

CATHLEEN L. DOHERTY (DALE)

Columbia Science Fellow

Lecturer in Discipline in the Department of Earth
& Environmental Sciences at Columbia University

Lamont-Doherty Earth Observatory
of Columbia University
61 Route 9W, Palisades, NY 10964
Ph: 908-304-3447, Fax 845-365-8155
email: cdale@ldeo.columbia.edu
<http://www.ldeo.columbia.edu/user/cdale>

EDUCATION

Columbia University, New York City, New York

Ph.D. in Earth & Environmental Sciences (Geochemistry), June 2016

M.Phil. in Earth & Environmental Sciences, February 2015

Montclair State University, Montclair, New Jersey

M.S. in Geoscience, May 2009

B.S. in Biology (Honors), May 2007

PROFESSIONAL EXPERIENCE

LABORATORY AND RESEARCH APPOINTMENTS

Postdoctoral Research Scientist, 2016-Present, Columbia University, New York, NY

Research Projects: Geochemical evolution of the lithospheric mantle; Analysis of low abundance trace elements and in abyssal peridotites

Mentor: Cornelia Class; Collaborators: Peter Kelemen, Steven Goldstein, Al Hofmann

Radiation Safety Manager, 2014-Present, Ultraclean Laboratory, LDEO

Laboratory Manager, 2009-2016, Summer 2017, Isotope Geochemistry Laboratory, LDEO

Graduate Research Assistant, 2009-2016, Columbia University, New York, NY

NSF Grant 10-543: Dynamic and geochemical evolution of the lithospheric mantle beneath the Western Ross Sea Area, Antarctica (PI: C. Class, Co-PI: S. Goldstein)

Graduate Student, 2007-2009, Montclair State University, Montclair, NJ

NSF Office of Polar Research Grant 0348274: CAREER: Tracing Antarctic Sediment Transport Pathways and Antarctic Ice Sheet Stability Using Iron-titanium Oxide Magnetic and Chemical fingerprints (PI: S. Brachfeld)

TEACHING APPOINTMENTS

Frontiers of Science Fellow/Lecturer in Discipline, 2016-Present, Columbia University

Research Mentor, Secondary School Field Research Program (SSFRP), Summer 2017,

Lamont-Doherty Earth Observatory, Columbia University

NSF Graduate STEM Fellow, 2012-2013, NSF GK-12, Columbia University

Placement: Young Women's Leadership School of East Harlem (Gr.9-12), NY

Teaching Assistant, 2012, Isotope Geology I, Columbia University

Teaching Assistant, 2011-2012, Earth Resources & Sustainable Develop., Columbia U.

Teaching Assistant, 2010, Modern Analytical Methods in Geochemistry, Columbia U.

NSF Graduate STEM Fellow, 2007-2009, Montclair State University

Placements: Franklin School, Kearny, NJ; Washington School, Kearny, NJ (Gr.8)

ANALYTICAL AND INSTRUMENTAL EXPERIENCE

- Established analytical procedure for the extraction and measurement of Re-Os isotopes in rocks and sediments, and responsible for training others in this procedure
- Method development for analysis of Re-Os isotopes by both TIMS and ICP-MS
- Method development for the analyses of low abundance trace elements in rocks, sediments, and water
- Method development for procedural blank reduction in low abundance elements
- Isotope dilution, rock dissolution, and column chromatography
- Low concentration ultra-clean lab chemistry
- Acid distillation and titration
- Analysis of major elements, trace elements, and Sr-Nd-Hf-Pb-Os isotope systems, and the ability to set up these methods and train others in new laboratories
- Preparation of elemental standards/reference materials and solutions
- Thermo-Fisher Triton Thermal Ionization Mass Spectrometer (TIMS)
- Thermo Scientific Neptune *Plus* Multi-Collector Inductively Coupled Plasma Mass Spectrometer
- Nu AttoM High Resolution ICP-MS
- VG PlasmaQuad Excell Inductively Coupled Mass Spectrometer Multi-Collector
- New Wave UP 193 FX Excimer Laser Ablation System (LA-ICP-MS)
- Agilent Technologies 700 Inductively Coupled Optical Emission Spectrometer (ICP-OES)
- Cameca SX-100 electron microprobe (EMP)
- Axiom Inductively Coupled Mass Spectrometer Multi-Collector (ICP-MS-MC)
- Zeiss Axioskop Petrographic Microscope and AxioVision camera software
- SELFRAG high voltage pulsed power fragmentation of rocks
- Preparation of rock powders and magnetic separation of minerals
- Set up and use of Oxy/Propane torch

MENTORED STUDENTS

Secondary School Field Research Program (SSFRP), Summer 2017

I served as a research mentor to a team of 6 high school students and 2 college students conducting a 6-week intensive research project.

