

## Elvira Mulyukova

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### RESEARCH EXPERIENCE

Assistant Professor, Earth and Planetary Sciences  
Northwestern University, Evanston, IL 2021 – present

Associate Research Scientist, Research Scientist, Earth and Planetary Sciences  
Yale University, New Haven, CT 2018 – 2021

Postdoctoral Associate, Geology and Geophysics  
Yale University, New Haven, CT 2015 – 2018

### EDUCATION

PhD in Geophysics, Geodynamic Modelling  
GFZ German Research Centre for Geosciences, Potsdam, Germany 2011 – 2015  
THESIS - “Numerical Modelling of Stability of the Large Low Shear Velocity Provinces”

Master of Science, Physics of Geological Processes, University of Oslo, Norway  
TOPIC - Numerical Modelling of Thermochemical Convection in the Earth’s Mantle 2009 – 2011

Bachelor of Science, Physics, University of Oslo, Norway  
Specialized in Astrophysics and Computational Physics 2006 – 2009

### PUBLICATIONS

- D. Bercovici, **E. Mulyukova**, J. Girard, P. Skemer, (2023), A coupled model for phase mixing, grain damage and shear localization in the lithosphere: Comparison to lab experiments, *Geophysical Journal International*, Volume 232, Issue 3, March 2023, Pages 2205-2230,  
<https://doi.org/10.1093/gji/ggac428>
- E. Mulyukova**, D. Bercovici, (2023), The Physics And Origin Of Plate Tectonics From Grain To Global Scales, Chapter for the book *Dynamics of Plate Tectonics and Mantle Convection*, edited by J. C. Duarte  
<https://doi.org/10.1016/C2020-0-02922-1>
- E. Mulyukova**, D. Bercovici, (2022), On the Co-Evolution of Dislocations and Grains in Deforming Rocks, *Physics of the Earth and Planetary Interiors*, 328, 106874,  
<https://doi.org/10.1016/j.pepi.2022.106874>
- D. Bercovici, **E. Mulyukova** (2021), Magnetization of Sinking Porous Diapirs in Planetesimal Cores, *Physics of the Earth and Planetary Interiors*, 313, 106678,  
<https://doi.org/10.1016/j.pepi.2021.106678>
- D. Bercovici, **E. Mulyukova** (2021), Evolution and Demise of Passive Margins Through Grain Mixing and Damage, *Proceedings of the National Academy of Sciences (PNAS)*, 118 (4) e2011247118,  
<https://www.pnas.org/content/118/4/e2011247118.short>
- F. Cramer, V. Magni, M. Domeier, G. E. Shephard, K. Chotalia, G. Cooper, C. Eakin, A. G. Grima, D. Gürer, A. Király, **E. Mulyukova**, K. Peters, B. Robert, M. Thielmann (2020), Subduction Zone Initiation on the Recent Earth Strongly Tied to Ongoing Subduction, *Nature Communications*, 11, 3750  
<https://doi.org/10.1038/s41467-020-17522-9>
- E. Mulyukova**, D. Bercovici (2020), Mantle Convection in Terrestrial Planets, *Oxford Research Encyclopedia of Planetary Science*,  
<http://dx.doi.org/10.1093/acrefore/9780190647926.013.109>
- D. Bercovici, **E. Mulyukova** (2020), Two-Phase Magnetohydrodynamics: Theory and Applications to Planetesimal Cores, *Physics of the Earth and Planetary Interiors*, 300, 106432,  
<https://doi.org/10.1016/j.pepi.2020.106432>

D. Bercovici, **E. Mulyukova** (2020), Mantle Convection, *Encyclopedia of Solid Earth Geophysics*, 1-21, edited by H. Gupta, Springer International Publishing, [https://doi.org/10.1007/978-3-030-10475-7\\_130-1](https://doi.org/10.1007/978-3-030-10475-7_130-1)

**E. Mulyukova**, D. Bercovici (2019), Origin of Plate Tectonics From Grains to Global Scales: A Brief Review, *Tectonics*, special volume “50th Anniversary of Plate Tectonic”, 38, 4058-4076, <https://doi.org/10.1029/2018TC005447>

