BOSTON COLLEGE

Morrissey College of Arts and Sciences

GRADUATE PROGRAM

Earth and Environmental Sciences

A MESSAGE FROM THE EARTH AND ENVIRONMENTAL SCIENCES FACULTY

Welcome to the Department of Earth and Environmental Sciences. Our department explores the way the earth works and the natural and anthropogenic processes that shape our evolving planet. We are a small and friendly department with a faculty that integrates a strong commitment to quality teaching with an active research program that addresses interrelationships among the solid earth, the hydrosphere, the biosphere, cryosphere, and the atmosphere.

Faculty are currently active in research areas that include coastal and estuarine processes; sedimentology, geomorphology, earthquake and exploration seismology; tectonics; structural geology, igneous and metamorphic petrology; isotope geochemistry and geochronology; groundwater hydrology; oceanography, paleoclimatology and cryospheric change; biogeochemistry; and environmental geology and geophysics. The department offers graduate courses and research programs leading to both a Ph.D. in earth and environmental sciences and an M.S. in geology or geophysics; typically, 20 graduate students are in residence.

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Students are encouraged to obtain a broad background by taking courses in geology, geophysics, and environmental geosciences along with other sciences and mathematics. The department is characterized by strong working relationships among faculty, graduate students, and undergraduates. The program stresses a solid background in the earth sciences as well as the ability to carry out research. It prepares students for successful careers as geoscientists in academia, environmental and engineering industries, oil and gas exploration, and government service, as well as continued studies toward a Ph.D. for students in our M.S. track.

Many of our students carry out field-based research that might include surveying rivers in Maine, geological mapping in our backyard in the Appalachians, work farther afield in areas such as the western U.S., Europe, New Zealand, Australia, China, and Greenland, or going out to sea on a research vessel to the Atlantic or Pacific oceans. Students are encouraged to publish their research and present results at professional meetings. We celebrate student research every year with a day-long student colloquium, organized and hosted by the graduate students, with talks and poster presentations.

Visit our website to learn more about our research, facilities, and instrumentation. We welcome visitors and will be happy to arrange tours of the department and meetings with faculty. For more information, visit bc.edu/eesciences or contact us at 617-552-3640.

PROGRAM OVERVIEW

PROGRAMS OF STUDY

Ph.D.

PLAN OF STUDY

The doctoral program provides students with the tools they need to perform novel research in the earth and environmental sciences. The program provides our graduates with the disciplinary credibility and the interdisciplinary vision they need to advance careers in academia, government, or the private sector. Students combine coursework with advanced research under the supervision of a faculty advisor. The doctoral program assumes a basic undergraduate foundation in the geosciences. Students lacking such a background may be required to complete certain additional coursework before or during their graduate program. Doctoral students must complete or have completed a minimum of two semesters (or equivalent) of college-level coursework in all three disciplines of calculus, physics, and chemistry.

REQUIREMENTS

Ph.D. students are required to complete the equivalent of 24 credit hours of graduate-level course work beyond their bachelor's degree. Students admitted to the Ph.D. program who have already earned an M.S. in an earth or environmental sciences-related field may have up to 12 course credits approved from their prior graduate course work. All Ph.D. students take an interdisciplinary course focused on Broader Impacts and Integrated Research. In addition, students must pass a qualifying oral examination by the end of their third semester and enter into candidacy by passing a comprehensive exam within one year of passing their qualifying exam. Finally, students must complete and defend a research-based thesis, of which one chapter must be devoted to the Broader Impacts of their work.

M.S.

PLAN OF STUDY

The M.S. program includes coursework and a research-based thesis. The curriculum is flexible, and a program that is consistent with the student's background, professional, and research objectives is developed by the student and his or her faculty advisory committee. As with the Ph.D. program, the M.S. program assumes a basic undergraduate foundation in the geosciences. Students lacking such a background may be required to complete certain subjects at the undergraduate level before or during their graduate program. Master's candidates in either geology or geophysics are expected to have taken two semesters (or equivalent) of a college-level physics or chemistry course before admission, and must complete, or have completed, a minimum of two semesters of college-level calculus before completing their degree.

REQUIREMENTS

M.S. students are required to successfully complete a minimum of 30 credit hours in the natural sciences, mathematics, and engineering, approved by the faculty advisory committee. In addition, students must pass a qualifying oral examination by the end of their third semester. Finally, students must complete a research thesis in order to graduate with an M.S.

M.S./M.B.A. Dual Degree

In conjunction with the Carroll Graduate School of Management at Boston College, the Department of Earth and Environmental Sciences offers interested students the opportunity to participate in the combined M.S./M.B.A. dual-degree program. This program is excellent preparation for careers in industrial or financial geoscience management, including areas such as the environmental and petroleum industries, natural hazard assessment and natural resource evaluation, and investment. For more information, contact Professor John Ebel at ebel@bc.edu.

PROGRAM OVERVIEW

M.S.T.

