

# Dr Matthew S. Tarling

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## Education

- 2015–2019 **PhD Geology**, *University of Otago*, Dunedin, New Zealand.  
Supervisor: Dr Steven A.F. Smith  
Thesis: The structure, petrology, and mechanics of a plate boundary-scale serpentinite shear zone: The Livingstone Fault, New Zealand.  
*Exceptional PhD thesis award, Division of Sciences*
- 2014–2015 **B.Sc. Geology**, *McGill University*, Montreal, Canada (GPA 4/4)
- 2009–2014 **B.Sc. Physics**, *McGill University*, Montreal, Canada (GPA 3.69/4)

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## Academic positions

- 2021-present **Postdoctoral Researcher**, *McGill University*, Montréal, Québec, Canada.  
Supervisors: Profs. Christie Rowe & James Kirkpatrick  
Project 1: Machine learning in structural geology and tectonics: Application of convolution neural networks to identifying fault scarps.  
Project 2: Deformation processes in fault gouge of active faults (San Andreas Fault, USA; Alpine Fault, NZ).  
Teaching: Lead course instructor for EPSC303 Structural Geology and EPSC231 Field School I
- 2019-2021 **Postdoctoral Fellow**, *University of Otago*, Dunedin, New Zealand.  
Supervisor: Dr Steven A.F. Smith  
Project: Experimental and field study of the interactions between ultramafic carbonation reactions and microstructure.
- 2013–2015 **Undergraduate research**, *Field Rheology Rowe Research Group*, McGill University.  
Supervisor: Prof. Christie D. Rowe.  
Work: Rock analogue deformation experiments studying shear distribution in scaly fabrics.
- 2012-2014 **Undergraduate research**, *Leslie Biophysics Research Lab*, McGill University.  
Supervisor: Prof. Sabrina R. Leslie.  
Work: Design, simulation, and construction of a custom fluorescence microscope with laser excitation and imaging systems.

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## Peer-reviewed publications (\* denotes equal contribution from multiple first authors)

- [1] **Tarling, M.S.**, Rowe, C.D., Kirkpatrick, J.D., & Wakabayashi, J. Origin of the ultramafic rocks on Ring Mountain, Marin County, California. *In Review in Tectonics*.
- [2] Tulley, C. J., Fagereng, Å., Ujiie, K., Piazzolo, S., **Tarling, M. S.**, & Mori, Y. Rheology of naturally deformed antigorite serpentinite: Strain and strain-rate dependence at mantle-wedge conditions. *Geophysical Research Letters*, 49, e2022GL098945, 2022.  
<https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2022GL098945>
- [3] **Tarling, M.S.**, Smith, S.A., Negrini, M., Kuo, L.W., Wu, W.H. & Cooper, A.F. An evolutionary model and classification scheme for nephrite jade based on veining, fabric development, and the role of dissolution–precipitation. *Scientific Reports*, 12(1):1-12, 2022.  
<https://www.nature.com/articles/s41598-022-11560-7>
- [4] **Tarling, M.S.**, Demurtas, M., Smith, S.A., Rooney, J.S., Negrini, M., Viti, C., Petriglieri, J.R. & Gordon, K.C., 2022. Crystallographic orientation mapping of lizardite serpentinite by Raman spectroscopy. *European Journal of Mineralogy*, 34(3):285-300, 2022.  
<https://ejm.copernicus.org/articles/34/285/2022/>
- [5] **Tarling, M.S.**, Smith, S.A., Rooney, J.S., Viti, C. and Gordon, K.C. A common type of mineralogical banding in serpentine crack-seal veins. *Earth and Planetary Science Letters*, 564:116930, 2021.  
<https://www.sciencedirect.com/science/article/pii/S0012821X21001898>
- [6] Lee J, Jung H, Klemd R, **Tarling M.S.**, & Konopelko D. Lattice preferred orientation of talc and implications for seismic anisotropy in subduction zones. *Earth and Planetary Science Letters*. 537:116178, 2020.  
<https://www.sciencedirect.com/science/article/pii/S0012821X20301217>
- [7] **Tarling, M.S.**, Smith, S.A. and Scott, J.M., Fluid overpressure from chemical reactions in serpentinite within the source region of deep episodic tremor. *Nature Geoscience*, 2019.  
<https://www.nature.com/articles/s41561-019-0470-z>
- [8] **Tarling, M.S.**, Smith, S.A., Scott, J.M., Rooney, J.S., Viti, C. and Gordon, K.C. The internal structure and composition of a plate-boundary-scale serpentinite shear zone: the Livingstone Fault, New Zealand. *Solid Earth*, 10(4):1025–1047, 2019.  
<https://www.solid-earth.net/10/1025/2019/>
- [9] Scott, J.M., Smith, S.A., **Tarling, M.S.**, le Roux, P.J., Harris, C., Hoffmann, J.E., Scherzer, S. & Tulley, C.J., Element and Sr–O isotope redistribution across a plate boundary-scale crustal serpentinite mélange shear zone, and implications for the slab-mantle interface. *Earth and Planetary Science Letters*, 522:198-209, 2019.  
<https://www.sciencedirect.com/science/article/pii/S0012821X19303735>
- [10] **Tarling, M.S.**, Smith, S.A., Viti, C. & Scott, J.M., Dynamic earthquake rupture preserved in a creeping serpentinite shear zone. *Nature communications*, 9(1):3552, 2018.  
<https://www.nature.com/articles/s41467-018-05965-0>
- [11] **Tarling, M.S.**, Rooney, J.S., Viti, C., Smith, S.A. & Gordon, K.C., Distinguishing the Raman spectrum of polygonal serpentine. *Journal of Raman Spectroscopy*, 49(12):1978-1984, 2019.  
<https://onlinelibrary.wiley.com/doi/full/10.1002/jrs.5475>
- [12] \*Rooney, J.S., \***Tarling, M.S.**, Smith, S.A. & Gordon, K.C., Submicron Raman spectroscopy mapping of serpentinite fault rocks. *Journal of Raman Spectroscopy*, 49(2):279–286, 2018.  
<https://onlinelibrary.wiley.com/doi/full/10.1002/jrs.5277>