**E. Mulyukova**, D. Bercovici (2018), A Theoretical Model for the Evolution of Microstructure in Lithospheric Shear Zones, *Geophysical Journal International*, 216, 803-819, <https://doi.org/10.1093/gji/ggy467>

**E. Mulyukova**, D. Bercovici (2018), Collapse of Passive Margins by Lithospheric Damage and Plunging Grain Size, *Earth and Planetary Science Letters*, 484, 341-352, <https://doi.org/10.1016/j.epsl.2017.12.022>

D. Bercovici, **E. Mulyukova** (2018), A Continuum Theory for Phase Mixing and Grain-Damage Relevant to Tectonic Plate Boundary Evolution, *Physics of the Earth and Planetary Interiors*, 285, 23-44, <https://doi.org/10.1016/j.pepi.2018.10.005>

D. Bercovici, **E. Mulyukova**, M. Long (2018), A Simple Toy Model for Coupled Retreat and Detachment of Subducting Slabs, *Journal of Geodynamics*, 129, 275-289, <https://doi.org/10.1016/j.jog.2018.03.002>

A. Bellas, S. Zhong, D. Bercovici, **E. Mulyukova** (2018), Dynamic Weakening with Grain-Damage and Implications for Slab Detachment, *Physics of the Earth and Planetary Interiors*, 285, 76-90, <https://doi.org/10.1016/j.pepi.2018.09.001>

**E. Mulyukova**, D. Bercovici (2017), Formation of Lithospheric Shear Zones: Effect of Temperature on Two-Phase Grain Damage, *Physics of the Earth and Planetary Interiors*, 270, 195-212, <https://doi.org/10.1016/j.pepi.2017.07.011>

**E. Mulyukova**, B. Steinberger, M. Dabrowski, S. Sobolev (2015), Survival of LLSVPs for Billions of Years in a Vigorously Convecting Mantle: Replenishment and Destruction of Chemical Anomaly, *Journal of Geophysical Research: Solid Earth*, 120, 3824-3847, <https://doi.org/10.1002/2014JB011688>

## TEACHING AND OUTREACH

*EARTH-450-0-01* Spring Quarter 2023  
• Advanced Topics: Nemmers Seminar: Rocks Get Weak. Northwestern University, Department of Earth and Planetary Sciences, Evanston, IL

*EARTH-102-6-02* Winter Quarter 2022, 2023  
• Earth is Out to Kill You: History and Science of Earthquakes & Volcanoes. Northwestern University, Department of Earth and Planetary Sciences, Evanston, IL

*Research Experience for Undergraduates (REU)* Summer 2022  
• Mentoring a student for the project “Water and Habitability on Venus” as part of the program “Preparing a Diverse Workforce through Interdisciplinary Astrophysics Research”, Northwestern University, <https://sites.northwestern.edu/cierareu/>, Evanston, IL

*EARTH-499* Fall Quarter 2022  
• Advisor for the graduate student Trevor Dempsey for the research project entitled “Using a Microphysical Theory of Lithospheric Rock Deformation to Predict Post-Seismic Relaxation” Northwestern University, Department of Earth and Planetary Sciences, Evanston, IL

*EARTH-499* Spring Quarter 2022  
• Advisor for the secondary proposition of the graduate student Ann Mariam Thomas, entitled “Incorporating the microphysics of transient viscosity to model postglacial rebound.” Northwestern University, Department of Earth and Planetary Sciences, Evanston, IL

*EARTH-180* Spring Quarter 2022  
• Fantasy Worlds: How to Build Your Own Planet. Northwestern University, Department of Earth and Planetary Sciences, Evanston, IL

*Integrated Refugee & Immigrant Services - Online Tutor for Immigrant Youth* 2020 - 2021