Designed for prospective teachers, the M.S.T. program is administered through the Lynch School of Education and Human Development at Boston College in cooperation with the Department of Earth and Environmental Sciences. It requires admission to both schools. For more information, please contact the Office of Graduate Admissions at the Lynch School of Education and Human Development at bc.edu/lsoe.

Research in Earth and Environmental Sciences

Research in the Department of Earth and Environmental Sciences includes a wide range of investigations into the way the earth works and the processes that shape our evolving planet. Opportunities are available for students to work with our faculty in the following research concentrations:

- Coastal and estuarine processes
- Earthquake and exploration seismology
- Environmental geology and geophysics
- Paleoclimatology and paleoceanography
- Groundwater hydrology
- Igneous and metamorphic petrology and geochemistry
- Isotope geochemistry and geochronology
- Marine biogeochemistry
- Dynamics and processes of sedimentary systems
- Fluvial geomorphology and remote sensing
- Oceanography
- Tectonics
- Structural geology

Additional information about our research programs can be found at bc.edu/eesciences.

FACULTY PROFILES

ETHAN BAXTER

Professor

Ph.D., University of California, Berkeley (2000)

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RESEARCH INTERESTS

- Isotope geochemistry
- Petrology
- Geochronology
- Earth history
- Tectonics

SELECTED PUBLICATIONS

- Haws, A.A.; Starr, P.S.; Dragovic, B.; Scambelluri, M.; Belmonte, D.; Caddick, M.J.; Broadwell, K.S.; Ague, J.J.; Baxter, E.F. (2021). Meta-rodingite Dikes as Recorders of Subduction Zone Metamorphism and Serpentinite Dehydration: Voltri Ophiolite, Italy. *Chemical Geology*, 565, 120077.
- Starr, P.G.; Broadwell, K.S.; Dragovic, B.; Scambelluri, M.; Haws, A.A.; Caddick, M.J.; Smye, A.S.; Baxter, E.F. (2020). The Subduction and Exhumation History of the Voltri Ophiolite, Italy: Evaluating Exhumation Mechanisms for High-pressure Metamorphic Massifs. *Lithos*, 376-77, 105767.
- Sjöqvist, A.S.L.; Zack, T.; Honn, D.K.; Baxter, E.F. (2020). Modification of A Rare-Earth Element Deposit By Low-Temperature Partial Melting During Metamorphic Overprinting: Norra Kärr Alkaline Complex, Southern Sweden. *Chemical Geology*, 545, 119640.
- Gerrits, A.R.; Inglis, E.; Starr, P.G.; Dragovic, B.; Baxter, E.F.; Burton, K. (2019). Release of Oxidizing Fluids in Subduction Zones Recorded By Iron Isotope Zonation in Garnet. *Nature Geoscience*, 12, 1029-33.
- Baxter, E.F.; Caddick, M.J.; Dragovic, B. (2017). Garnet: A Rock Forming Mineral Petrochronometer. *Reviews in Mineralogy & Geochemistry*, 83, 469-533.

MARK D. BEHN

Professor

Ph.D., MIT/WHOI Joint Program in Oceanography and Applied Ocean Science and Engineering (2002)

mark.behn@bc.edu

RESEARCH INTERESTS

- Geodynamics
- Marine geophysics
- Tectonics
- Cryosphere

SELECTED PUBLICATIONS

- Tian, X.; Behn, M.D.; Ito, G.; Schierjott, J.; Kaus, B.J.P.; Popov, A.A. (2024). Magmatism Controls Oceanic Transform Fault Topography. *Nature Communications*, 15, 1914.
- Clerc, F.; Behn, M.D.; Minchew, B.M. (2024) Deglaciation-Enhanced Mantle Co2 Fluxes At Yellowstone Imply Positive Climate Feedback. *Nature Communications*, 15, 1526.
- Olive, J.-A.; Malatesa, L.C.; Behn, M.D.; Buck, W.R. (2022). Rift Tectonics Modulated by the Efficiency of River Erosion. *Proceedings of the National Academy of Sciences*, 119(13), e2115077119.

✣ Klein, B.Z.; Behn, M.D. (2021). On the Evolution and Fate of Subducted Sediment Diapirs. *Geochemistry, Geophysics, Geosysystems*, 22, e2021GC009873.

✣ Behn, M.D.; Goldsby, D.L.; Hirth, G. (2021). The Role of Grain-size Evolution in the Rheology of Ice: Implications for Reconciling Laboratory Creep Data and the Glen Flow Law. *The Cryosphere*, 15, 4589-605.

JOHN E. EBEL

Professor

Senior Research Scientist, Weston Observatory of Boston College

Ph.D., California Institute of Technology (1981)

ebel@bc.edu

RESEARCH INTERESTS

- Earthquake seismology
- Theoretical seismology
- Exploration geophysics
- Seismic hazards

SELECTED PUBLICATIONS

✣ Pontrelli, M.; Baise, L.; Ebel, J.E. (2023) Regional-Scale Site Characterization Mapping in High Impedance Environments Using Soil Fundamental Resonance (f0): New England, USA. *Engineering Geology*, 315, 107043.

