

Andrew J. Cross, Assistant Scientist

5/31/2024

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APPOINTMENTS

2019–present	Assistant Scientist , Woods Hole Oceanographic Institution, USA
2018–2019	Postdoctoral Researcher , University of Pennsylvania, USA
2015–2018	Postdoctoral Researcher , Washington University in St. Louis, USA
2013–2014	Visiting Researcher , Brown University, USA
2011–2015	Graduate Student , University of Otago, New Zealand

EDUCATION

2011–2015	Ph.D. , Geophysics with Geology University of Otago, New Zealand
2007–2011	M.E.Sci. (with First Class Honours) , Geophysics with Geology University of Liverpool, UK

SUBMITTED MANUSCRIPTS

* denotes student or postdoc under primary supervision

- [19] Skemer, P., Couvy, H., **Cross, A. J.**, Littleton, J. A. H. & Bollinger, C. (submitted to *Review of Scientific Instruments*). Large volume torsion (LVT) apparatuses for rock deformation at high pressure and temperature
- [18] **Cross, A. J.**, *Goddard, R. M., Kumamoto, K. M., Goldsby, D. L., Hansen, L. N., Chen, H., Hein, D., Thom, C. A. & Nehring, A. (submitted to *Nature Geoscience*). Synchrotron radiation reveals transient weakening during mineral phase transformations. <https://doi.org/10.31223/X52D86>
- [17] Seltzer, C., Llorens, M.-G. & **Cross, A. J.** (in review at *Geophysical Research Letters*). Meltwater orientations modify seismic anisotropy in temperate ice. [10.22541/essoar.170916121.10138707/v1](https://doi.org/10.22541/essoar.170916121.10138707/v1)
- [16] Hao, M., Codillo, E. A., Walter, M. J., **Cross, A. J.**, Hrubciak, R., Wagner, L., Thompson, A. R., Backhouse, N. & Pommier, A. (in review at *Journal of Geophysical Research: Solid Earth*). Electrical conductivity and sound velocities of talc under high pressure and high temperature conditions and application to the subducting Cocos plate
- [15] *Goddard, R. M., Kumamoto, K. M., Hansen, L. N., Wallis, D., **Cross, A. J.** & Thom, C. A. (in revision for *Journal of Geophysical Research: Solid Earth*). Validation of subgrain-size piezometry as a tool for measuring stress in polymineralic rocks. [10.22541/essoar.169755254.46171679/v1](https://doi.org/10.22541/essoar.169755254.46171679/v1)

