

Philip A. Skemer

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EDUCATION

Ph.D., Yale University, Geology and Geophysics, 2007
M.Phil., Yale University, Geology and Geophysics, 2003
B.A., Pomona College, Geology, 2000

APPOINTMENTS

07/2016 - present *Associate Professor*
Department of Earth and Planetary Sciences
Washington University in St. Louis

07/2016 - present *Associate Director*
Institute of Materials Science and Engineering
Washington University in St. Louis

07/2009 - 06/2016 *Assistant Professor*
Department of Earth and Planetary Sciences
Washington University in St. Louis

09/2007 - 07/2009 *Postdoctoral Research Associate*
Department of Geological Sciences
Brown University

09/2001 - 09/2007 *Graduate Research Assistant*
Department of Geology and Geophysics
Yale University

PROFESSIONAL SERVICE AND ACTIVITIES

Organizing Committee, GeoPRISMS Synthesis and Integration, Technical and Experimental Institute (Feb 27 – Mar 1, 2019, San Antonio, TX)

Organizing Committee (chair), Conference on Experimental Studies of Subduction Zone Processes (July 4-6, 2018, St Louis, MO)

Lecturer, CIDER Summer Program (June-July 2017)

Organizing Committee, Subduction Zone Observatories Workshop (September 28-30, 2016, Boise, ID)

President-elect (2013-14); President (2015-16); Past President (2017-18) Mineral and Rock Physics Focus Group, American Geophysical Union (AGU)

American Geophysical Union Council member, (2013-2016)
 Executive Committee, Mineral and Rock Physics Focus Group, AGU (2010 – present; *chair* 2015-2016)
 Organizing Committee, Workshop on Advancing Experimental Rock Deformation Research: Scientific and Technical Needs (August 16-19, 2012, Cambridge, MA)
 Guest Instructor, TTT Short Course (Texture Topics in Tromsø), University of Tromsø, Norway (2011)
 Steering Committee, Physical Properties of Earth Materials (Subcommittee of AGU Mineral and Rock Physics Focus Group) (2010-2012)
 Washington University Elector, COMPRES consortium for high-pressure research (2010 - present)
 AGU Fall Meeting Session Organizer:
 2017 – Recent Advances in Understanding Deformation Microstructures
 2017 – Small Samples Yield Big Insights
 2016 – G, LAB, and MLDs: What are they anyway? Lithospheric boundary structures within and beneath the oceans and continents
 2014 – Town Hall Meeting: Developing a Digital Data System for Microstructural and Related Spatially Linked Data
 2013 – Seismic Anisotropy: Predictions, Observations, and Interpretations
 2011 – Deformation Processes: Microstructure, Rheology, and the Effects of Fluids
 2009 – Rock Deformation from Grain Boundaries to Plate Boundaries
 2007 – Shear Localization from Experimentation, Modeling, and Observation
 Ad hoc Peer Reviewer: NSF (Geophysics; Tectonics; CSEDI; Instrumentation/Facilities; MG&G; CAREER); Physics of Earth and Planetary Interiors; Earth and Planetary Science Letters; Journal of Geophysical Research; Geophysical Research Letters; Journal of Petrology; G-cubed; Geophysical Journal International; Geology; PNAS

WASHINGTON UNIVERSITY SERVICE AND ACTIVITIES

EPSc – Department of Earth and Planetary Sciences; A&S – School of Arts and Sciences; IMSE – Institute of Materials Science and Engineering