Project title: Heavy metal distribution in water samples from Piermont Marsh, NY

Young Women's Leadership School, East Harlem, NY 2012-2014

I served as a research mentor to a team of high school students conducting wetlands science research.

Project title: Modern and past carbon dynamics in Piermont Marsh, Hudson River Estuary

Michele Mabson, Howard University, Lamont Summer Intern Program (REU), 2010

Project title: Variations in the Nd isotope composition of Late Miocene to Early Pliocene glacially derived sediments in Prydz Bay, East Antarctica

Joel Gombiner, Columbia University, Lamont Summer Intern Program (REU), 2010

Project title: Spatial and temporal variation of last ice age mega-floods in the Pacific Northwest: Sediment provenance using single-aliquot K/Ar dating

PROFESSIONAL DEVELOPMENT

- GeoPRISMS Theoretical and Experimental Institute (TEI) for the Rift Initiation and Evolution (RIE) initiative, February 8-10, 2017, Albuquerque, NM
- Reflective Teaching Seminar, Columbia Center for Teaching and Learning (weekly Sept-Dec 2016)
- Innovative Summer Teaching Institute: Preparing Doctoral Students for 21st Century Teaching, June 15-18, 2015, Graduate School of Arts & Sciences Teaching Center, Columbia University (Certificate of completion June 30, 2015)
- Cooperative Institute for Dynamic Earth Research (CIDER) 2012 Tutorial Program and Workshop: "Deep Time: How did early Earth become our modern world?" July 15, 2012-August 10, 2012, Kavli Institute for Theoretical Physics, U.C. Santa Barbara
- Communicating Science and Mathematics: GK-12 Teacher Professional Development Workshops, May 21, 2008, New Jersey Institute of Technology
- New Jersey Science Convention: Science Educator professional development, October 10, 2007, Somerset, NJ
- Connected Math Project lead by Nancy Schultz, PRISM, Montclair State University, GK-12 Summer Institute, 2007
- Limited English Proficiency lead by Anna Mazzaro, PRISM, Montclair State University, GK-12 Summer Institute, 2007
- Specific Learning Disabilities simulation lead Fran Greb, Montclair State University School of Education, GK-12 Summer Institute, 2007

PREVIOUS EMPLOYMENT

Research Staff Assistant, 2009-2010, Geochemistry Division, Lamont-Doherty Earth Observatory, Columbia University.

Laboratory Technician, 2007-2009, Marine Geology & Geochemistry, Montclair State University, Montclair, NJ

FIELD EXPERIENCE

- Semail Ophiolite, Oman field trip, 2013, Petrology and high/low temperature alteration of ophiolite sequence
- Wyoming student organized field trip, 2011, Wyoming regional geology, Yellowstone, and the Stillwater complex
- Antarctica Peninsula, 2006, Marine Geology and Geophysics field season aboard *Nathaniel B. Palmer*
- St. John, USVI, 2006, Marine Biology and Ecology field work investigating mangrove and seagrass biodiversity

FUNDING

- Columbia Climate Center NSF Grant, 2016 (Co-PI), “Provenance of the Marlboro Clay, a unique formation deposited during the PETM”, Co-PIs: M. Cai, M. Zimmer, W. Broecker, S. Goldstein (\$10,000)
- Chevron Student Initiative Fund, 2014, Funded Research Proposal: Creation and calibration of Rb-Sr, Sm-Nd, Lu-Hf isotopic spike solution (\$2044)
- Chevron Student Initiative Fund, 2011, Funded Research Proposal: Re-Os Extraction Procedure (\$950)

