Megan Holycross

holycross@cornell.edu

Current position: Assistant Professor, Cornell University

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EXPERIENCE

Assistant Professor — July 1, 2020+
Earth and Atmospheric Sciences, Cornell University

National Science Foundation Postdoctoral Fellow — 2019- 2020
Geology & Geophysics, Yale University
Mineral Sciences, National Museum of Natural History

Smithsonian Institution Peter Buck Postdoctoral Fellow — 2017- 2019
Mineral Sciences, National Museum of Natural History

EDUCATION

Doctor of Philosophy in Geology — August 2017
Rensselaer Polytechnic Institute, Troy, NY

Bachelor of Science in Environmental Geoscience, Honors — May 2012
Michigan State University, East Lansing, MI

APPOINTMENTS

Faculty Fellow — 2021+
Carl Sagan Institute, Cornell University

Faculty Fellow — 2021+
Atkinson Center for Sustainability, Cornell University

Research Associate — 2020+
Mineral Sciences, National Museum of Natural History

Visiting Assistant Professor — 2019-2020
Earth and Atmospheric Sciences, Cornell University

Graduate Research/Teaching Assistant — 2012-2017
Earth and Environmental Sciences, Rensselaer Polytechnic Institute

Research Intern — 2015
Glass Science, Corning Incorporated

NSF-REU Intern — 2011
Earth and Planetary Sciences, American Museum of Natural History

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Professorial Research Assistant 2008-2012
Earth and Environmental Sciences, Michigan State University

PUBLICATIONS

Submitted

Medin S., Schmitz A.M., Pian B., Kuunemuebari M., Reid M.C., **Holycross M.,** Gazel E., Wu M., Barstow B. Genomic characterization of rare earth binding by *Shewanella oneidensis*. *Submitted to Nature Communications Feb. 2023*

In press

Holycross M., Cottrell E. (2023) Garnet crystallization does not drive oxidation at arcs. *Science*

Published

Fortin M., Gazel E., Kaltenegger L., **Holycross M.E.** (2022) Volcanic exoplanet surfaces. *Monthly Notices of the Royal Astronomical Society* 516: 4569-4575

Holycross M., Cottrell E. (2022) Experimental quantification of vanadium partitioning between eclogitic minerals (garnet, clinopyroxene, rutile) and silicate melt as a function of temperature and oxygen fugacity. *Contributions to Mineralogy and Petrology* 177: 1-23

Ague J.J., Tassara S., **Holycross M**., Li J., Cottrell E., Schwarzenbach E., Fassoulas C.G., John T. (2022) Oxidation of slab-derived fluids by subducted metasedimentary rocks. *Nature Geoscience* 15: 320-326

Newcombe, M.E., Plank, T.A., Zhang, Y., **Holycross, M**., Barth, A., Lloyd, A.S., Ferguson, D.J., Hauri, E. (2020) Magma pressure-temperature-time paths during mafic explosive eruptions. *Frontiers in Earth Science* 8

Holycross M., Cottrell E. (2020) Partitioning of V and 19 other trace elements between rutile and silicate melt as function of oxygen fugacity and melt composition: implications for subduction zones. *American Mineralogist* 105: 244-254

Osborne Z., Thomas J.B., Nachlas W., Baldwin S., **Holycross M.E.**, Spear F., Watson E.B. (2019) An experimentally calibrated thermobarometric solubility model for titanium in coesite (TitaniC). *Contributions to Mineralogy and Petrology* 174: 34

Holycross M.E., Watson E.B. (2018) Trace element diffusion and kinetic fractionation in wet rhyolitic melt. *Geochimica et Cosmochimica Acta* 232: 14-29

Holycross M.E., Watson E.B., Richter F., Villeneuve J. (2018) Diffusive fractionation of Li in wet, highly silicic melts, *Geochemical Perspectives Letters* 6: 39-42

Holycross M.E., Watson E.B. (2016) Diffusive fractionation of trace elements in basaltic melt, *Contributions to Mineralogy and Petrology* 171: 1-15

Watson E.B., Cherniak D.J., **Holycross M.E.** (2015) Diffusion of phosphorus in olivine and molten basalt, *American Mineralogist* 100: 2053-2065

Brandt D.S., Csonka J., **Holycross M**., McCoy V., Seitz M. (2012) In search of the Arthophycus parallelus tracemaker, *Palaios* 27: 116-121

FUNDING

Current

Cornell Atkinson Center for Sustainability, Summer Mentored Research Grant. "Quantifying the formation of lithium resources for the sustainable energy transition". **PI, $26,209**, 2023-2024

National Science Foundation, Division of Earth Sciences, Petrology and Geochemistry. "*CAREER: Tracing sulfur in subducting slabs with apatite oxybarometry*". **PI, $819,493**, 2023-2028

President's Council of Cornell Women and Affinito Stewart Grants Program. "Probing the primary water contents of martian magmas with lithium". **PI, $9,515,** 2022-2023