- [13] Viti, C., Collettini, C., Tessei, T., **Tarling, M.S.** & Smith, S.A., Deformation processes, textural evolution and weakening in retrograde serpentinites. *Minerals*, 8(6):241, 2018.  
<https://www.mdpi.com/2075-163X/8/6/241>
- [14] Negrini, M., Smith, S.A., Scott, J.M. & **Tarling, M.S.**, Microstructural and rheological evolution of calcite mylonites during shear zone thinning: Constraints from the Mount Irene shear zone, Fiordland, New Zealand. *Journal of Structural Geology*, 106:86–102, 2018.  
<https://www.sciencedirect.com/science/article/pii/S0191814117302705>
- [15] Rowe, C.D., Ross, C., Swanson, M.T., Pollock, S., Backeberg, N.R., Barshi, N.A., Bate, C.E., Carruthers, S., Coulson, S., Dascher-Cousineau, K. and Harrichhausen, N., Peña Castro, A.F., Nisbet, H., Rakoczy, P., Scibek, J., Smith, H., **Tarling, M.S.**, Timofeev, A., Young, E. Geometric complexity of earthquake rupture surfaces preserved in pseudotachylyte networks. *Journal of Geophysical Research: Solid Earth*, 123(9):7998-8015, 2018  
<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018JB016192>
- [16] Regalla, C.A., Rowe, C.D., Harrichhausen, N., **Tarling, M.S.** and Singh, J., Styles of underplating in the Marin Headlands terrane, Franciscan complex, California. *Geology and Tectonics of Subduction Zones: A Tribute to Gaku Kimura*, 534:155, 2018.
- [17] Jacob, J.B., Scott, J.M., Turnbull, R.E., **Tarling, M.S.** and Sagar, M.W., High-to ultrahigh-temperature metamorphism in the lower crust: An example resulting from Hikurangi Plateau collision and slab rollback in New Zealand. *Journal of Metamorphic Geology*, 35(8):831-853, 2017.  
<https://onlinelibrary.wiley.com/doi/full/10.1111/jmg.12257>
- [18] **Tarling, M.S.** and Rowe, C.D., Experimental slip distribution in lentils as an analog for scaly clay fabrics. *Geology*, 44(3):183-186, 2016.  
<https://pubs.geoscienceworld.org/gsa/geology/article/44/3/183/132001/>
- [19] Arsenault, A., Leith, J.S., Henkin, G., McFaul, C.M., **Tarling, M.S.**, Talbot, R., Berard, D., Michaud, F., Scott, S. & Leslie, S.R. Open-frame system for single-molecule microscopy. *Review of Scientific Instruments*, 86(3):033701, 2015.  
<https://pubs.geoscienceworld.org/gsa/geology/article/44/3/183/132001/>

