W. Becker, D. Schorlemmer, C. G. Sammis, G. Dresen (2012a), Stress driven variations in micro-seismicity during laboratory stick-slip tests, *Lamont-Doherty*

Earth-Observatory Seminar, Jan. 12, 2012, Palisades, New York.

- T.H.W. Goebel, T. W. Becker, D. Schorlemmer (2011), Fault heterogeneity and *b*-value mapping, *Swiss Seismological Service Seminar*, June 27, 2011, ETH-Zurich, Switzerland.

Service, activities and professional memberships

Current Students

Roshan Koirala, Geophysics, University of Memphis, Ph.D. 2024
Kiran Pandey, Geophysics, University of Memphis, Ph.D. 2024
Navin Thapa, Geophysics, University of Memphis, Ph.D. 2026
Alamgir Hosain, Geophysics, University of Memphis, Ph.D. 2026
Sadia Rinty, Geophysics, University of Memphis, Ph.D. 2026

Previous Students

Ryan Williamson, Physics/EE, University of Memphis, B.S. Honors 2022
Cesar Matal, Geophysics, Universidad National de El Salvador, Santa Ana, M.Sc. 2020
Primary Advisor, Jose Efrain Benitez
Zach Rosson, Geophysics, University of Oklahoma, M.Sc. 2019
Primary Advisor, Dr. Jake Walter
Mehran Hosseini, Petroleum Engineering, USC, Ph.D. 2018
Primary Advisor, Prof. Fred Aminzadeh

Current Postdocs

Valerian Schuster, GFZ-Potsdam/University of Memphis

Editor

Seismological Research Letters (Associate Editor)
Journal of Geophysical Research (Associate Editor)
Pure and Applied Geophysics (Guest Editor, 3 volumes)

Reviewer

Geology, Geochem. Geophys. Geosys., Phys. Earth Planet. Int., Pure Appl. Geophys., Bullet. Seis. Soc. Am., J. Geophys. Res., Nature Comm., Geophys. Res. Lett., Earth Planet. Sc. Lett., PNAS, Sc. Adv.

Session Convener

20 sessions at AGU, SSA and EGU between 2014 and 2021

Proposal Review Panel Member (3 panels)

United States Geological Survey, National Earthquake Hazards Reduction Program

Faculty Adviser

Bridges at Caltech (Bridges International), *California Institute of Technology*, 07/2014 to 08/2015
Advised leaders of Christian student association for international students and scholars, support and transitional help for new international students

Voluntary Work

International Friends: international student group at the University of Memphis
Youth with a Mission, El Salvador - 8/2017 to 11/2017; 9/2018:
Nutrition, construction and education programs in underprivileged neighborhoods of San Salvador

Lecture: "La subida dramática de sismicidad inducida en el centro de Estados Unidos", Ministerio de Medio Ambiente y Recursos Naturales, San Salvador
Laboratory rock mechanics, seismology and induced seismicity lectures (Spanish), Universidad Nacional de El Salvador, Santa Ana

Memberships

Seismological Society of America (SSA), American Geophysical Union (AGU), Society of Exploration Geophysicists (SEG), American Association of Petroleum Geologists (AAPG)

Grants and proposals

Assessing the relative contributions of fluid pressure and elastic stress perturbations to induced seismic energy release
U.S. Department of Energy, 03/2022 – 03/2025
$550,000
PI: Goebel 1 mo./yr

CAREER: From slow to fast, micro to macro, single events to cascades: A multi-scale study of seismic event triggering in lab and nature
National Science Foundation, 05/2022 – 05/2027
$620,000
PI: Goebel 1 mo./yr

Conditions that promote or inhibit deep and distant induced earthquake in southern California hydrocarbon basins
Southern California Earthquake Center, 02/2021 – 12/2022
$30,000
PI: T.H.W. Goebel 0.5 mo./yr

Experimental Constraints on Preparatory Processes and Seismic Velocity Changes before Induced Slip
U.S. Geological Survey, 1/2021-1/2022
$74,000
PI: T.H.W. Goebel (joint proposal with Taka'Aki Taira from UC Berkeley)

Using the spatial distribution of earthquakes as a tool to compare induced seismicity cases and infer mechanisms
U.S. Department of Energy, 9/2019-4/2021
PI: E. Brodsky & T.H.W. Goebel

Co-written proposals

How far can it go?: Determining the reach of induced seismicity
U.S. Department of Energy, 2016-2019
PI: E. Brodsky, Researcher: T.H.W. Goebel

Physical and observational reasons for the lack of conspicuous induced seismicity in Central California
Southern California Earthquake Center, 2016, Proposal Number: 16170

PI: E. Brodsky, Postdoc: T.H.W. Goebel

Assessing fault zone structure and permeability in regions of active faulting and fluid injection: Can fault maps and structure help evaluate induced seismicity in California
Southern California Earthquake Center, 2015, Proposal Number: 15168
PI: E. Brodsky, Postdoc: T.H.W. Goebel

Joint seismotectonic and source spectra analysis of the Ventura Basin and San Gorgonio SCEC Special Fault Study Areas, CA
Southern California Earthquake Center, 2014, Proposal Number: 14033
PIs: E. Hauksson, J.H. Shaw, Researchers: A. Plesch, T.H.W. Goebel

Fault mechanics and structure during laboratory stick-slip experiments: Can we infer fault properties and stress from acoustic emission statistics?
Southern California Earthquake Center, 2012, Proposal Number: 13022
PIs: T.W. Becker, C. G. Sammis, Graduate Student: T.H.W. Goebel

Characterizing fault roughness evolution using acoustic emission and micro-structural analysis of frictional sliding experiments
Southern California Earthquake Center, 2011, Proposal Number: 11017
PIs: T.W. Becker, D. Schorlemmer, G. Dresen, Graduate Student: T.H.W. Goebel