✣ Ebel, J.E.; Chapman, M.C.; Kim, W.-Y.; Withers, M. (2020). Current Status and Future of Regional Seismic Network Monitoring in the Central and Eastern United States. *Seismological Research Letters*, 91(2A), 660-76.

✣ Dahal, N.R.; Ebel, J.E. (2020). Method for Determination of Focal Mechanisms of Magnitude 2.5-4.0 Earthquakes Recorded by a Sparse Regional Seismic Network. *Bulletin of the Seismological Society of America*, 110(2), 715-26.

✣ Jacobi, R.D.; Ebel, J.E. (2019). Seismotectonic implications of the Berne Earthquake Swarms West-southwest of Albany, New York. *Lithosphere*, 11(5), 750-64.

✣ Ebel, J.E. *New England Earthquakes: The Surprising History of Seismic Activity in the Northeast*. Globe-Pequot Press, 2019.

TARA PISANI GAREAU

Associate Professor of the Practice

Director of Environmental Studies Program

Ph.D., University of California, Santa Cruz (2008)

tara.pisanigareau@bc.edu

RESEARCH INTERESTS

- Agroecology
- Conservation biological control
- Sustainable food systems
- Pollination services

SELECTED PUBLICATIONS

✣ Pisani Gareau, T.; Vortman, C.; Barbercheck, M. (2019). Carabid Beetles (Coleoptera: Carabidae) Differentially Respond to Soil Management Practices in Feed and Forage Systems in Transition to Organic Management. *Renewable Agriculture and Food Systems*, 35(6), 1-18.

✣ Gareau, B.J.; Huang, X.; Pisani Gareau, T. (2018) Social and Ecological Conditions of Cranberry Production and Climate Change Attitudes in New England. *PLOS ONE*, 13(12), e0207237.

✣ Jabbour, R.; Pisani Gareau, T.; Smith, R.; Barbercheck, M. (2016). Cover Crop and Tillage Intensities Alter Ground-dwelling Arthropod Communities During the Transition to Organic Production. *Renewable Agriculture and Food Systems*, 31(4), 361-74.

✣ Schipanski, M.; Smith, R.G.; Pisani Gareau, T.; Jabbour, R.; Lewis, D.; Barbercheck, M.; Mortensen, D.; Kaye, J. (2014). The Structure of Multivariate Relationships Influencing Crop Yields During the Transition to Organic Management. *Agriculture, Ecosystems, and Environment*, 189, 119-26.

✣ Pisani Gareau, T.; Letourneau, D.K.; Shennan, C. (2013). Relative Densities of Natural Enemy and Pest Insects Within California Hedgerows. *Environmental Entomology*, 42(4), 688-702.

J. CHRISTOPHER HEPBURN

Professor Emeritus

Ph.D., Harvard University (1972)

hepburn@bc.edu

RESEARCH INTERESTS

- Regional geology and tectonics
- Metamorphic and igneous petrology
- Geochemistry

SELECTED PUBLICATIONS

✣ Hepburn, J.C.; Kuiper, Y.D.; McClary, K.J.; Loan, M.L.; Tubrett, M.; Buchwaldt, R. (2021). Detrital Zircon Ages and the Origin of the Nashoba Terrane and Merrimack Belt in Southeastern New England, USA. *Atlantic Geology*, 57, 343-96.

✣ Kuiper, Y.D.; Hepburn, J.C. (2021). Detrital Zircon Populations of the Eastern Laurentian Margin in the Appalachians. *Geology*, 49, 233-37.

✣ Kuiper, Y.D.; Thompson, M.D.; Barr, S.M.; White, C.E.; Hepburn, J.C.; Crowley, J.L. (2017). Detrital Zircon Evidence For Paleoproterozic West African Crust Along the Eastern North American Continental Margin, Georges Bank, Offshore Massachusetts, USA. *Geology*, 45(9), 811-14.

✣ Kay, A.; Hepburn, J.C.; Kuiper, Y.D.; Baxter, E.F. (2017). Geochemical Evidence for a Ganderian Arc/back-arc Remnant in the Nashoba Terrane, SE New England, USA. *American Journal of Science*, 317(4), 413-48.

✣ Piñán Llamas, A.; Hepburn, J.C. (2013). Geochemistry of Silurian-Devonian Volcanic Rocks in the Coastal Volcanic Belt, Machias-Eastport Area, Maine: Evidence For A Pre-Acadian Arc. *Geological Society of America Bulletin*, 125(11-12), 1930-42.

FACULTY PROFILES

ALAN L. KAFKA

Associate Professor

Ph.D., Stony Brook University (1980)

kafka@bc.edu

RESEARCH INTERESTS

- Seismology
- Earthquake science and environmental systems
- Science education and community science for the greater good

SELECTED PUBLICATIONS

✣ Lecocq, T.; Kafka, A.L.; et al. (2020). Global Quieting of High-Frequency Seismic Noise Due to COVID-19 Pandemic Lockdown Measures. *Science*, 367 (6509), 1338-43.