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## Invited talks

- [1] Invited speaker for St. Lawrence University Geology Department Seminar. March 8<sup>th</sup> (*upcoming*)
- [2] Invited speaker for “SerpentineDays” webinar, Utrecht University. October 3<sup>rd</sup> (*upcoming*)
- [3] Invited speaker for the 2023 Goldschmidt Conference. Session 4f Serpentinites: from sub-surface to subduction zones and beyond. Lyon, France. 9-14 July 2023.
- [4] Invited speaker. Structural Geology & Tectonics Seminar, Department of Earth Sciences, Utrecht University, Utrecht, Netherlands, 4 July 2023.
- [5] Invited keynote speaker for the 2022 Gordon Research Conference on Rock Deformation: Combining Laboratory Measurements with Observational Constraints to Understand Tectonic Processes. Bates College, Lewiston, Maine. 7-11 August 2022.
- [6] Invited speaker for the 2022 Northern California Earthquake Hazards Workshop (NCEHW): Colouring Outside the Earthquake: Creepy Crawly Faults. United States Geological Survey. 25-27 January 2022.
- [7] **Tarling, M.S.**, Smith, S.A., Rooney, J.S., Viti, C. and Gordon, K.C. Serpentine crack-seal veins: a unique record of fluid conditions during faulting. Session GMPV6.1: "Fluid-rock interaction: Kickstarter of metamorphic, deformation and geo-engineering processes". *EGU General Assembly*, April 2021. *Invited Speaker*.

- [8] Invited speaker. Lakehead University Geology Department Research Seminar, Lakehead University, Thunder Bay, Ontario, Canada. February 2021.
- [9] Invited speaker for IGPP (Institute for Geophysics and Planetary Physics) Seminar, University of California, Santa Cruz, CA, USA. June 2020.
- [10] Invited speaker for BiSEPPS (Biweekly Seminar in Earth, Planetary, and Physical Sciences) Seminar, Harvard University, MA, USA. April 2020.
- [11] Invited speaker for Japan Geoscience Union Meeting. Session S-CG50: "Intraslab and Intraplate earthquakes". Declined invitation due to time commitments, May 2019.
- [12] **Tarling, M.S.**, Smith, S.A.F., and Viti, C. Dynamic earthquake rupture preserved in a creeping serpentinite shear zone. Session SM2.5: "The Mechanics of Faulting from shallow to deep earthquakes: Interplay between multiple length scales". *EGU General Assembly*, April 2019. *Invited Speaker*.
- [13] **Tarling, M.S.**, Smith, S.A.F., Viti, C., Rooney, J.S., and Gordon, K.C. Coseismic dehydration and amorphisation of serpentinite in a creeping shear zone. Session MR23A: "Physical Properties of Earth Materials (PPEM): The rheology and processes of transient and steady state rock deformation". *AGU Fall Meeting*, December 2017. *Invited Speaker*.

## Teaching experience

- 2023 **Course instructor** for EPSC 303 Field School I – Spring 2023 semester  
Department of Earth and Planetary Sciences, McGill University  
Task: Introductory field mapping course. Led 2 week undergraduate field course in Nevada and California designed to introduce students to geological field mapping of tectonically deformed landscapes.
- 2022 **Course instructor** for EPSC 303 Structural Geology – Fall 2022 semester  
Department of Earth and Planetary Sciences, McGill University  
Task: Third year structural geology course. Designed and taught lectures with regular hands-on exercises, designed new student-lead laboratory experiments and led field trips to promote experiential learning. Top rated course in the EPS Department in student course evaluations for Fall 2022
- 2022 **Co-instructor/Demonstrator** for EPSC 231 Field School 1 – Spring 2022 semester  
Department of Earth and Planetary Sciences, McGill University  
Lead Instructor: Prof Christie Rowe  
Task: Introductory field geology mapping course. Prepared and taught field skills refresher days to prepare students prior to field camp. Assisted with teaching students observational field geology, geological field mapping and field interpretations during the field camp.
- 2020 **Co-instructor** for GEOL 251 Introduction to Field Geology  
Department of Geology, University of Otago  
Lead Instructor: Senior lecturer Dr Steven A.F. Smith  
Task: Introductory field geology mapping course. Trained students in field observation, taught geological field mapping, field interpretation, and geometry of geological structures.
- 2018 **Demonstrator** for GEOL344 Advanced Field Studies  
Department of Geology, University of Otago  
Lead Instructors: Senior lecturers Dr Steven A.F. Smith and Dr James M. Scott  
Task: Advanced field geology mapping course. Trained students in advanced geological field mapping, structural mapping, and stereographic projection.
- 2016-2018 **Demonstrator** for GEOL 251 Introduction to Field Geology  
Department of Geology, University of Otago  
Lead Instructor: Senior lecturer Dr Steven A.F. Smith  
Task: Introductory field geology mapping course. Trained students in field observation, taught geological field mapping, field interpretation, and geometry of geological structures in the field.