PEER-REVIEWED PUBLICATIONS

- [14] Fan, S., Wheeler, J., Prior, D. J., Negrini, M., **Cross, A. J.**, Hager, T. F., Goldsby, D. L. & Wallis, D. (2022). Using misorientation and weighted Burgers vector statistics to understand intragranular boundary development and grain boundary formation at high temperatures. *Journal of Geophysical Research: Solid Earth*, 127(8), e2022JB024497, [10.1029/2022JB024497](https://doi.org/10.1029/2022JB024497)
- [13] Fan, S., **Cross, A. J.**, Prior, D. J., Goldsby, D. L., Hager, T. F., Negrini, M. & Qi, C. (2021). Crystallographic preferred orientation (CPO) development governs strain weakening in ice: insights from high-temperature deformation experiments. *Journal of Geophysical Research: Solid Earth*, 126(12), e2021JB023173, [10.1029/2021JB023173](https://doi.org/10.1029/2021JB023173)
- [12] Fan, S., Prior, D. J., Hager, T. F., **Cross, A. J.**, Goldsby, D. L. & Negrini, M. (2021). Kinking facilitates grain nucleation and modifies crystallographic preferred orientations during high-stress ice deformation. *Earth and Planetary Science Letters*, 572, 117136, [10.1016/j.epsl.2021.117136](https://doi.org/10.1016/j.epsl.2021.117136)
- [11] Fan, S., Prior, D. J., **Cross, A. J.**, Goldsby, D. L., Hager, T. F., Negrini, M. & Qi, C. (2021). Using grain boundary irregularity to quantify dynamic recrystallization in ice. *Acta Materialia*, 209, 116810, [10.1016/j.actamat.2021.116810](https://doi.org/10.1016/j.actamat.2021.116810)
- [10] **Cross, A. J.**, Goldsby, D. L., Hager, T. F. & Smith, I. B. (2020). The rheological behavior of CO₂ ice: application to glacial flow on Mars, *Geophysical Research Letters*, 47(22), e2020GL090431, [10.1029/2020GL090431](https://doi.org/10.1029/2020GL090431)
- [9] Fan, S., Hager, T. F., Prior, D. J., **Cross, A. J.**, Goldsby, D. L., Qi, C., Negrini, M. & Wheeler, J. (2020), Temperature and strain controls on ice deformation mechanisms: insights from the microstructures of samples deformed to progressively higher strains at -10, -20 and -30°C, *The Cryosphere*, 14, 3875–3905, [10.5194/tc-14-3875-2020](https://doi.org/10.5194/tc-14-3875-2020)
- [8] **Cross, A. J.**, Olree, E., Couvy, H. & Skemer, P. A. (2020). How does viscosity contrast influence phase mixing and strain localization? *Journal of Geophysical Research: Solid Earth*, 125(8), e2020JB020323, [10.1029/2020JB020323](https://doi.org/10.1029/2020JB020323)
- [7] **Cross, A. J.** & Skemer, P. (2019), Rates of dynamic recrystallization in geologic materials. *Journal of Geophysical Research: Solid Earth*, 124(2), 1324–1342, [10.1029/2018JB016201](https://doi.org/10.1029/2018JB016201)
- [6] **Cross, A. J.**, Hirth, G. & Prior, D. J. (2017), Effects of secondary phases on crystallographic preferred orientations in mylonites. *Geology*, 45(10), 955–958, [10.1130/G38936.1](https://doi.org/10.1130/G38936.1)
- [5] **Cross, A. J.**, Prior, D. J., Stipp, M. & Kidder, S. (2017), The recrystallized grain size piezometer for quartz: an EBSD-based calibration. *Geophysical Research Letters*, 44(13), 6667–6674, [10.1002/2017GL073836](https://doi.org/10.1002/2017GL073836)
- [4] **Cross, A. J.** & Skemer, P. (2017), Ultramytonite generation via phase mixing in high-strain experiments. *Journal of Geophysical Research: Solid Earth*, 122(3), 1744–1759, [10.1002/2016JB013801](https://doi.org/10.1002/2016JB013801)
- [3] **Cross, A. J.**, Ellis, S. & Prior, D. J. (2015), A phenomenological numerical approach for investigating grain size evolution in ductile deforming rocks. *Journal of Structural Geology*, 76, 22–34, [10.1016/j.jsg.2015.04.001](https://doi.org/10.1016/j.jsg.2015.04.001)
- [2] **Cross, A. J.**, Kidder, S. & Prior, D. J. (2015), Using microstructures and TitaniQ thermobarometry of quartz sheared around garnet porphyroclasts to evaluate microstructural evolution and constrain an Alpine Fault geotherm. *Journal of Structural Geology*, 75, 17–31, [10.1016/j.jsg.2015.02.012](https://doi.org/10.1016/j.jsg.2015.02.012)
- [1] Wheeler, J., **Cross, A.**, Drury, M., Hough, R. M., Mariani, E., Piazzolo, S. & Prior, D. J. (2011), Time-lapse misorientation maps for the analysis of electron backscatter diffraction data from evolving microstructures. *Scripta Materialia*, 65(7), 600–603, [10.1016/j.scriptamat.2011.06.035](https://doi.org/10.1016/j.scriptamat.2011.06.035)