- Mentoring a female Afghan high school student through video chat two hours per week, adapting her homework assignments to her English level, bringing her up to speed with the curriculums, including English, History, Mathematics, and others. New Haven, CT
- APS Conference for Undergraduate Women in Physics* January 2020
- Served on the panel for Climate Physics and Geophysics, helping undergraduate women to navigate professions in physics, and have access to other women in physics of all ages with whom they can share experiences, advice, and ideas, Yale University, New Haven, CT
- EGU (European Geophysical Union)* January 2018
- Invited blogger for the geodynamics division: [“Rheological Laws: Atoms on the Move”](#)
- Girls’ Science Investigations* April 2017
- Supervised a day-long course about physics principles, ran hands-on demonstration and experiments for local middle school girls, New Haven, CT
- Computational Geodynamics, Graduate Level Course* 2013, 2014  
Universität Potsdam, Germany
- Prepared and taught lectures entitled: “Introduction to Finite Element Method”
- UNGFORSK - Outreach Program at the University of Oslo, Norway* 2008, 2011
- Wrote and presented a manuscript about natural sciences to high school students (audience of about 150-200).
- ENT3R UiO - Tutoring Organisation at the University of Oslo, Norway* 2009 – 2010
- Taught Mathematics to senior High School students (groups of 10-20)
  - Designed scientific experiments to encourage students’ interest in natural sciences

### INVITED TALKS

- Talk in the Session on “The Upper Mantle: Rheology, Conductivity and (An)elasticity”, Gordon Research Conference - Interior of the Earth, Mount Holyoke, MA, June 2023
- “Microphysics of Solid-State Creep in Planetary Interiors”, Caltech Seismological Laboratory, Pasadena, CA, March 2023
- “Microphysics of Solid-State Creep in Planetary Interiors”, University of Wisconsin-Madison, Madison, WI, February 2023
- “How microscopic crystalline defects control the motion of tectonic plate”, Ecole Normale Supérieure, Paris, France, October 2022
- “A New Microphysical Model of Composite Solid-State Creep in Mantles and Lithospheres”, Ada Lovelace Workshop on Numerical Modelling of Mantle and Lithosphere Dynamics, Hungary, August 2022
- “A New Microphysical Model of Composite Solid-State Creep in Mantles and Lithospheres”, Texas A&M University, College Station, TX, March 2022
- “How Planetary Scientists Get Hooked On Crystal Math”, University of London, UK, November, 2021
- “Microphysics of Shear Localization and Weakening at Tectonic Plate Boundaries”, Committee on Solid Earth Geophysics, The National Academies of Sciences, October, 2021
- “How Planetary Scientists Get Hooked On Crystal Math”, University of Chicago, IL, October, 2021
- “How Planetary Scientists Get Hooked On Crystal Math”, GeoPhysics Seminar of the Upper Midwest (GYPSUM), virtual, October, 2021
- “Grain Expectations: Microphysics of Plate Boundaries from Geological to Human Timescales”, Florida State University, FL, USA, February, 2021
- “A Dislocation and A Grain Boundary Walk into a Bar: or On The Microphysics Of Lithospheric Deformation”, UK International Geophysics & Tectonics Seminar, February, 2021
- “A Dislocation and A Grain Boundary Walk into a Bar: or On The Microphysics Of Lithospheric Deformation”, University of Delaware, DE, October, 2020
- Keynote speaker on “Evolution and Transient Behavior of Lithospheric Shear Zones”, Computational Infrastructure for Geodynamics (CIG) - Tectonics Community Workshop, July, 2020
- “Grain Expectations: Microphysics of Plate Boundaries from Geological to Human Timescales”, Northwestern University, Evanston, IL, USA, March 2020

“Grain Expectations: Microphysics of Plate Boundaries from Geological to Human Timescales”, University of Texas, Austin, USA, November 2019

“Chemical Homogenization in the Upper Mantle by Grain Mixing”, Goldschmidt Conference, Spain, August 2019

“Grain Expectations: Microphysics of Postseismic Recovery”, University of Minnesota, USA, June 2019

“Grain Scale Physics of Plate Boundaries: Tectonic Processes from Geological To Human Time Scales”, University of Oregon, USA, April 2019

“Grain by Grain to Plate Tectonics: From Geological to Human Time Scales”, The University of British Columbia, Canada, February 2019

“Grain Scale Physics Of Plate Boundaries: Tectonic Processes From Geological To Human Time Scales”, Georgia Tech, USA, January 2019

“Grain by Grain to Plate Tectonics”, DTM Washington DC, USA, July 2018

“Evolution of the Microstructure in Lithospheric Shear Zones”, ENS Lyon, France, June 2018