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## Mentorship experience

- 2022-2023 Lekima Yakuden, B.Sc. McGill University (co-supervised with Prof. James Kirkpatrick)  
Project: Numerical modelling of shear heating in pseudotachylyte during earthquake rupture
- Nathalie Redick, B.Sc. McGill University (co-supervised with Prof. James Kirkpatrick)  
Project: Machine learning segmentation of geospatial data w/ convolutional neural networks
- 2021-2023 Field Rheology Research Group, McGill University (PI Prof. Christie Rowe)  
Training group members for Raman spectroscopy, sample and thin section preparation
- 2020 Laura McDonald, B.Sc. Honours Otago University (co-supervised with Dr Steven Smith)  
Project: Single crystal olivine thermal cracking protocols
- 2018-2019 Samantha Allan, B.Sc. Honours Otago University (co-supervised with Dr Steven Smith)  
Project: Controls on distributed and localised deformation within serpentinite shear zones

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## Academic awards, distinctions, and grants

- 2023** National Earthquake Hazards Reduction Program (pending; 88635 USD)
- 2021** Wares Science Innovation Prospectors Fund, *McGill University*. (\$50k CAD, Co-PI Kirkpatrick)
- 2019** Sciences Divisional List of Exceptional Doctoral Theses, *University of Otago*.
- 2016** Outstanding Student Paper Award, Tectonophysics section, *AGU Fall Meeting 2016*.
- 2015** University of Otago Doctoral Scholarship, *University of Otago* (\$35k NZD p.a. for 3 yrs.)
- 2015** Dean's Honour List, *McGill University*.
- 2015** David Harrigan Memorial Prize, *McGill University*.
- 2014** Osisko Scholarship in Earth and Planetary Sciences, *McGill University*. (\$6k CAD)
- 2014** Dean's Multidisciplinary Undergraduate Research List, *McGill University*

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## Technical skills

### Numerical modelling

Numerical and analytical modelling of geological systems: heat flow and transfer, phase transformations, advective, diffusive fluid flow and rock deformation with Matlab, python and COMSOL Multiphysics.

### Electron microscopy techniques

Scanning electron microscopy techniques, including high resolution sample imaging, energy dispersive X-ray spectrometry (EDS), electron backscatter diffraction (EBSD) and Transmission Kikuchi Diffraction (TKD).

### Computer programming

Matlab, developing proficiency in Python.

### General computer software

Proficient in LaTeX, Word, Excel, Power Point, Adobe Illustrator and Photoshop.

### CAD design

Proficient in CAD Drawing using Autodesk Fusion 360 and CAD design for 3D printing.

### Circuit design

Proficient in basic circuit design and general electronics, including motor control, data capture using microcontrollers, high-temperature induction heating and resistive heating control.

### Basic machining

Base-level proficiency in machining including turning, milling and manual fabrication.

### Petrographic preparation

Preparation of mineral mounts and polished petrographic thin sections. Preparing fragile geological samples. Preparation of electron-transparent samples for transmission-type electron microscopy.

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## Professional activities

- 2024      **Organiser and convener for *Fluids in Subduction Zones* workshop**, Montréal, Quebec, Canada. Follow-up workshop to a joint New Zealand-Canada workshop on fluids and serpentinites in subductions zone held in Wellington, New Zealand in 2019. (*Upcoming, planned for 2024*).
- 2023      **Session Co-Convener** for AGU 2023 Fall meeting session: T002 - Bridging field and laboratory studies to unveil the mechanisms of unstable fault slip (*Upcoming*).
- 2018-present      **Reviewer for:** Geophysical Research Letters, Earth and Planetary Science Letters, Journal of Structural Geology, Journal of Geophysical Research: Solid Earth, Contributions to Mineralogy and Petrology, European Journal of Mineralogy, Lithos, Nature Geoscience, Nature Communications, Scientific Reports, National Science Foundation, Minerals.

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## Language skills

- French      Native speaker  
English      Native speaker