RESEARCH FUNDING

- 01/2024–11/2024: WHOI Independent Research and Development (IR&D #30771), *Towards in-situ measurements of iceberg calving at the laboratory scale*. **PI: A. J. Cross.** \$82,244 total
- 08/2023–07/2026: NSF Antarctic Sciences (OPP-2317263), *Microstructural evolution during superplastic ice creep*. **PI: A. J. Cross.** \$494,195 total
- 04/2023–04/2024: Soft and Hybrid Nanotechnology Experiment Resource (SHyNE) SEED program, *Developing transmission Kikuchi diffraction (TKD) capabilities to "SHyNE" a light on nanotectonic processes*. **PI: A. J. Cross.** \$2,495 total
- 01/2023–11/2023: WHOI Independent Research and Development (IR&D #29649), *Nanoscale controls on oceanic tectonics: developing tools for high-resolution microanalyses of oceanic ultramylonites*. **PI: A. J. Cross.** \$73,677 total
- 12/2022–11/2025: NSF Marine Geology & Geophysics (OCE-2224725), *Strength of the oceanic lower crust: new experimental and microstructural constraints*. **PIs: A. J. Cross**, R. M. Goddard; co-I: V. Le Roux. \$641,214 total
- 01/2022–11/2022: WHOI Independent Research and Development (IR&D #28578), *Probing the grain-scale origins of tidal heating in ocean worlds: a pilot study*. **PI: A. J. Cross.** \$70,329 total
- 01/2021–11/2021: WHOI Independent Research and Development (IR&D #27518), *Development of a next-generation ice rheology apparatus*. **PI: A. J. Cross.** \$75,425 total
- 09/2020–08/2024: NSF Geophysics (EAR-2023128), *Collaborative research: transformation plasticity as a transient creep mechanism in Earth's crust and mantle*. **PI: A. J. Cross**; co-Is: D. L. Goldsby, L. N. Hansen. \$542,320 total (\$389,328 to WHOI)
- 07/2020–06/2022: NSF Instrumentation & Facilities (EAR-2003389), *Upgrade of an electron backscatter diffraction system to establish a center for state-of-the-art microstructural analyses*. **PI: A. J. Cross.** \$165,527 total
- 01/2020–06/2020: WHOI Independent Research and Development (IR&D #26476), *An experimental study of ice bicrystal deformation to illuminate the mechanisms of glacial flow*. **PI: A. J. Cross.** \$70,611 total

INVITED TALKS

- 2024 MIT, Department of Earth, Atmospheric, and Planetary Sciences geophysics seminar
- 2024 University of Wisconsin-Madison, Department of Geosciences seminar
- 2023 University of Minnesota Twin Cities, Earth and Environmental Sciences department seminar
- 2023 American Museum of Natural History; Earth and Planetary Sciences department seminar
- 2023 Chinese Academy of Sciences planetary science symposium (Session: *The physical properties of materials under planetary extreme conditions*)
- 2022 Northwestern University; Earth and Planetary Sciences department seminar
- 2022 University of Wyoming; Department of Geology & Geophysics Distinguished Lecturer Series
- 2021 AGU 2021 (Session T8: *Effects of heterogeneities on strain localization in the crust and mantle*)
- 2021 GSA 2021 (Session T6: *Hot rocks: high-temperature microstructures from mantle to surface*)
- 2021 Collaborative Organization for Rock Deformation (CORD research coordination network seminar)
- 2021 MIT Chemical Oceanography, Geology, Geochemistry, and Geobiology (COG3) seminar
- 2020 MIT Experimental Rock Deformation group seminar
- 2020 GSA 2020 (Session T27: *Approaches for Extracting Shear Zone History from the Ductile Rock Record: Probing Their Initiation, Evolution, and Reactivation*)
- 2020 MIT Glaciology group seminar

- 2018 Lamont-Doherty Earth Observatory; Seismology, Geology, and Tectonophysics Seminar
- 2018 Woods Hole Oceanographic Institution; Geology and Geophysics department seminar
- 2016 Gordon Research Conference on Rock Deformation
- 2016 Electron Backscatter Diffraction (EBSD) 2016 conference
- 2015 Missouri University of Science and Technology; Department of Geosciences and Geological and Petroleum Engineering Seminar
- 2014 Brown University; Rock Deformation Laboratory brown bag seminar