AWARDS AND HONORS

- Goldschmidt Student Travel Grant, Geochemical Society & NASA, 2015
- Chrysalis Scholarship Recipient, Association for Women Geoscientists, 2015
- Teaching Assistant of the Year, 2013, Dept. of Earth & Environmental Sciences, Columbia University
- Outstanding Student Paper Award in Tectonophysics Section, 2012, AGU Fall Meeting
- NSF Graduate STEM Fellow, NSF GK-12, 2012-2013, Columbia University
- Outstanding Graduate Student in Geoscience Award, 2009, Montclair State University
- NSF Graduate STEM Fellow, NSF GK-12, 2007-2009, Montclair State University
- Conservation Scholarship recipient, 2007, The Greater Pascack Valley Woman’s Club
- Lechner Scholarship recipient, 2006, The Association of NJ Environmental Commissions

OUTREACH AND SYNERGISTIC ACTIVITIES

- Field Trip Guide, 2015: Fieldstone Middle School trip to American Museum of Natural History
- First Lego League, 2014-17: Assistant Coach, Fieldstone Middle School, Montvale, NJ
- Mentor, 2014-2015: Young Women’s Leadership School of East Harlem (Gr. 9-12), NY
- Women in Science at Columbia University, 2012-2014: Department of Earth and Environmental Sciences Representative
- Lamont-Doherty Open House 2014: Volcanic eruptions demonstration
- AGU Meeting Session Convener, Fall 2013: Characterizing Antarctic Geology & Tectonics (T12A)
- Field Trip Guide, 2013: Fieldstone Middle School trip to American Museum of Natural History
- Girls Science Day at Columbia University Demonstration 2013: Volcanic Eruptions
- A Day in the Life of the Hudson River, 2013, Site leader in water sampling studies
- Research Mentor, 2012-13, Young Women’s Leadership School of East Harlem, NY
- Lamont-Doherty Open House 2012: Volcanic eruptions demonstration, mass-spectrometer laboratory tour
- Girls Science Day at Columbia University Demonstration 2011: Volcanic Eruptions
- Lamont-Doherty Earth Observatory Open House 2010-11: Volcanic eruptions demonstration
- Research Experience for Undergraduates (REU) 2010: 2 students, Lamont-Doherty Summer Intern Program, Columbia University
- Math & Science Day Workshop Leader, 2009: Analyzing Antarctic Ice Cores, Montclair State U.
- Science Fair Judge, 2009: Benjamin Franklin Middle School, Teaneck, NJ

- Math & Science Day Workshop Leader, 2008: Antarctic Marine Sediments, Montclair State U.
- New Jersey Community Water Watch, Chapter President, 2003-2007, Montclair State U.

PROFESSIONAL AFFILIATIONS

- Geochemical Society
- Association for Women Geoscientists
- American Geophysical Union
- Geological Society of America
- Gamma Theta Upsilon Geographical Honor Society

SEMINARS/INVITED TALKS

- “Beneath the Ice: Antarctica’s history recorded in mantle xenoliths”, Science Spotlight Public Lecture Series, Columbia University, December 1, 2016 (**Invited Talk**)
- “Geochemical Evolution of the Lithospheric Mantle in the West Antarctic Rift System”, Department of Earth & Planetary Sciences Seminar, American Museum of Natural History, NY, October 2015 (**Invited Talk**)
- “Lithospheric mantle evolution of the Western Ross Sea Area in the West Antarctic Rift System”. Research Experience for Undergraduates (REU) Summer Intern Lecture Series, Lamont-Doherty Earth Observatory, Columbia University, July 16, 2015 (**Invited Talk**)
- “Geochemical Evolution of the Lithospheric Mantle in the West Antarctic Rift System”, Department of Earth & Environmental Science, Sustainability Seminar Series, Montclair State University, NJ, April 5, 2015 (**Invited Talk**)
- “Melt depletion and geochemical evolution of the lithospheric mantle in the West Antarctic Rift System”, Lamont-Doherty Earth Observatory, Columbia University, Geochemistry Seminar Series, October 2014
- “Understanding the behavior of the mantle in the West Antarctic Rift System using Re-Os isotopes”. Secondary School Field Research Program-Piermont Marsh, August 2, 2013 (**Invited Talk**)
- “Re-Os systematics of the lithospheric mantle beneath the Western Ross Sea area, Antarctica: Depletion ages and dynamic response during rifting”. Lamont-Doherty Earth Observatory, Columbia University, Geodynamics Seminar Series, October 2013
- “Procedural blanks and isobaric interferences: measuring Os isotopes via N-TIMS”, Mass Spectrometry Special Seminar, Lamont-Doherty Earth Observatory, Columbia University, May 2013
- Re-Os Systematics Reading Seminar Leader, Lamont-Doherty Earth Observatory, Columbia University, Summer 2012