Institutional iLab Management Committee (2018-)
 Faculty Search Committees, EPSc (2010, 2013 –*co-chair*, 2017 – *chair*); MEMS (2014)
 Director of Fossett Laboratory for Virtual Planetary Exploration, EPSc, (2016-present)
 Executive Committee, IMSE, (2016-present)
 Strategic Advisory Committee (*ex officio*), IMSE, (2016-present)
 Facilities Committee (*chair*), IMSE, (2016-present)
 Course Evals Committee, A&S, (2016)
 Website Committee, EPSc (2016-present)
 Mentee in STEM Teaching (MiST) Program, A&S, (2015-2016)
 Ampersand Week Faculty Committee A&S, (2014)
 Undergraduate Curriculum Committee (*chair*), EPSc (2013-present)
 Institute of Materials Science and Engineering, Core Faculty (2013-2016)
 Director of Undergraduate Studies, EPSc (2012-present)
 Faculty Associate, Danforth College (2012-2014)
 Curriculum Development Committee, EPSc (2012-2013)
 Institute of Materials Science and Engineering PhD Program Organizing Committee (2012)
 Undergrad Recruiting Committee (*chair*), EPSc (2011-2013)

Fossett Postdoctoral Fellowship Selection Committee, EPSc (2011-2016)
 Compton Scholarship Selection Committee (2010-2012)
 Center for Materials Innovation Internal Advisory Group (2010-2011)
 Panelist, Grad Student Senate forum on "The Academy and The Economy" (2010)
 Undergrad Brochure Committee, EPSc (2009)
 TA Award Committee, EPSc (2009, 2012)
 Graduate Admissions Committee, EPSc (2009-2012)

PROFESSIONAL AFFILIATIONS

American Geophysical Union
 Physical Properties of Earth Materials (PPEM)

WASHINGTON UNIVERSITY AFFILIATIONS

McDonnell Center for the Space Sciences (MCSS)
 Institute of Materials Science and Engineering (IMSE)
 Environmental Studies Program

COMMUNITY OUTREACH

Invited speaker for Science in St. Louis seminar series (May, 2018)
 Outreach with science classes at The Wilson School (November 2015-present)
 Invited speaker for WU Science On Tap (September, 2015)
 Outreach with curatorial staff at the Saint Louis Art Museum (2011-present)
 Outreach with Flynn Park Elementary School Lego League (April, 2014)
 On-call Geologist Calvin Hill Kindergarten, New Haven, CT (2003-2006)

TEACHING EXPERIENCE

<i>Washington University Course Number</i>	<i>Title</i>	<i>Last Taught</i>
EPS L19 104	Geology in the Field (Freshman Seminar)	Fall, 2018
EPS L19 131	Natural Disasters	Spring, 2011
EPS L19 201	Earth and the Environment	Fall, 2018
EPS L19 460	Introduction to Structural Geology	Fall, 2017
EPS L19 496	Undergraduate Field Geology	Spring, 2018
EPS L19 580	Deformation of Planetary Materials	Fall, 2013

HONORS

2014: NSF CAREER award
 2012: Cornerstone Faculty Mentor Award (Washington University)
 2012: Sony Junior Faculty Equipment Prize (Washington University)

2012: Washington University nominee for Packard Fellowship
2005: William E. Ford Prize for excellence in Mineralogy
2004: Outstanding Student Paper, Tectonophysics Section, AGU Fall Meeting
2002-03: Frederick C. Stanley Fellowship in Mineralogy
2002: Honorable Mention, Outstanding Student Paper, Tectonophysics Section, AGU Fall Meeting
2001-02: Henry Gardiner Ferguson Fellowship in Geology