✣ Sargsyan, L.; Toghramadjian, N.E.; Kafka, A.L. (2018). Cellular Seismology Analysis of Reservoir-Triggered Seismicity Associated with Armenian Dams. *Bulletin of the Seismological Society of America*, 1081(5B), 3126-40.

✣ Kafka, A.L.; Ebel, J.E. (2011). Proximity to Past Earthquakes as a Least Astonishing Hypothesis for Forecasting Locations of Future Earthquakes. *Bulletin of the Seismological Society of America*, 101(4), 1618-29.

✣ Kafka, A.L. (2007). Does Seismicity Delineate Zones Where Future Large Earthquakes Will Occur in Intraplate Environments. In *Geological Society of America Special Papers: Continental Intraplate Earthquakes: Science, Hazard, and Policy Issues*, eds. S. Stein and S. Mazzotti, 425, 35-48.

SETH C. KRUCKENBERG

Associate Professor

Ph.D., University of Minnesota, Twin Cities (2009)

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RESEARCH INTERESTS

- Structural geology, tectonics and earth history
- Micromechanics of rock deformation, textural analysis, and electron backscatter diffraction
- Magnetic fabric analysis, anisotropy of magnetic susceptibility in rocks

SELECTED PUBLICATIONS

✣ Chatzaras, V.; Kruckenberg, S.C. (2021). Effects of Melt-percolation, Refertilization, and Deformation on Upper Mantle Seismic Anisotropy: Constraints from Peridotite Xenoliths, Marie Byrd Land, Antarctica. *Geological Society, London, Memoirs*, 56.

✣ Chatzaras, V.; Tikoff, B.; Kruckenberg, S.C.; Titus, S.J.; Teyssier, C.; Drury, M.R. (2020). Stress Variations in Space and Time Within the Mantle Section of an Oceanic Transform Zone: Evidence for the Seismic Cycle. *Geology*, 46(6), 569-73.

✣ Zhao, N.; Hirth, G.; Cooper, R.F.; Kruckenberg, S.C.; Cukjati, J. (2019). Low Viscosity Mantle Rocks Linked to Phase Boundary Sliding. *Earth and Planetary Science Letters*, 517, 83-94.

✣ Kruckenberg, S.C.; Michels, Z.D.; Parsons, M. (2019). From Intracrystalline Distortion to Plate Motion: Unifying Structural, Kinematic, and Textural Analysis in Heterogeneous Shear Zones Through Crystallographic Orientation-Dispersion Methods. *Geosphere*, 15(2), 357-81.

✣ Montz, W.J.; Kruckenberg, S.C. (2017). Cretaceous Partial Melting, Deformation, and Exhumation of the Potters Pond Migmatite Domain, West-Central Idaho. *Lithosphere*, 9(2), 205-22.

YI MING

Professor

Ph.D., Princeton University (2003)

yi.ming@bc.edu

RESEARCH INTERESTS

- Climate dynamics
- Climate modeling
- Regional climate change
- Climate impacts

SELECTED PUBLICATIONS

✣ Zheng, Y.; Ming, Y. (2023). Low-Level Cloud Budgets Across Sea Ice Edges. *Journal of Climate*, 36(1), 3-18.

✣ Frazer, M.E.; Ming, Y. (2022). Understanding the Extratropical Liquid Water Path Feedback in Mixed-Phase Clouds With An Idealized Global Climate Model. *Journal of Climate*, 35(8), 2391-406.

✣ Chemke, R.; Ming Y.; Yuval, J. (2022). The Intensification of Winter Mid-latitude Storm Tracks in the Southern Hemisphere. *Nature Climate Change*, 12, 553-57.

✣ MacDonald, C.G.; Ming, Y. (2022). Tropical Intraseasonal Variability Response to Zonally Asymmetric Forcing in an Idealized Moist GCM. *Journal of Climate*, 35(24), 4479-501.

✣ Smyth, J.E.; Ming, Y. (2021). Investigating the Impact of Land Surface Characteristics on Monsoon Dynamics with Idealized Model Simulations and Theories. *Journal of Climate*, 34(19), 7943-58.

HILARY I. PALEVSKY

Assistant Professor

Ph.D., University of Washington (2016)

hilary.palevsky@bc.edu

RESEARCH INTERESTS

- Marine carbon cycling
- Biogeochemistry
- Climate science

SELECTED PUBLICATIONS

✣ Palevsky, H.I.; Doney, S.C. (2021). Sensitivity of 21st Century Ocean Carbon Export Flux Projections to the Choice of Export Depth Horizon. *Global Biogeochemical Cycles*, 35, e2020GB006790.

✣ Quay, P.D.; Emerson, S.; Palevsky, H.I. (2020). Regional Pattern of the Ocean's Biological Pump Based on Geochemical Observations. *Geophysical Research Letters*, 47(14), e2020GL088098.