National Science Foundation, Division of Earth Sciences, Petrology and Geochemistry "*Calibration of the lithium-in-feldspar diffusion chronometer for timing magmatic events"* **PI, $405,922**, 2021-2024

National Science Foundation, Division of Earth Sciences Postdoctoral Fellowship "*A new oxybarometer to quantify spatial and temporal scales of redox variation in subducting slabs*" **PI, $174,000**, 2019-2020 (in no-cost extension)

Previous

U.S. Department of Energy, Advanced Research Projects Agency- Energy "*Engineered microorganisms for enhanced rare earth element bio-mining and separations*", Co-I, $1M total, **subcontract $62,850**, 2021-2023

Advanced Photon Source General User Proposal "*Probing Earth's deep oxygen cycle with vanadium: a new fO_2 proxy for high pressure metamorphic rocks*, **PI, $180,000 in-kind value** @ Department of Energy, 2018-2020

Geological Society of America Student Research Grant "*Diffusion of titanium in quartzite grain boundaries*", **PI, $1,375**, 2016

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MENTORING

Direct graduate student advisees

Odalys Callejas (PhD, Geological Sciences)	2022+
Brendan Garvey (PhD, Geological Sciences)	2022+
Megan Fairchild (MS, Geological Sciences)	2021- 2023 (expected)

- Cornell Sloan/Colman Fellow 2021-2023

Graduate student committees (other than direct advisees)

Special Committee for Andrea Gomez-Patron (PhD, Geological Sciences)	2022+
Special committee for Charlotte Devitre (PhD, Geological Sciences, now postdoctoral associate at Berkeley)	2020+
Special committee for Elizabeth Eiden (PhD, Geological Sciences)	2021+
Special committee for Kyle Dayton (PhD, Geological Sciences)	2020+
Temporary committee for River Himmer (PhD, Geological Sciences)	2022+
Temporary committee for Jiawei Wang (PhD, Geological Sciences)	2022+
Temporary committee for Peiyu Wu (PhD, Geological Sciences)	2020+

Senior personnel

Benoit Welsch, Senior Research Associate	2021-2022

Undergraduate research advisees

Griheydi Garcia, Manhattan College (CorGGLE student)	2022
Rilla McKeegan, Amherst College (now PhD student at Princeton)	2018

HONORS, AWARDS and FELLOWHIPS

CAREER Award, National Science Foundation	2023-2028
EAR Postdoctoral Fellowship, National Science Foundation	2019-2020
Peter Buck Postdoctoral Fellowship, Smithsonian Institution	2017-2019
Founder's Award of Excellence, Rensselaer Polytechnic Institute	2014
James Neal Research Scholarship, Michigan State University	2011
Honors College Scholarship, Michigan State University	2008-2012

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CLASSES TAUGHT

At Cornell University

How to Build a Habitable Planet (EAS 1180) F21, SP22, SP23

Course covers introductory geochemistry from a planetary perspective for non-EAS majors. Wide range of students enrolled from freshman to seniors with varying science background.
Fall 2021 enrollment: 16 students
Spring 2022 enrollment: 122 students
Spring 2023 enrollment: 148 students

Geochemistry (EAS 4550) SP21, F22

Course covers high level geochemistry, thermodynamics and kinetics and is aimed at juniors, senior and grad students in the major.
Fall 2022 enrollment: 15 students

As teaching assistant at RPI

Introduction to Geochemistry	2014
Field Methods	2012, 2013
Structural Geology, Geology II: Earth's Surface	2013
Earth Materials	2012

PRESENTATIONS

Invited seminars and conference abstracts

2023: keynote speaker at ExTerra 2023 workshop (Lyon, France)

2022: Rochester University; Goldschmidt Conference (Hawaii); Pennsylvania State University

2021: CHESS 2030 Workshop: X-LEAP; Syracuse University; University of Michigan

2020: Goethe University Frankfurt; Michigan State University; Lamont-Doherty Earth Observatory; University of Washington; Yale University (canceled due to COVID-19)

2019: Cornell University; Princeton University; University of Maryland

2018: Amherst College; Geological Society of Washington, D.C.; American Museum of Natural History

2017: Rice University; National Museum of Natural History

*Selected conference abstracts; *student presentation (direct advisees only)*

Holycross M, Cottrell E (2023) "The partitioning of iron species between garnet and melt in subduction zones" Goldschmidt Conference, Lyon, France.

Balta JB, *Garcia G**, **Holycross ME** (2023) "Assessing the accuracy of thermodynamic modeling software for martian magmatism" Lunar and Planetary Science Conference, Houston TX

Holycross M, Cottrell E (2022) "The partitioning of ferric and ferrous iron between garnet and melt in subduction zones". AGU Fall Meeting, Chicago IL

Holycross M, Cottrell E (2022) "Vanadium partitioning during eclogite melting and arc cumulate fractionation in subduction zones". Goldschmidt Conference, Honolulu, HI.