PROFESSIONAL SERVICE AND ACTIVITIES

- Chair, Physical Properties of Earth Materials (PPEM) AGU focus group, 2024–present
- Steering committee, In-Situ Studies of Rock Deformation (ISRD) research coordination network, 2022–present
- Lead organizer, Electron Backscatter Diffraction 2022 (EBSD 2022), virtual conference
- Co-lead organizer, Electron Backscatter Diffraction 2020 (EBSD 2020), Ann Arbor, MI (postponed due to COVID-19 pandemic)
- Panelist, “Important Issues Facing Early Career Researchers”, Gordon Research Seminar on Rock Deformation, 2018
- Organizing committee, Electron Backscatter Diffraction 2018 (EBSD 2018), Ann Arbor, MI
- AGU Fall Meeting session organizer (* denotes primary convener role):
 - *2024, Physical Properties of Earth Materials (PPEM): Deformation, Flow, and Failure
 - 2024, Solar System Ices and Hydrates: Mechanics, Thermodynamics, and Crystal Structures
 - 2021, Modeling of the Cryosphere: Glaciers and Ice Sheets
 - *2017, Recent Advances in Understanding Deformation Microstructures
 - 2017, The Microphysics of Plate Boundary Deformation
- Proposal reviewer:
 - National Science Foundation (NSF EAR–Geophysics, EAR–Tectonics, EAR–Postdoctoral Fellowships); European Research Council (ERC); Natural Environment Research Council (NERC); US Army Corps of Engineers’ Engineer Research and Development Center (USAC–ERDC)
- Manuscript reviewer:
 - Contributions to Mineralogy and Petrology; Earth and Planetary Science Letters; Geodinamica Acta; Geological Journal; Geology; Geophysical Journal International; Geophysical Research Letters; Geosphere; Icarus; Journal of Geophysical Research: Solid Earth; Journal of Glaciology; Journal of Metamorphic Petrology; Journal of Structural Geology; Nature Geoscience; Physics of the Earth and Planetary Interiors; Science Advances; Solid Earth; Tectonics, Tectonophysics

WHOI SERVICE AND ACTIVITIES

- Committee member, Mental health employee resource group, 2024–present
- Planning committee member, MIT-WHOI annual geophysics retreat, 2024
- Hiring committee (geochemistry), WHOI Geology & Geophysics department, 2024
- Ad hoc* reviewer, 2023 Innovative Technology proposals
- Ad hoc* reviewer, 2023 Technical Staff Training proposals
- Chief People Officer hiring committee, 2022
- Department safety committee, WHOI Geology & Geophysics department, 2021–present
- Joint Committee for Marine Geology & Geophysics, MIT-WHOI Joint Program, 2021–present
- Hiring committee (geophysics), WHOI Geology & Geophysics department, 2020
- Faculty member, MIT-WHOI Joint Program, 2020–present

SUPERVISION, MENTORING, AND EDUCATION

Postdoctoral Investigators:

Subhajt Ghosh; 2024–present

Rellie Goddard; 2021–2023

Graduate Students:

Caroline Needell; MIT-WHOI Joint Program, 2024–present (second generals advisor)

Maia Cohen; MIT-WHOI Joint Program, 2023–present

Rilee Thomas; MIT-WHOI Joint Program, 2022–present

Undergraduate Students:

Halley DeRacheal Wilkinson; WHOI Summer Student Fellowship, 2024

Namitha Kumar; WHOI Summer Student Fellowship, 2022 (co-supervised with V. Le Roux)

Examination and advisory committees (excluding own students):

Jae Deok Kim; MIT-WHOI Joint Program, thesis committee, 2023–present

Cassandra Seltzer; MIT, thesis committee, 2023–2024

Travis Hager; University of Pennsylvania, thesis committee, 2023–2024

Zach Molitor; MIT, thesis committee, 2023–2024

Joanna Millstein; MIT-WHOI Joint Program, thesis examination (chair), 2023

Jonas Kaare-Rasmussen; MIT-WHOI Joint Program, general examination (chair), 2023

Jae Deok Kim; MIT-WHOI Joint Program, general examination (chair), 2023

AWARDS AND HONORS

2023	2nd place, Oxford Instruments NanoAnalysis Scientific Paper Award (Fan et al., 2022)
2021	Top 10% of papers downloaded from JGR Solid Earth (Fan, Cross, et al., 2021)
2015	University of Otago Exceptional Thesis award
2013	University of Otago international conference travel grant (\$2,000 NZD)
2011–2014	University of Otago doctoral scholarship (\$75,000 NZD)
2009	University of Liverpool Morris Ranger Scholarship (£75 GBP)
2008–2011	University of Liverpool Attainment Scholarship (£4,500 GBP)