✣ Henson, S.A.; Laufkötter, C.; Leung, S.; Giering, S.L.; Palevsky, H.I.; Cavan, E.L. (2022). Uncertain Response of Ocean Biological Carbon Export in a Changing World. *Nature Geoscience*, 15(4), 248-54.
✣ Palevsky, H.I.; Nicholson D.P. (2018). The North Atlantic Biological Pump: Insights from the Ocean Observatories Initiative Irminger Sea Array. *Oceanography*, 31(1), 42-49.
✣ Palevsky, H.I.; Quay, P.D. (2017), Influence of the Biological Pump on Ocean Carbon Uptake Over the Annual Cycle Across the North Pacific Ocean. *Global Biogeochemical Cycles*, 31(1), 81-95.

JEREMY D. SHAKUN

Associate Professor

Ph.D., Oregon State University (2010)

jeremy.shakun@bc.edu

RESEARCH INTERESTS

- Paleoclimate
- Cryosphere
- Geochemistry

SELECTED PUBLICATIONS

✣ LeBlanc, D.E.; Shakun, J.D.; Corbett, L.B.; Bierman, P.R.; Caffee, M.W.; Hidy, A.J. (2023). Laurentide Ice Sheet Persistence During Pleistocene Interglacials. *Geology*, 51(5), 496-99.
✣ Biller-Celander, N.; Shakun, J.D.; McGee, D.M.; Wong, C.I.; Reyes, A.B.; Hardt, B.; Tal, I.; Ford, D.C.; Lauriol, B. (2021). Increasing Pleistocene Permafrost Persistence and Carbon Cycle Conundrums Inferred from Canadian Speleothems. *Science Advances*, 7(8), eabe5799.
✣ Koester, A.J.; Shakun, J.D.; Bierman, P.R.; Davis, P.T.; Corbett, L.B.; Goehring, B.M.; Vickers, A.C.; Zimmerman, S.R. (2021). Laurentide Ice Sheet Thinning and Erosive Regimes at Mount Washington, New Hampshire, Inferred from Multiple Cosmogenic Nuclides. *GSA Special Paper*, 548.
✣ Vickers, A.C.; Shakun, J.D.; Goehring, B.M.; Gorin, A.; Kelly, M.A.; Jackson, M.S.; Doughty, A.; Russell, J. (2021). Similar Holocene Glaciation Histories in Tropical South America and Africa. *Geology*, 49, 140-44.
✣ Shakun, J.D.; Corbett, L.B.; Bierman, P.R.; Underwood, D.; Zimmerman, S.R.; Caffee, M.W.; Naish, T.; Golledge, N.; Hay, C. (2018). Minimal East Antarctic Ice Sheet Retreat onto Land During the Past Eight Million Years. *Nature*, 558, 284-87.

NOAH P. SNYDER

Professor and Department Chair

Ph.D., Massachusetts Institute of Technology (2001)

noah.snyder@bc.edu

RESEARCH INTERESTS

- Geomorphology
- Remote sensing
- River restoration

SELECTED PUBLICATIONS

✣ Cook, T.L.; Snyder, N.P.; Oswald, W.W.; Paradis, K. (2020). Timber Harvest and Flood Impacts on Sediment Yield in a Postglacial, Mixed-forest Watershed, Maine, USA. *Anthropocene*, 29, 100232.
✣ Johnson, K.M.; Snyder, N.P.; Castle, S.; Hopkins, A.J.; Waltner, M.; Merritts, D.J.; Walter, R.C. (2019). Legacy Sediment Storage in New England River Valleys: Anthropogenic Processes in a Postglacial Landscape. *Geomorphology*, 327, 417-37.
✣ Lisius, G.L.; Snyder, N.P.; Collins, M.J. (2018). Vegetation Community Response to Hydrologic and Geomorphic Changes Following Dam Removal. *River Research and Applications*, 34(4), 317-27.
✣ Collins, M.J.; Snyder, N.P.; Boardman, G.; Banks, W.S.L.; Andrews, M.; Baker, M.E.; Conlon, M.; Gellis, A.; McClain, S.; Miller, A.; Wilcock, P. (2017). Channel Response to Sediment Release: Insights from a Paired Analysis of Dam Removal. *Earth Surface Processes and Landforms*, 42(11), 1636-51.

LAURA J. STEINBERG

Professor and Seidner Family Executive Director, Schiller Institute for Integrated Science and Society

Ph.D., Duke University (1993)

ljs@bc.edu

RESEARCH INTERESTS

- Infrastructure management
- Disaster preparedness and response
- Environmental modeling
- Interdisciplinary research

SELECTED PUBLICATIONS

✣ Basolo, V.; Steinberg, L.J.; Stephen Gant, S. (2017). Hurricane Threat in Florida: Examining Household Beliefs, Perceptions, and Actions. *Environmental Hazards*, 16(3), 253-75.
✣ Sengul, H.; Santella, N.; Steinberg, L.J.; Cruz, A.M. (2012). Analysis of Hazardous Material Releases Due to Natural Hazards in the U.S. *Disasters: The Journal of Disaster Studies, Policy, and Management*, 36(4), 723-43.
✣ Santella, N.; Steinberg, L.J. (2011). Accidental Releases of Hazardous Materials and Relevance to Terrorist Threats at Industrial Facilities. *Journal of Homeland Security and Emergency Management*, 8(1), 000010220215477355180 9.
✣ Santella, N.; Steinberg, L.J.; Zoli, C. (2011). Baton Rouge Post Katrina: The Role of Critical Infrastructure Modeling in Promoting Resilience. *Homeland Security Affairs* 7, 7.