INVITED AND KEYNOTE TALKS

Gordon Research Conference on Rock Deformation, August 2018
Cooperative Institute for Dynamic Earth Research (CIDER), June 2017
University of Illinois, Chicago, Department of Earth and Environmental Sciences Seminar, April 2017
Yale University, Department of Geology and Geophysics Colloquium, February 2017
Anisotropy and Dynamics of the Lithosphere-Asthenosphere Boundary, May 2016
American Geophysical Union Fall Meeting (Physical Properties of Earth Materials: Deformation Mechanisms from Crystals to Plates), December 2015
American Geophysical Union Fall Meeting (Crustal and Mantle Deformation: Microstructure, Rheology and the Effects of Fluids), December 2015
University of Rochester, Department of Earth and Environmental Sciences Seminar, October 2015
Southern California Earthquake Center, Community Rheology Model Workshop, September, 2015
Lamont-Doherty Earth Observatory Earth Science Colloquium, February 2015
University of Pennsylvania, Department of Earth and Environmental Science Colloquium, February 2015
Structural Geology and Tectonics 3rd Biennial Forum, June 2014
American Geophysical Union Fall Meeting (Geophysical Observations and Models of Subduction), December 2013
American Geophysical Union Fall Meeting (Deformation Processes, Rheology, and the Effects of Fluids), December 2013
EarthCube End-user Domain Workshop for DEFORM and COMPRES, November 2013
Missouri University of Science and Technology, Department of Geological Sciences and Engineering Department Seminar, November 2013
Caltech, Seismological Laboratory Brown Bag, January 2013
Ruhr-Universität Bochum, Institut für Geologie, Mineralogie und Geophysik, Department Seminar, October 2011
Stanford University, Department of Geophysics Seminar, April 2011
European Geophysical Union, General Assembly, (Deformation processes: microstructures, textures, rheology, and fluid migration) April 2011
Gordon Research Conference on Rock Deformation, August 2010
Saint Louis University, Department of Earth and Atmospheric Sciences Seminar, April 2010
Southern Illinois University, Department of Geology Seminar Series, March 2010
University of Missouri, Department of Geological Sciences Colloquium, January 2010
Woods Hole Oceanographic Institute, Geochemistry & Geophysics Seminar, March 2009
Washington University in St. Louis, Departmental Colloquium, February 2009
University of Minnesota, Hard Rock Lunch, January 2009

Washington & Lee University, Departmental Seminar, January 2009
Lamont-Doherty Earth Observatory Seismology, Geology, and Tectonophysics Division
Seminar Series, November 2006
Woods Hole Oceanographic Institute, Geophysics Seminar, November 2006

PUBLICATIONS (PEER-REVIEWED)

**denotes student or postdoc author under direct research supervision*

Xiong, W., *Wells, R.K., Horner, J.A., Schaef, H.T., Skemer, P., Giammar, D.E. (2018) CO₂ Mineral Sequestration in Naturally Porous Basalt, *Environmental Science and Technology Letters*, 5(3) 142-147, doi: 10.1021/acs.estlett.8b00047

Xiong, W., *Wells, R.K., Menefee, A.H., Skemer, P., Ellis, B.R., Giammar, D.E. (2017) CO₂ mineral trapping in fractured basalt, *International Journal of Greenhouse Gas Control*, 66:204-217, doi:10.1016/j.ijggc.2017.10.003

*Wells, R.K., Xiong, W., Giammar, D., Skemer, P. (2017) Dissolution and surface roughening of Columbia River Flood Basalt at geologic carbon sequestration conditions, *Chemical Geology*, 467:100-109, doi:10.1016/j.chemgeo.2017.07.028

*Boneh, Y., Wallis, D., Hansen, L.N., Krawczynski, M.J., Skemer, P. (2017) Oriented grain growth and modification of 'frozen anisotropy' in the lithospheric mantle, *Earth and Planetary Science Letters*, 474:368-374, doi:10.1016/j.epsl.2017.06.050

Adeoye, J.T., Menefee, A.H., Xiong, W., *Wells, R.K., Skemer, P., Giammar, D.E., Ellis, B.R. (2017) Effect of transport limitations and fluid properties on reaction products in fractures of unaltered and serpentinized basalt exposed to high P_{CO2} fluids, *International Journal of Greenhouse Gas Control*, 63:310-320, doi:10.1016/j.ijggc.2017.06.003

Bercovici, D.B., Skemer, P., (2017) Grain damage, mixing, and plate boundary formation, *Journal of Geodynamics*, 104:40-55 doi:10.1016/j.jog.2017.05.002

Skemer, P., *Chaney, M.M., *Emmerich, A.L., Miller, K.J., Zhu, W., (2017) Network topology of olivine – basalt partial melts, *Geophysical Journal International*, 210:284-290 doi:10.1093/gji/ggx160