CONFERENCE ABSTRACTS (PAST THREE YEARS ONLY)

* denotes student or postdoc under primary supervision; † denotes invited presentation

*Thomas, R. E., **Cross, A. J.**, Prior, D. J., Fleming, M. & Palmer, M. (2024). Can superplastic creep produce a crystallographic preferred orientation in ice? *Gordon Research Conference on Rock Deformation*

Peč, M., Ghaffari, H.-O., Mittal, T., Mok, U., Chang, H., Evans, B., **Cross, A. J.** & Bernabé, Y. (2024). Microscopic defect dynamics during a brittle-to-ductile transition. *American Rock Mechanics Association (ARMA 2024)*

Molitor, Z., Jagoutz, O., **Cross, A. J.**, Cruz-Uribe, A. & Moser, A. (2024). Constraining the 3D geometry of conjugate orogenic strike-slip shear zones in the New England Appalachians. *GSA Northeastern Section Annual Meeting*

Nehring, A., Hansen, L. N., *Goddard, R. M., **Cross, A. J.**, Seyler, C., Hein, D. & Breithaupt, T. (2023). Developing a constitutive model for the brittle-ductile transitions zone of Earth's mantle using the deformation-DIA apparatus. *AGU Fall Meeting*

Hao, M., Codillo, E., Pommier, A., Walter, M. J., Hrubciak, R., **Cross, A. J.** & Thomson, A. R. (2023). Electrical conductivity and sound velocities of talc under high pressure and high temperature conditions. *AGU Fall Meeting*