FACULTY PROFILES

PAUL K. STROTHER

Research Professor

Ph.D., Harvard University (1980)

strother@bc.edu

RESEARCH INTERESTS

- Paleobotany and palynology
- Fossil origins of development

SELECTED PUBLICATIONS

✣ van de Schootbrugge, B.; Koutsodendris, A.; Taylor, W.A.; Weston, F.; Wellman, C.H.; Strother, P.K. (2023). Recognition of an Extended Record of Euglenoid Cysts: Implications for the End-Triassic Mass Extinction. *Review of Palæobotany and Palynology*, 322, 105043.

✣ Strother, P.K.; Foster, C. (2021). A Fossil Record of Land Plant Origins from Charophyte Algae. *Science*, 373(6556), 792-96.

✣ Strother, P.K.; Brasier, M.; Wacey, D.; Saunders, M.; Timpe, L.; Wellman, C.H. (2021). A Possible Billion-year-old Holozoan with Differentiated Multicellularity. *Current Biology*, 31(12), P2658-65. E2.

✣ Berbee, M. L.; Strullu-Derrien, C.; Delaux, P.-M.; Strother, P.K.; Kenrick, P.; Selosse, M.-A.; Taylor, J. (2020). Genomic and Fossil Windows into the Secret Lives of the Most Ancient Fungi. *Nature Reviews Microbiology*, 18, 717-30.

HANQIN TIAN

Schiller Institute Professor of Global Sustainability

Ph.D., State University of New York, Syracuse (1996)

hanqin.tian@bc.edu

RESEARCH INTERESTS

- Global biogeochemical cycles and greenhouse gas budgets
- Dynamic land ecosystem modeling and analysis
- Land-ocean-atmosphere continuum
- Food-energy-water nexus and global sustainability

SELECTED PUBLICATIONS

✣ Shi, H.; Tian, H.; Pan, N.; Reyer, C.P.O.; Ciais, P.; et al. (2021). Saturation of Global Terrestrial Carbon Sink Under a High Warming Scenario. *Global Biogeochemical Cycles*, 35 (10), e2020GB006800.

✣ Tian, H.; Xu, R.; Canadell, J.G.; Thompson, R.L.; Winiwarter, W.; et al. (2020) A Comprehensive Quantification of Global Nitrous Oxide Sources and Sinks. *Nature*, 586(7828), 248-56.

✣ Tian, H.; Xu, R.; Pan, S.; Yao, Y.; Bian, Z.; et al. (2020) Long–Term Trajectory of Nitrogen Loading and Delivery From Mississippi River Basin to the Gulf of Mexico. *Global Biogeochemical Cycles* 34(5), e2019GB006475.

✣ Tian, H.; Yang, J.; Xu, R.; Lu, C.; Canadell, J.G.; et al. (2019) Global Soil Nitrous Oxide Emissions Since the Preindustrial Era Estimated By an Ensemble of Terrestrial Biosphere Models: Magnitude, Attribution, and Uncertainty. *Global Change Biology*, 25, 640-59.

✣ Tian, H.; Lu, C.; Ciais, P.; Michalak, A.M.; Canadell, J.G.; et al. (2016) The Terrestrial Biosphere as a Net Source of Greenhouse Gases to the Atmosphere. *Nature*, 531(7593), 225-28.

XINGCHEN TONY WANG

Assistant Professor

Ph.D., Princeton University (2016)

xingchen.wang@bc.edu

RESEARCH INTERESTS

- Ocean biogeochemistry
- Paleoclimate
- Isotope geochemistry
- Geobiology

SELECTED PUBLICATIONS

✣ Zhang, R.; Wang, X.T.; Ren, H.; Huang, J.; Chen, M.; Sigman, D. (2020). Dissolved Organic Nitrogen Cycling in the South China Sea from An Isotopic Perspective. *Global Biogeochemical Cycles*, 34(12), e2020GB006551.

✣ Kast, E.R.; Stolper, D.A.; Auderset, A.; Higgins, J.A.; Ren, H.; Wang, X.T.; Martinez-Garcia, A.; Haug, G.H.; Sigman, D.M. (2019). Nitrogen Isotope Evidence for Expanded Ocean Suboxia in the Early Cenozoic. *Science*, 364(6438), 386-89.

✣ Wang, X.T.; Cohen, A.L.; Luu, V.; Ren H.; Su, Z.; Haug, G. H.; Sigman, D.M. (2018). Natural Forcing of the North Atlantic Nitrogen Cycle in theAnthropocene. *Proceedings of the National Academy of Sciences*, 115 (42), 10606-11.