RELEVANT COURSEWORK

Physical Geology, Historical Geology, Structural Geology, Stratigraphy, Mineralogy, Igneous & Metamorphic Petrology, Geomorphology, Environmental Geoscience, Tectonics, Environmental Geochemistry, Evolutionary Biology, Advanced Marine Geology, Isotope Geology, Geochronology & Thermochronology, Intro to Igneous Petrology, Modern Analytical Methods in Geochemistry, Advanced Isotope Geochemistry, Geologic Mapping, Wyoming Field Trip, Oman Ophiolite Field Trip

PUBLICATIONS

Bologna, P.A.X., Papagian, R., Regetz, S., **Dale, C.**, 2008. Assessment of turtle grass (*Thalassia testudinum* ex Banks Konig) community structure in a UNESCO Biosphere Reserve. *Journal of Experimental Marine Biology and Ecology*, 365, 2, 148-155p.

IN PREPARATION

Doherty, C.L., Class, C., S. L. Goldstein, S. B. Shirey, A. Martin, A. Cooper, (additional authors TBD) Paleoproterozoic stabilization of the lithospheric mantle beneath the Western Ross Sea area, Antarctica

Doherty, C.L., Class, C., S. L. Goldstein, (additional authors TBD). Ancient subcontinental lithospheric mantle overprinted by carbonatite metasomatism in the West Antarctic Rift System

Doherty, C.L., Class, C., S. L. Goldstein, (additional authors TBD). Isotopic constraints on the depletion and metasomatic history of the lithospheric mantle beneath the West Antarctic Rift System and its role in intraplate magmatism

THESES

Doherty, C.L., 2016. Multi-stage evolution of the lithospheric mantle in the West Antarctic Rift System-a mantle xenolith study, Columbia University Department of Earth and Environmental Sciences, New York, NY, Ph.D. Thesis

Dale, C.L., 2009. Geochemical and petrographic signatures from Marie Byrd Land and Larsen-B Ice Shelf: Implications for provenance tracing, Montclair State University Department of Earth and Environmental Studies, Montclair, NJ, M.S. Thesis

CONFERENCE PROCEEDINGS

Doherty, C.L., Class, C., S. B. Shirey, S. L. Goldstein, A. F. Cooper, A. P. Martin, J. H. Berg, J. A. Gamble, 2015. Multi-Stage Evolution of the Lithospheric Mantle in the West Antarctic Rift System. GeoPRISMS RIE TEI Workshop, 2017

Doherty, C.L., Class, C., S. B. Shirey, S. L. Goldstein, A. F. Cooper, A. P. Martin, J. H. Berg, J. A. Gamble, 2015. Lithospheric mantle evolution of the Western Ross Sea Area in the West Antarctic Rift System. Goldschmidt Conference, August 20, 2015. (**Oral Presentation**)

Doherty, C.L., Class, C., S. B. Shirey, S. L. Goldstein, A. F. Cooper, A. P. Martin, J. H. Berg, J. A. Gamble, 2013. Re-Os systematics of the lithospheric mantle beneath the Western Ross Sea area, Antarctica: depletion ages and dynamic response during rifting. American Geophysical Union Meeting, December 9-13, 2013.

Doherty, C.L., Class, C., S. B. Shirey, S. L. Goldstein, A. F. Cooper, A. P. Martin, J. H. Berg, J. A. Gamble, 2013. Constraining the dynamic response of subcontinental lithospheric mantle to rifting using Re-Os model ages in the Western Ross Sea, Antarctica. Graduate Student Symposium, March 1, 2013.