*Cross, A. J., and Skemer, P. (2017), Ultramylonite generation via phase mixing in high strain experiments, *J. Geophys. Res. Solid Earth*, 122, doi:10.1002/2016JB013801

*Wells, R.K., Xiong W., Sesti, E., Cui, J., Giammar, D., Skemer, P., Hayes, S.E., and Conradi, M.S., (2017) Spatially-variable carbonation reactions in polycrystalline olivine, *Geochimica et Cosmochimica Acta*, 252-266, doi:10.1016/j.gca.2017.02.003

Hansen, L.N., Conrad, C.P., *Boneh, Y., Skemer, P., Warren, J.M., Kohlstedt, D.L. (2016) Viscous anisotropy of textured olivine aggregates, Part 2: Micromechanical model, *Journal of Geophysical Research* doi:10.1002/2016JB013240

- Rahl, J.M., Skemer, P., (2016) Microstructural evolution and rheology of quartz in a mid-crustal shear zone, *Tectonophysics*, 680:129-139, doi:10.1016/j.tecto.2016.05.022
- *Kranjc, K., Rouse, Z., Flores, K.M., Skemer, P. (2016) Low temperature plastic rheology of olivine determined by nanoindentation, *Geophysical Research Letters*, 43:176-184, doi:10.1002/2015GL065837.
- Skemer, P., Hansen, L.N. (2016) Inferring upper-mantle flow from seismic anisotropy: An experimental perspective, *Tectonophysics*, 668-669:1-14, doi:10.1016/j.tecto.2015.12.003
- *Boneh, Y., Morales, L.F.G., Kaminski, E., Skemer, P. (2015) Modeling olivine CPO evolution with complex deformation histories – Implications for the interpretation of seismic anisotropy in the mantle, *Geochemistry Geophysics Geosystems*, 16, doi:10.1002/2015GC005964
- Moore, J., Surface, J.A., Brenner, A., Wang, L., Skemer, P., Conradi, M., Hayes, S., (2015) Quantitative identification of metastable magnesium carbonate minerals by solid-state ¹³C NMR Spectroscopy, *Environmental Science and Technology*, doi:10.1021/es503390d
- *Boneh, Y., Skemer, P., (2014) The effect of deformation history on the evolution of olivine CPO, *Earth and Planetary Science Letters*, 406:213-222, doi:10.1016/j.epsl.2014.09.018
- *Bruijn, R.H.C., Skemer, P., (2014) Grain size sensitive rheology of orthopyroxene, *Geophysical Research Letters*, 41, doi: 10.1002/2014GL060607
- *Linckens, J., *Bruijn, R.H.C, Skemer, P., (2014) Dynamic recrystallization and phase mixing in experimentally deformed peridotite, *Earth and Planetary Science Letters*, 388:134-142, doi:10.1016/j.epsl.2013.11.037
- Skemer, P., Warren, J.M., Hansen, L.N., Hirth, J.G., Kelemen, P.B., (2013) The influence of water and LPO on the initiation and evolution of mantle shear zones, *Earth and Planetary Science Letters*, 375:222-233, doi:10.1016/j.epsl.2013.05.034
- Surface, J.A., Skemer, P., Hayes, S., Conradi, M., (2012) In situ measurement of magnesium carbonate formation from CO₂ using static high pressure and temperature ¹³C NMR, *Environmental Science and Technology*, doi:10.1021/es301287n
- Skemer, P., Warren, J.M., Hirth, G., (2012) The influence of deformation history on the interpretation of seismic anisotropy, *Geochemistry Geophysics Geosystems*, 13:3, doi:10.1029/2011GC003988
- Skemer, P., Sundberg, M., Hirth, G., Cooper, R., (2011), Torsion experiments on coarse-grained dunite: implications for microstructural evolution when diffusion creep is suppressed, *Deformation Mechanism, Rheology & Tectonics: Microstructures, Mechanics & Anisotropy* Geological Society of London Special Publication, 360:211-223.