✣ Wang, X.T.; Sigman, D.M.; Prokopenko, M.G.; Adkins, J.; Robinson, L.F.; Hines, S.K.; Chai, J.; Studer, A.S.; Martínez-García, A.; Chen, T.; Haug, G.H. (2017) Deep-sea Coral Evidence for Lower Southern Ocean Surface Nitrate Concentrations During the Last Ice Age. *Proceedings of the National Academy of Sciences*, 114 (13), 3352-57.

KAT WILSON

Assistant Professor

Ph.D., The University of Texas at Austin (2022)

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RESEARCH INTERESTS

- Coastal geomorphology
- Aeolian sedimentology
- Quarternary climate and sea level change

SELECTED PUBLICATIONS

✣ Rendall, B.; Wilson, K.E.; Kerans, C.; Helper, M.; Mohrig D. (2022). Coriolis Effect Entombed in Pleistocene (MIS5) Bahamian Dune Fields: Evidence from Regional Mapping Using Remote Sensing (TanDEM-X) Data. *Geology*, 50(5), 567-71.

✣ Wilson, K.E.; Mohrig, D. (2021). Modern Coastal Tempestite Deposition By a Non-Local Storm: Swell-generated Transport of Sand and Boulders on Eleuthera, The Bahamas. *Sedimentology*, 68(5), 2043-68.

✣ Wilson, K.E.; Lentz, E.E.; Miselis, J.L.; Safak, I.; Brenner, O.T. (2019). A Bayesian Approach to Predict Sub-annual Beach Change and Recovery. *Estuaries and Coasts*, 42, 112-31.

✣ Wilson, K.E.; Adams, P.N.; Hapke, C.J.; Lentz, E.E.; Brenner, O.T. (2015). Application of Bayesian Networks to Hindcast Barrier Island Morphodynamics. *Coastal Engineering*, 102, 30-43.

OUTCOMES

Recent Theses

2023

Charlotte Lorthioir, "Timescales of Oceanic Lithosphere Hydration: Constraints from Rodingites, Apennines, Italy"

2022

Hong Cai, "Fractal Dimension Study of Southern California Temporospatial Seismicity Patterns from 1982 to 2020"

Skylar Goliber, "Iron and Zinc Isotopes Reveal Redox Reactions Associated with Fluid Flow in Subduction Zones"

Megan Kopp, "High-resolution Multi-temporal Analysis of Geomorphic Change on the Sandy Pond Spit, Eastern Shore of Lake Ontario, NY"

Josh Rines, "Quantifying Feedbacks Between Ice Flow, Grain Size, and Basal Meltwater on Annual and Decadal Time-Scales Using a 2-D Ice Sheet Model"

Audrey Turcotte, "Geomorphic Effects and Habitat Impacts of Large Wood at Restoration Sites in New England"

2021

Ian Cooper, "Coherence as a Measure of Body-Wave Signal to Noise Ratio in the Northeastern United States and Southeastern Canada"

Andrew Gorin, "Recent Tropical Andes Glacier Retreat Unprecedented in the Holocene"

Miranda Wiebe, "Investigating the Microstructural Record of Deformation and Strain Localization Processes in a Kilometer-Scale Lower Crustal Shear Zone, Capricorn Ridge, Central Australia"

2020

Oriana Battifarano, "Road Salt Deicers as Contaminants in the Environment"

Joel Frisch, "Geochemistry, Weathering and Diagenesis of the Bermuda Paleosols"

Sean Kondas, "Crustal Unloading as a Source of Induced Seismicity in Plainfield, Connecticut"

Alexander Leich, "Eudialyte Geochronology: Investigating the Timing of REE Mineralization in the Grenville Province"

Xinyi Zeng, "The Impact of Dams on Sediment Transport from the Parker River Watershed to the Plum Island Estuary"

2019

Elisabeth Ames, "A Comparison of Glacial and Land-use Controls on Erosion in the Northeastern United States"

Nawa Dahal, (PhD joint with Physics) "Improving the Determination of Moment Tensors, Moment Magnitudes and Focal Depths of Earthquakes Below M4 Using Regional Broadband Seismic Data"

Samantha Dow, "Measuring 20th Century Fluvial Response to 18-19th Century Anthropogenic Activity Using Two Generations of Damming in the South River, Western Massachusetts"

Thomas Farrell, "Investigating the Tectonic Significance of Spiral Garnets from the Beltic-Rif Arc of Southern Spain and Northern Morocco Using SM-ND Garnet Geochronology"

Christopher Halsted, "Determining the Timing and Rate of Southeastern Laurentide Ice Sheet Thinning During the Last Deglaciation with 10Be Dipsticks"

James LeNoir, "Post-glacial Sedimentation in Ossipee Lake, New Hampshire: Land-use Versus Climate Change"

Lauren Shea, "Microstructural and Textural Analysis of Naturally Deformed Granulites in the Mount Hay Block of Central Australia: Implications for the Rheology of Polyphase Lower Crustal Materials"

2018

Hannah Chambless, "Cellular Seismology Predictability as a Measure of Association Between Wastewater Injection Wells and Earthquakes in Oklahoma"

Celeste Gambino, "Assessing Permafrost Stability: A Uranium-Lead Chronology of Speleothem Deposition in the Canadian Arctic"