- Skemer, P., Billings, K., Couvy, H., **Cross, A. J.** & Ela, E. (2023). Shear localization in planetary lithospheres: insight from high-strain deformation experiments. *AGU Fall Meeting*
- Prior, D. J., Qi, C., Craw, L., **Cross, A. J.**, Fan, S., Goldsby, D. L., Hager, T. & Wang, Q. (2023). What controls crystallographic preferred orientations (fabrics) of deformed ice: constraints from laboratory experiments. *15th International Conference on Physics and Chemistry of Ice*
- †*Goddard, R. M., **Cross, A. J.**, Breithaupt, T., Wallis, D., Le Roux, V., Goldsby, D., Kumamoto, K., Hansen, L., Hein, D., Nehring, A. & Seyler, C. (2023). There and back again: using microscopy to unlock the secrets of the Earth's Interior. *3rd Annual Women in Microscopy Conference*
- †*Goddard, R. M., **Cross, A. J.**, Wallis, D., Goldsby, D. L., Le Roux, V., Kumamoto, K. M., Hansen, L. N. & Hein, D. (2022). Transient weakening and microstructures associated with the quartz-coesite phase transition. *AGU Fall Meeting*
- Hein, D., Hansen, L. N., **Cross, A. J.**, *Goddard, R. M., Kumamoto, K. M., Thom, C., Chen, H., Nehring, A., Seyler, C. & Goldsby, D. L. (2022). Nonlinear viscoelasticity and transient creep of the upper mantle in response to large stress changes. *AGU Fall Meeting*
- *Kumar, N., **Cross, A. J.**, Le Roux, V. & *Goddard, R. M. (2022). Determining the strength of the oceanic lower crust: a geochemical, microstructural, and rheological investigation of ODP hole 735B, Southwest Indian Ridge. *AGU Fall Meeting*
- *Cohen, M., Ghaffari, H.-O., **Cross, A.** & Peč, M. (2022). From Mylonites to Cataclasites: an experimental study of a brittle-to-ductile transition for quartz-feldspar aggregates. *Gordon Research Conference on Rock Deformation*
- †*Goddard, R. M., **Cross, A. J.**, Kumamoto, K. M., Bidgood, A. M., Parsons, A. J., Lloyd, G. E., Waters, D. J. & Hansen, L. N. (2022). Microstructural signatures of quartz-after-coesite: new insights from high-pressure experiments. *Gordon Research Conference on Rock Deformation*
- Hein, D., Hansen, L. N., Kumamoto, K. M., Thom, C., *Goddard, R. M., **Cross, A. J.**, Chen, H. & Goldsby, D. L. (2022). Microstructural evolution in olivine aggregates undergoing high-stress forced oscillation. *Gordon Research Conference on Rock Deformation*
- *Thomas, R. E., Prior, D. J., Kerr, G., Goldsby, D. L., **Cross, A. J.**, Hager, T. F., Negrini, M. & Fan, S. (2022). Water chemistry and ice mechanics. *Gordon Research Conference on Rock Deformation*
- Cross, A. J.**, *Goddard, R. M., Kumamoto, K. M., Goldsby, D. L., Chen, H., Hansen, L., Thom, C. A. & Hein, D. (2022). There and Back Again: Transient weakening across the quartz-coesite phase transition revealed in synchrotron D-DIA experiments. *Gordon Research Conference on Rock Deformation*
- *Cohen, M., Ghaffari, H.-O., **Cross, A.** & Peč, M. (2022). From Mylonites to Cataclasites: an experimental study of the brittle-to-ductile transition of quartz-feldspar aggregates. *GSA Penrose Conference: The Geological Fingerprints of Slow Earthquakes*
- *Goddard, R. M., **Cross, A. J.**, Kumamoto, K. M., Bidgood, A. M., Parsons, A. J., Lloyd, G. E. & Waters, D. J. (2022). Microstructural signatures of the coesite-quartz transformation: new insights from EBSD analysis. *Electron Backscatter Diffraction 2022 (EBSD 2022)*
- *Goddard, R. M., Wallis, D., Hansen, L., Kumamoto, K. M., Dyck, B., Ohl, M., **Cross, A. J.** & Martel, E. (2022). Tools for unpicking complex stress histories in continental and oceanic shear zones. *Tectonic Studies Group Annual Meeting*
- Hager, T. F., Qi, C., Fan, S., Prior, D. J., Thomas, R., **Cross, A. J.** & Goldsby, D. L. (2021). Grain size sensitive flow of ice in the putative dislocation creep regime. *AGU Fall Meeting*
- Fan, S., Wheeler, J., Prior, D. J., **Cross, A. J.**, Hager, T. F. & Goldsby, D. L. (2021). Mixed dislocations control the development of intragranular boundaries during mineral deformation: a case study on the subgrain structure of experimentally deformed ice. *AGU Fall Meeting*

- Cross, A. J.**, Kumamoto, K. M., *Goddard, R. M., Chen, H., Thom, C. A., Goldsby, D. L. & Hansen, L. (2021). There and back again: transformation plasticity across the quartz-coesite and fayalite-ringwoodite phase transitions revealed in synchrotron D-DIA experiments. *AGU Fall Meeting*
- †**Cross, A. J.**, Skemer, P., Couvy, H. & Olree, E. (2021). Strain localization in polymineralic rocks: the role of phase mixing. *AGU Fall Meeting*
- Thomas, R., Prior, D., Kerr, G., Goldsby, D., **Cross, A.**, Hager, T., Negrini, M. & Fan, S. (2021). Water chemistry and ice mechanics. *Proceedings of the New Zealand Antarctic Science Conference: Connecting through change*
- Fan, S., Prior, D. J., Goldsby, D. L., Hager, T. F., **Cross, A. J.** & Negrini, M. (2021). The control of crystallographic preferred orientation (CPO) development and grain size reduction on ice mechanical weakening. *Proceedings of the New Zealand Antarctic Science Conference: Connecting through change*
- †**Cross, A. J.**, Fan, S., Prior, D. J., Skemer, P., Goldsby, D. L., Hager, T. F., Kidder, S., Negrini, M., Qi, C. & Stipp, M. (2021). Tracking dynamic recrystallization across a broad range of homologous temperatures and stresses. *GSA Annual Meeting*