Cull, S., Arvidson, R.E., Mellon, M.T., Skemer, P., Shaw, A., Morris, R.V., (2010) Composition of subsurface ices at the Mars Phoenix Landing Site, *Geophysical Research Letters*, 37:L24203, doi:10.1029/2010GL045372

Skemer, P., Warren, J.M., Kelemen, P.B., Hirth, J.G., (2010) Microstructural and rheological evolution of a mantle shear zone, *Journal of Petrology*, 51:43-53.

Skemer, P., Karato, S-i., (2008) Sheared lherzolite xenoliths revisited, *Journal of Geophysical Research*, 113: B07205, doi:10.1029/2007JB005286.

Karato, S-i., Jung, H., Katayama, I., Skemer, P., (2008) Geodynamic significance of seismic anisotropy of the upper mantle: New insights from laboratory studies, *Annual Review of Earth and Planetary Science* 36:59–95.

Skemer, P., Karato, S-i., (2007) Effects of solute segregation on the grain-growth kinetics of orthopyroxene with implications for the deformation of the upper mantle, *Physics of Earth and Planetary Interiors* 164:186-196.

Skemer, P., Katayama, I., Karato, S-i., (2006) Deformation fabrics of the Cima di Gagnone Peridotite Massif, Central Alps, Switzerland: Evidence of deformation at low temperatures in the presence of water, *Contributions to Mineralogy and Petrology* 152:43-51.

Skemer, P., Katayama, I., Jiang, Z., Karato, S-i., (2005) The misorientation index: Development of a new method for calculating the strength of lattice-preferred orientation, *Tectonophysics* 411:157-167.

SELECTED MANUSCRIPTS IN PREPARATION

*Cross, A.J., Skemer, P. (in prep) Rates of dynamic recrystallization in crystalline materials, *Journal of Geophysical Research*

ADDITIONAL REPORTS AND PUBLICATIONS (NOT PEER REVIEWED)

McGuire, J.J., T. Plank, et al. (2017) The SZ4D Initiative: Understanding the Processes that Underlie Subduction Zone Hazards in 4D. Vision Document Submitted to the National Science Foundation. *The IRIS Consortium*, 63 pp.

*Wells, R.K., Giammar, D., Skemer, P. (2016) Sample library of natural and artificial basalts. *National Energy Transfer Lab, Energy Data eXchange*

Tullis, T.E.; Chester, F.; Skemer, P.; Zhu, W.; Burgmann, R. (2012) Advancing Experimental Rock Deformation Research: Scientific, Personnel, and Technical Needs, *White Paper*

Skemer, P., Karato, S-i., (2007) Reply to Comment on “The misorientation index: Development of a new method for calculating the strength of lattice-preferred orientation,” *Tectonophysics* 441:119-120.

ADVISING AND RESEARCH SUPERVISION

Research Staff

Martin Pratt (1/2017-present)
Hélène Couvy (10/2013-present)

Postdoctoral Supervisor

Caroline Bollinger (9/2018-present)
Rachel Wells (4/2015-3/2018)
Andrew Cross (2/2015-6/2018)
Rolf Bruijn (9/2012-8/2014)
Jolien Linckens (2/2011-2/2013)

Graduate Student Advisor

Charis Horn (9/2017-present)
Elizabeth Olree (9/2017-6/2018)
Michael Sly (9/2016-present)
Yuval Boneh (9/2012-5/2017)
Brandon Mahan (9/2010-12/2012)

Visiting Graduate Students

Masanori Kido (5/2018 – 7/2018)