“Grain by Grain to Plate Tectonics”, CGU/CIG Joint Meeting, Canada, June 2018

“Dynamics Of Grain Defects And The Formation Of Plate Boundaries”, ETH Zurich, Switzerland, May 2018

“Piles, Grains and the Paths Not Taken”, ETH Zurich PhD-students retreat, Liechtenstein, May 2018

“Dynamics Of Grain Defects And The Formation Of Plate Boundaries”, Center for Space and Habitability (CSH), University of Bern, Switzerland, May 2018

“Grain Micromechanics from Shallow to Deep Mantle: Theory and Experiments”, Brown University, RI, USA, April 2018

“The Microphysics of Forming Tectonic Plate Bondaries”, Brown University, RI, USA, October 2017

“Grain by Grain to Plate Tectonics”, Arizona State University, AZ, USA, March 2017

“Modelling Segregation of Subducted Oceanic Crust: Comparison of Numerical Techniques”, ETH Zurich, Switzerland, March 2014

“Numerical Modeling of Deep Mantle Flow: Thermal Convection and Entrainment”, Freie Universität Berlin, Germany, August 2013

## GRANTS AND AWARDS

<i>NSF Grant (Co-PI) “Theoretical and Experimental Investigation of Grain Damage and the Formation of Plate Boundaries” (\$273 000)</i>	2019-2021
<i>CIDER Multi-Disciplinary Working Group Grant (\$4985)</i>	2015
<i>AGU Student Travel Grant (\$1000)</i>	2013
<i>EGU Outstanding Student Poster Award (OSPA)</i>	2012
<i>“EGU-talk” Award at GFZ PhD-day</i>	2012
– Annual prize granted by GFZ-German Research Centre for Geosciences, Potsdam, Germany	
<i>GeoSim 3-year PhD-Scholarship</i>	2011
– Came first among ~ 50 applicants	
<a href="#"><u>FameLab Audience Prize Award</u></a>	2011
– Wrote and performed on guitar a song about mantle convection (audience of about 300)	
<i>Master’s Student Award: “Larvae Prize”</i>	2010
– Annual prize granted by the department of Physics of Geological Processes, University of Oslo	

## PROFESSIONAL SERVICE / VOLUNTARY WORK

- Serve as a Member of the Integrated Science Program Committee* 2022 - present
- Northwestern University
- Served on Review Panels for Grant Proposals for :* 2018 - present
- National Science Foundation (NSF)  
NSF Graduate Research Fellowships Program (GRFP);  
NASA - Solar System Workings, Geophysics
- CIG - Computational Infrastructure for Geodynamics:* 2022 - present
- Vice-Chair of the Science Steering Committee
- AGU (American Geophysical Union)*
- Convener of the Session “The Microphysics Of Mantle Flow and Plate Boundary Formation”  
Mineral and Rock Physics Section, Chicago, IL December 2022
  - Convener of the Session “The Microphysics of Plate Boundary Formation”  
Tectonophysics Section, New Orleans, LA December 2017
  - Judge for the Outstanding Student Poster Award (OSPA), December 2017, 2018, 2019
- Reviewed manuscripts and grant proposals for:* 2015 - present
- NSF Division of Earth Sciences - Geophysics; Swiss National Science Foundation; Swiss National Supercomputing Centre; Earth and Planetary Science Letters (EPSL); Geochemistry, Geophysics, Geosystems (G-cubed); Proceedings of the National Academy of Sciences of the USA (PNAS); Physics of the Earth and Planetary Interiors (PEPI); Tectonophysics-Elsevier; Frontiers in Earth Science
- Deputy Chair of the Committee on Culture, Diversity, and Inclusion* 2020 - 2021
- Serving on the committee to promote diversity, equity and inclusion at the department of Earth and Planetary Sciences at Yale, by organizing invited lectures, town-hall meetings, department surveys, etc., and proposing strategies towards improving the culture of the department
- GRS (Gordon Research Seminar)* June 2019
- Co-Chair for the 2019 meeting on the Interior of the Earth, South Hadley, MA
- IRIS (Integrated Refugee & Immigrant Services)* January 2017 – present
- English tutoring for children (4-10 years old) from the refugee families at the Roberto Clemente Leadership Academy for Global Awareness, New Haven, CT
  - Help organizing [Run for Refugees](#) - annual fundraiser to support services for refugees like housing, education, employment, health care, etc
- GEOSIM seminars* 2013 – 2014
- Organised seminars with focus on interdisciplinary research for PhD-students at GFZ-Potsdam, Freie Universität Berlin, and Universität Potsdam, Germany
- PhD Representative* 2012 – 2013
- Organised workshops for PhD-students at GFZ-Potsdam, including ‘Time- and Self-Management’ and ‘Writing Proposals’ workshops, and the annual PhD-day for over 300 PhD-students in Potsdam, Germany