Cottrell E, Lanzirotti A, **Holycross M**, Brounce M, Muth M (2022) "Can I have fewer photons please? Analytical challenges due to radiation-induced redox changes in silicate glasses". Advanced Photon Source User Meeting, virtual.

Holycross M, Cottrell E (2021) "Experimental quantification of vanadium partitioning between eclogitic minerals (garnet, clinopyroxene, rutile) and silicate melt as a function of temperature and oxygen fugacity", AGU Fall Meeting, New Orleans LA

Cottrell E, **Holycross M**., Langmuir C (2020) "Are slab contributions to the wedge oxidized?" Goldschmidt Virtual

Holycross M, Cottrell E (2019) "A vanadium-based redox proxy for eclogites", Goldschmidt, Barcelona, Spain

Holycross M., Cottrell E. (2018) "Rutile controls on vanadium during eclogite partial melting", AGU Fall Meeting, Washington DC

*McKeegan R.**, **Holycross M.**, Cottrell E. (2018) "Probing the Earth's deep oxygen cycle with vanadium: the temperature dependence of partitioning between rutile and silicate melt", GSA Annual Meeting, Indianapolis IN

Holycross M., Watson E.B. (2018) "Li diffusion in plagioclase: a geospeedometer for rapid heating events", GSA Annual Meeting, Indianapolis IN

Holycross M., Cottrell E. (2018) "A new oxybarometer for rutile", Goldschmidt conference, Boston MA

Holycross M.E., Watson E.B. (2017) "Complex diffusion mechanism for Li in feldspar: re-thinking Li-in-plag geospeedometry", AGU Fall Meeting, New Orleans, LA

Holycross M.E., Watson E.B., Richter F., Villeneuve J. (2017) "Diffusive fractionation of Li in wet, highly silicic melts", GSA Annual Meeting, Seattle WA

Holycross M.E., Watson E.B. (2016) "Diffusive fractionation of 25 trace elements in basaltic and rhyolitic melt", AGU Fall Meeting, San Francisco, CA

Holycross M.E., Watson E.B. (2016) "The compensation law for trace element diffusion in silicate melts" Research Nucleation Workshop, joint initiative between Rensselaer and Corning Inc., Troy, NY

Holycross M.E., Watson E.B. (2015) "Trace element diffusion in basaltic melt", AGU Fall Meeting, San Francisco, CA

Holycross M., Watson E.B. (2014) "Trace element diffusion in hydrous rhyolitic melt" Goldschmidt conference, Sacramento, CA

SELECTED SERVICE and OUTREACH

Departmental service

Faculty Search in "Critical Elements and Minerals"
Committee co-chair 2023
Committee member 2022

EAS Student Awards Committee 2020+

First year advisor to students in 17 students in ENGRG 1050 2022+

EAS seminar series co-organizer 2021-2022

Graduate Admissions Committee, Field of Geological Sciences 2020+

Professional service

Panel Review, National Science Foundation EAR Division 2022

AGU Canvassing Committee, VGP Section 2022+

AGU Outstanding Student Poster Award Committee, VGP Section 2019-2022

Session convener, AGU Fall Meeting 2019, 2021, 2022

Meeting Secretary 2019
Geological Society of Washington, D.C.

Reviewer for *American Mineralogist*; *Chemical Geology; Journal of Geophysical Research; Contributions to Mineralogy and Petrology; Earth and Planetary Science Letters; Geology, Nature…* 2018+

Community engagement

Speaker, Women in STEM Networking Panel 2023
Cornell Society of Women Engineers, Graduate Chapter

Science Programming Tour Host, 2022
Cornell Pre-Collegiate Summer Scholars Program

Cornell EAS Unlearning Racism in the Geosciences Pod Member 2021+

Invited speaker, Women in STEM+ Club 2021
Stanford University Online High School

SERC Early Career Geoscience Faculty Workshop attendee 2020

"*Expert Is In*" Event Host 2019, 2020
National Museum of Natural History, Washington, DC

Volunteer science presenter 2017
Troy High Earth Day Celebration, Troy, NY

Science instructor 2016
Hoosick Falls Schools Career Day, Troy, NY

Earth and Environmental Sciences representative 2013-2015
RPI School of Science Graduate Student Council

LABORATORY EXPERIENCE/LEADERSHIP

Co-I of Cornell University Mass Spectrometry (CMaS) Facility 2020+
Co-mentor to lab technician Lyndsey Fisher
Instrumentation

Agilent 8900 QQQ- MS/MS

ESIL 193 nm high energy laser

PI of Experimental Geochemistry Lab (Cornell)
Major instrumentation

Two 150-ton Rockland Research Corporation end-loaded piston cylinders
T= 0- 2200 °C; *P*= 0.5 – 4 GPa

Two Deltech controlled-atmosphere vertical tube furnaces
T= 0- 1700 °C; *P*= 1 atm; *gases:* CO-CO_2, capable of reaching fO_2s over 11 log unit range

Sentrotech horizontal tube furnace
T= 0- 1700 °C; *P*= 1 atm; capable for gas-soaking or vacuum conditions