Graduate Thesis/Examination Committee Member

Arashdeep Thind (IMSE, 2018-present); Zhengyang Zhou (EPSc, 2018-present); Amanda Price (EPSc, 2017-present); Ming Wu (EPSc, 2017-present); Arjun Neupane (EPSc, 2017); Melody Eimer (EPSc, 2016-present); Rongrong Dai (IMSE, 2015); Linhua Xu (IMSE, 2014); Wei Xiong (EECE, 2014-2017); Kelly Kranjc (MEMS/IMSE, 2013-2017); Chen Cai (EPSc, 2013-present); Amanda Lough (EPSc, 2012-2014); Lin Wang (EECE, 2013-2015); Narelle Hillier (Physics, 2013); Andrew Lloyd (EPSc, 2012-present); Erica Emry (EPSc, 2012); Garrett Euler (EPSc, 2012); Martin Pratt (EPSc, 2012-2016); Teresa Wong (EPSc, 2012-2016); Shawn Wei (EPSc, 2012-2016); Andy Surface (Chemistry, 2010-2013); David Heeszal (EPSc, 2011); Wenli Bi (Physics, 2011); Maitrayee Bose (Physics, 2011); Yandi Hu (EECE, 2011); Mitchell Barklage (EPSc, 2010); Kasey Wagoner (Physics, 2010)

Undergraduate Research Supervisor

Anna Baker (2018-present); Ben Strozewski (2016-present); Josh Waddell (2017-2018); Zachary Rouse (2014-2016); Molly Chaney (2014); Corie Miller (2013); Matthew Guiang (2013-2015); Adrienne Emmerich (2012-2014); Ethan Kahn (2012); Hannah Rabinowitz (2011-2012)

Undergraduate Major Advisor

Approximately 50 students total (currently 20)

GRANT SUPPORT AND PI STATUS

** denotes grants that are currently active*

*11/2017-10/2018: Conference on Experimental Studies of Subduction Zone Processes,
NSF-Petrology and Geochemistry, EAR-1757791 – \$39,215

PI

*09/2017 – 08/2020: Earthcube Data Infrastructure: Collaborative Proposal: A Unified
Experimental – Natural Digital Data System for Analysis of Rock Microstructure, NSF
Earthcube, ICER-1639641 – \$126,335

PI

*09/2017 – 08/2020: Using Micromechanical Experiments to Investigate the Rheology of
Geologic Materials, NSF Tectonics, EAR-1726165 – \$447,438

PI, with Katherine Flores (co-PI) and Rohan Mishra (co-PI)

08/2017 – 07/2018: Reaction-driven fracturing for enhanced carbon sequestration in mafic
and ultramafic rocks, Washington University CCCU - \$41,195

PI, with Daniel Giammar (co-I)

07/2016 – 06/2017: Classroom Innovation Grant: Freshman Seminar: Geology in the Field
Washington University College of Arts and Sciences - \$5,000

Co-PI, with Alexander Bradley (Co-PI)

08/2014 – 07/2017: Early Career: Development of a new rock deformation apparatus for
investigating Earth's upper mantle

NSF Instrumentation and Facilities, EAR-1360584 - \$68,420

PI, with H el ene Couvy (Co-PI)

09/2014 – 03/2018: Impact of microstructure on the containment and migration of CO₂ in
fractured basalts

DOE/National Energy Technology Laboratory - \$1,284,701 (\$231,272 to Skemer)

Co-I with Daniel Giammar (PI), Mark Conradi, Brian Ellis (University of Michigan),
Sophia Hayes

*2014-2019: CAREER: Microphysical evolution of highly sheared polymineralic rocks

NSF EAR-1352306 - \$600,000

PI

2012-2017: Two-stage deformation of olivine: Effects of deformation history on seismic
anisotropy

NSF Geophysics EAR-1141795, \$266,664

PI

2012-2015: MRI: Acquisition of SIMS instrument

NSF EAR-1229370 - \$2,071,491

Co-PI with David Fike (PI), Jeffrey Catalano, Christine Floss, & Ernst Zinner

2011-2013: EAGER: Development of a new rock deformation apparatus for investigating Earth's upper mantle
NSF Instrumentation and Facilities, EAR-1139706, \$50,000
PI

2010-2013: Development of unique NMR tools for utilization and sequestration of CO₂
Washington University CCCU, \$225,000 (\$16,123 to Skemer)
Co-I, with Mark Conradi (PI) & Sophia Hayes

2009-2013: Deformation and microstructural evolution of harzburgite
NSF Geophysics, EAR-0911289, \$285,000
PI