## COMPUTER SKILLS

*Operating System:* Linux OS, Windows, Mac OS  
*Programming:* MATLAB, C++, Python  
*Code-development:* Finite Elements, Finite Differences, Finite Volumes, Image Analysis  
*Geodynamics Software:* MILAMIN, MUTILS, ASPECT

## LANGUAGE SKILLS

English: fluent; Russian: mother tongue; Norwegian: fluent; German: basic; French: basic

## WORK EXPERIENCE

- Kongsberg Oil and Gas Technologies, AS* June – August 2010
- As part of the software development team, I performed various quality assurance tasks on the SIM Reservoir application - a post-processing tool for reservoir engineering, automated manual tests in Squish, both by using the Squish IDE and by programming the test-drivers in Python

## FIELD EXPERIENCE

<i>Tectonics of Appalachia</i> Virginia and West Virginia, USA Part of the course “Natural Disasters”, Yale University	March 2020 (Duration: 6 days)
<i>Volcanic landscapes of the ocean islands</i> Azores Islands, Portugal Part of the course “Natural Disasters”, Yale University	March 2018 (Duration: 7 days)
<i>Lava flows and evolution of a volcanic island chain</i> Big Island, Hawaii, USA Part of the course “Natural Disasters”, Yale University	March 2016 (Duration: 7 days)
<i>High-pressure rocks, extensional detachments, and supradetachment basins in the Caledonian Orogeny</i> Bremanger, Western Norway Part of the course “Tectonics”, University of Oslo	April 2010 (Duration: 4 days)

## CONFERENCE ABSTRACTS AND PRESENTATIONS

### ORAL PRESENTATIONS:

- E. Mulyukova, D. Bercovici, *A New Microphysical Model of Composite Solid-State Creep in Mantles and Lithospheres*, AGU General Assembly, New Orleans, LA, USA, December 2021
- E. Mulyukova, D. Bercovici, *A Theoretical Model For The Evolution Of Microstructure In Lithospheric Shear Zones*, AGU General Assembly, Washington, DC, USA, December 2018
- E. Mulyukova, D. Bercovici, *Collapse of Passive Margins by Lithospheric Damage and Plunging Grain Size*, CEED: Conceiving Earth Evolution and Dynamics, Tenerife, Spain, October 2017
- E. Mulyukova, D. Bercovici, *Formation of Lithospheric Shear Zones: Effect of Temperature on Two-Phase Grain Damage*, AGU General Assembly, San Francisco, CA, USA, December 2016
- E. Mulyukova, M. Dabrowski, and B. Steinberger, *Numerical Modeling of Deep Mantle Flow: Thermochemical Convection and Entrainment*, EGU General Assembly, Vienna, Austria, April 2013
- E. Mulyukova, M. Dabrowski, and B. Steinberger, *Thermochemical Modeling of Stability of the Large Low Shear Velocity Provinces*, Weierstrass Institute, Berlin, Germany, February 2012
- E. Mulyukova, M. Dabrowski, and B. Steinberger, *The Question of Survival of Large Piles in the Deep Mantle*, Texas A&M University, October 2012