Lloyd, A., Bouilhol, P., Carlson, R.W., **Doherty, C.L.**, Emry, E.L., Li, M., Paulson, E., Wiens, D.A., Yuan, H., 2012. Reconciling geophysical and geochemical data to understand craton architecture. American Geophysical Union Meeting, December 3-8, 2012.

- Bouilhol, P., Carlson, R.W., **Doherty, C.L.**, Emry, E.L., Li, M., Paulson, E., Wiens, D.A., Yuan, H., 2012. Reconciling geophysical and geochemical data to understand craton architecture and stability: Special focus on the Kaapvaal, Slave, and North Atlantic Cratons. Post-AGU 2012 Cooperative Institute for Dynamic Earth Research (CIDER) Workshop, University of California, Berkeley. December 8, 2012.
- Doherty, C.L.**, Class, C., S. B. Shirey, S. L. Goldstein, A. F. Cooper, A. P. Martin, J. H. Berg, J. A. Gamble, 2012. Constraining the dynamic response of subcontinental lithospheric mantle to rifting using Re-Os model ages in the Western Ross Sea, Antarctica. American Geophysical Union Meeting, December 3-8, 2012.
- Doherty, C.L.**, Class, C., S. B. Shirey, S. L. Goldstein, A. F. Cooper, A. P. Martin, J. H. Berg, J. A. Gamble, 2012. Constraints on the dynamic response of subcontinental lithospheric mantle to rifting from Re-Os model ages – a case study from the Western Ross Sea Area, Antarctica. Cooperative Institute for Dynamic Earth Research (CIDER) Summer Program, UC Santa Barbara, CA, July-August, 2012.
- Williams, T., Hemming, S.R., van de Flierdt, T., Brachfeld, S., Pierce, E., **Dale, C.**, Cook, C., Goldstein, S., Roy, M., 2011. Isotope geochemistry of circum-Antarctic marine core tops for sub-glacial geology and sediment provenance. International Symposium of Antarctic Earth Sciences, July 2011.
- Brachfeld, S., Cuomo, D., van de Flierdt, T., Hemming, S., **Dale, C.**, Goldstein, S., Pierce, E., Williams, T. 2011. Iron oxide geochemistry and texture as a tracer of Antarctic sediment provenance. International Symposium of Antarctic Earth Sciences, July 2011.
- Hemming, S.R., Goldstein, S.L., Van De Flierdt, T., Pierce, E., **Dale, C.**, Williams, T., Brachfeld, S., Licht, K.J., 2010. Tracing Antarctica's terrigenous sediment contributions to the Southern Ocean. GEOCHIMICA ET COSMOCHIMICA ACTA, Goldschmidt Conference, August 2010
- Dale, C.**, Brachfeld, S., Hemming, S., van de Flierdt, T., 2009. Geochemical and petrographic signatures from Marie Byrd Land and Larsen-B Ice Shelf sediments: Implications for provenance tracing. NSF GK-12 Annual Meeting, March 27-29, 2009.
- Dale, C.**, Brachfeld, S., Hemming, S., van de Flierdt, T., 2009. Geochemical and petrographic signatures from Marie Byrd Land and Larsen-B Ice Shelf sediments: Implications for provenance tracing. Poster selected for presentation at NSF Headquarters, Arlington, VA, March 26, 2009.
- Dale, C.**, Brachfeld, S., Hemming, S., van de Flierdt, T., 2008. Geochemical and lithology results from Marie Byrd Land and Larsen-B Ice Shelf sediments: Implications for provenance tracing. American Geophysical Union Meeting, December 15-19, 2008.
- Hemming, S., Brachfeld, S., **Dale, C.**, Ar-Ar Ages of Glacially Derived Detrital Hornblende Grains along the West Antarctic Margin. American Geophysical Union Meeting, December 15-19, 2008.
- Dale, C.**, Brachfeld, S., Hemming, S., van de Flierdt, T., 2008. Geochemical and ϵ_{Nd} results from Larsen-B Ice Shelf and Marie Byrd Land sediments: Implications for provenance tracing. Joint Annual Meeting Geological Society of America, October 5-9, 2008. **(Oral Presentation)**
- Dale, C.**, Brachfeld, S., Hemming, S., van de Flierdt, T., 2008. Tracing Larsen Ice Shelf and West Antarctic Ice-Sheet stability through sediment provenance. Antarctic Peninsula Climate Change Meeting, June 24-26, 2008, UC Irvine.