### POSTER PRESENTATIONS:

- A. M. Thomas, E. Mulyukova, *Incorporating the Microphysics of Transient Viscosity to Model Post-glacial Rebound*, AGU Fall meeting, Chicago, IL, December 2022
- T. Depsey, E. Mulyukova, *Using a Microphysical Theory of Lithospheric Rock Deformation to Predict Post-Seismic Relaxation*, AGU Fall meeting, Chicago, IL, December 2022
- E. Mulyukova, *How Microscopic Crystalline Defects Control the Motion of Tectonic Plates*, AGU Fall meeting, Chicago, IL, December 2022
- E. Mulyukova, D. Bercovici, *A New Microphysical Model of Composite Creep in Mantles and Lithospheres*, GRC - Gordon Research Conferences, Lewiston, ME, USA, August 2022
- E. Mulyukova, D. Bercovici, *A Dislocation and a Grain Boundary Walk Into a Bar*, AGU Fall meeting, virtual, December 2020
- E. Mulyukova, D. Bercovici, *Grain Expectations: Microphysics of Plate Boundaries from Geological to Human Timescales*, Ada Lovelace Workshop on Mantle and Lithosphere Dynamics, Siena, Italy, August 2019
- E. Mulyukova, D. Bercovici, *Grain Expectations: Microphysics of Plate Boundaries from Geological to Human Timescales*, GRC - Gordon Research Conferences, South Hadley, MA, USA, June 2019
- E. Mulyukova, D. Bercovici, *Dynamics Of Grain Defects and The Formation Of Plate Boundaries*, 50 Years of Plate Tectonics: Then, Now, and Beyond, Paris, France, June 2018
- E. Mulyukova, D. Bercovici, *A Tale of Two Grains: Competition Between Grain Boundaries and Intra-granular Defects*, Earth dynamics and the development of plate tectonics, The Royal Society, London, UK, March 2018

- E. Mulyukova, D. Bercovici, *Collapse of Passive Margins by Lithospheric Damage and Plunging Grain Size*, AGU Fall meeting, New Orleans, LA, USA, December 2017
- E. Mulyukova, D. Bercovici, *Collapse of Passive Margins by Lithospheric Damage and Plunging Grain Size*, GRC - Gordon Research Conferences, South Hadley, MA, USA, June 2017
- E. Mulyukova, D. Bercovici, *Formation of Lithospheric Shear Zones: Effect of Temperature on Two-Phase Grain Damage*, Melt in the Mantle Workshop, Cambridge, UK, June 2016
- E. Mulyukova, D. Bercovici, *Characteristic Size of Tectonic Plates: Insights from Boundary Layer Theory with Grain-Damage*, AGU General Assembly, San Francisco, CA, USA, December 2015
- E. Mulyukova, B. Steinberger, M. Dabrowski, S. Sobolev, *Residence Time of Oceanic Crust in the Deep Mantle*, GRC - Gordon Research Conferences, South Hadley, MA, USA, June 2015
- E. Mulyukova, M. Dabrowski, B. Steinberger, *Lagrangian Numerical Techniques for Modelling Multi-component Flow*, EGU General Assembly, Vienna, Austria, April 2015
- E. Mulyukova, B. Steinberger, M. Dabrowski, S. Sobolev, *Survival of LLSVPs for Billions of Years in a Vigorously Convecting Mantle: Replenishment and Destruction of Chemical Anomaly*, GEOMOD conference, Potsdam, Germany, August 2014
- E. Mulyukova, B. Steinberger, M. Dabrowski, S. Sobolev, *Entrainment and Survival Time of the LLSVPs: Effects of Flow in the Thermochemical Pile Interior*, AGU Fall meeting, San Francisco, USA, December 2013
- E. Mulyukova, B. Steinberger, M. Dabrowski, *Thermo-Chemical Convection and Entrainment: Carrying Capacity of Deep Mantle Plumes*, GRC - Gordon Research Conferences, South Hadley, MA, USA, June 2013
- E. Mulyukova, M. Dabrowski, B. Steinberger, *Numerical Modeling of Deep Mantle Convection: Accuracy of the Tracer Methods*, EGU General Assembly, Vienna, Austria, April 2012
- E. Mulyukova, M. Dabrowski, T. H. Torsvik, D. W. Schmid, *Thermomechanical Modelling of Stability of Large Low Shear Velocity Provinces*, EGU General Assembly, Vienna, Austria, April 2011
- E. Mulyukova, M. Dabrowski, T. H. Torsvik, D. W. Schmid, *Towards Unstructured FEM Model of Mantle-Lithosphere Interaction*, 6<sup>th</sup> TOPO-EUROPE Workshop, Hønefoss, Norway, October 2010