- Dale, C.**, Brachfeld, S., Hemming, S., van de Flierdt, T., 2008. Tracing Antarctic Ice-Sheet stability through sediment provenance. Sigma Xi Student Research Symposium, May 3, 2008, Montclair, NJ.
- Dale, C.**, Regetz, S., Papagian, R., Ward, D., Townsend, T., Bologna, P., 2006. Sediment size, structure, and organic carbon content of *Rhizophora mangle* and *Thalassia testudinum* beds, in St. John, United States Virgin Islands, New Jersey Academy of Sciences Meeting, April 15, 2006. Sigma Xi Student Research Conference, May 6, 2006, Montclair, NJ.
- Papagian, R., Regetz, S., **Dale, C.**, Townsend, T., Ward, D., Kontos, C., Rudorfer, E., Gizas, M., Bologna, P., 2006. A comparative study of seagrass (*Thalassia testudinum*) and mangrove (*Rhizophora mangle*) community structure in St. John, USVI, New Jersey Academy of Sciences Meeting, April 15, 2006. Sigma Xi Student Research Conference, May 6, 2006, Montclair, NJ.
- Townsend, T., Papagian, R., Ward, D., Kontos, **C.**, **Dale, C.**, Regetz, S., Bologna, P., 2006. An assessment of the relationship of *Didema antillarum* and juvenile coral reef fishes, New Jersey Academy of Sciences Meeting, April 15, 2006. Sigma Xi Student Research Conference, May 6, 2006, Montclair, NJ.

Select presentations by mentored undergraduate students (*) and high school students (*)

- Haroon, A. ⁺, Chowdhury, A. ⁺, Feng, S. ⁺, Fernandez, R. ⁺, Lopez, C. ⁺, Reyes, N. ^{*}, Newton, R., 2012. Carbon Content of Sediment in Piermont Marsh, Hudson River Estuary. Poster, Geological Society of America Annual Meeting, Charlotte, NC, November 4-7, 2012
- Tatiana Gallardo⁺, **Cathleen Doherty**, Martha Montufar⁺, and Susan Vincent, 2013. Levels of Enterococcus and Nutrients in Piermont Marsh. Poster, Society of Wetlands Scientists, Duluth, MN, June 2-6, 2013
- Areej Haroon⁺, Amira Chowdhury⁺, **Cathleen Doherty**, Shiyong Feng⁺, Rossibel Fernandez⁺, Cristal Lopez⁺, Nunny Reyes^{*}, Susan Vincent, 2013. Modern and Past Carbon Dynamics in Piermont Marsh, Hudson River Estuary. Poster, Society of Wetlands Scientists, Duluth, MN, June 2-6, 2013
- Keyla Lora⁺, **Cathleen Doherty**, Susan Vincent, 2013. Seasonal Changes in Plankton Community of Piermont Marsh. Poster, Society of Wetlands Scientists, Duluth, MN, June 2-6, 2013
- Nancy Ramirez⁺, Lavern Cash⁺, **Cathleen Doherty**, Susan Vincent, 2013. Impact of Invasive Plant Species Phragmites Australis in Piermont Marsh. Poster, Society of Wetlands Scientists, Duluth, MN, June 2-6, 2013
- Fernandez, R. ⁺, Haroon, A. ⁺, Lopez, C. ⁺, Poster, New York City Science and Engineering Fair, Finals Round, American Museum of Natural History, March 19, 2013. 2nd Place Award.
- Mabson, M.^{*}; Pierce, E. L.; **Dale, C. L.**; Williams, T.; Hemming, S. R.; van de Flierdt, T.; Cook, C.; Goldstein, S. L., 2010. Variations in the Nd isotope composition of Late Miocene to Early Pliocene glacially derived sediments in Prydz Bay, East Antarctica, American Geophysical Union Meeting, December 2010
- Gombiner, J.^{*}, Hendy, I., Hemming, S., Fleisher, M., **Doherty, C.**, 2010. Spatial and temporal variation of last ice age mega-floods in the Pacific Northwest: Sediment provenance using single-aliquot K/Ar dating, American Geophysical Union Meeting, December 2010