Anna Gerrits, "Tracing the Source of Oxidizing Fluids in Subduction Zones Using Iron Isotopes in Garnet"

Kevin Simans, "Sediment Flux and Salt-wedge Dynamics in a Shallow, Stratified Estuary"

Alana Spaetzel, "Investigating Uncertainty of Phosphorus Loading Estimation in the Charles River Watershed, Eastern Massachusetts"

Anthony Vickers, "Coherent Holocene Expansion of a Tropical Andean and African Glacier"

Brittany Ward, "Reconstruction of Holocene Coupling Between the South America Monsoon System and Local Moisture Variability from Speleothem $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ Records"

OUTCOMES

Recent Placements

Our Ph.D. program prepares students for successful careers in academia and industry; our M.S. program prepares students for successful careers as geoscientists in the environmental and engineering industries, oil and gas exploration, or government service, or for continued studies toward a Ph.D.

Energy and Engineering

- AECOM
- CH2M Hill
- ExxonMobil Corporation
- Galehead Development
- Loureiro Engineering Associates
- Norstar Petroleum
- Schlumberger Geoquest

Environmental Consulting and Nonprofits

- Antea Group
- Brown and Caldwell
- Earthwatch Institute
- Environ
- ERM: Environmental Resources Management
- Hager Geoscience
- Kleinfelder
- Lake Champlain Basin Program
- Ransom Consulting
- World Wildlife Fund

Government and Teaching

- Boston College High School
- Idaho Conservation League
- NASA
- National Park Service
- Oregon Parks and Recreation
- Pearson Education
- U.S. Geological Survey

Academic Programs

- Boise State University
- Louisiana State University
- Pennsylvania State University
- Princeton University
- Purdue University
- Stony Brook University
- University of California, Berkeley
- University of California, Davis
- University of Memphis
- University of Texas at Austin
- University of Vermont
- University of Waikato, New Zealand

COURSES

The combined and varied interests of the faculty, as indicated in the faculty profiles, ensure that the department offers a wide range of graduate courses. While the number and content of the graduate electives vary from year to year, the following courses are illustrative of the range of offerings.

Fall

Agroecology: The Science of Sustainable Agriculture	Pisani Gareau
Advanced Structural Geology	Kruckenberg
Climate Change Debates	Shakun
Marine Biogeochemistry	Palevsky
Remote Sensing and Image Interpretation	Snyder
Environmental Hydrology	Collins
Isotope Geochemistry and Geochronology	Baxter
Marine Geology	Department
Environmental Geophysics	Cipar
Earth Systems Seminar	Kafka/Wang
Petrology	Baxter
Watershed Science	Department
Paleoclimate Dynamics	Shakun
Tectonics	Kruckenberg
Geophysical Data Processing	Ebel

Spring

Stable Isotope Biogeochemistry	Wang
Environmental Data Exploration and Analysis	Palevsky
Introduction to Geophysics	Behn
Statistical Analysis of Scientific Data	Kafka
Topics in Geobiology	Strother
Applications of GIS (Geographical Information Systems)	Willis
Introduction to Seismology	Ebel
Paleobiology	Strother
Geodynamics	Behn/ Kruckenberg
Geophysical Modeling	Behn

MORRISSEY COLLEGE OF ARTS AND SCIENCES

The oldest and largest of the University's eight schools and colleges, the Morrissey College of Arts and Sciences offers graduate programs in the humanities, social sciences, and natural sciences, leading to the degrees of Doctor of Philosophy, Master of Arts, and Master of Science. In addition, numerous dual-degree options are offered in cooperation with the Carroll School of Management, the Boston College Law School, the Lynch School of Education and Human Development, and the School of Social Work.

With approximately 900 graduate students and more than 500 full-time faculty, the Morrissey College of Arts and Sciences is small enough to know you as a person, but large enough to serve you and prepare you for a rewarding life and satisfying career.

Academic Resources

RESEARCH INSTRUMENTATION AND FACILITIES

The Department of Earth and Environmental Sciences' research facilities are housed in Devlin Hall, with additional research facilities at Weston Observatory. Our research laboratories are outfitted with the most modern scientific equipment.

Electron and Optical Microscopy Lab

The microscopy facility in Earth and Environmental Sciences is home to a recently upgraded Tescan Mira 3 Schottky field emission gun scanning electron microscope that can be operated in either high-vacuum or variable pressure modes, allowing for the characterization of coated or non-conductive specimens. This instrument is equipped with a range of analytical detectors for materials imaging and characterization, including secondary electron (SE), backscattered electron (BSE), and cathodoluminescence (CL) detectors. The SEM is also equipped with a state-of-the-art Oxford Instruments Symmetry electron backscatter diffraction (EBSD) detector and an integrated X-MaxN 50 mm2 SDD EDS x-ray detector, allowing for the rapid determination of crystallographic fabrics (i.e., crystallographic preferred orientation), patterns of rock microstructure (textural mapping), and semi-quantitative mineralogical and compositional maps used in structural, deformation, and materials studies. Supporting instrumentation in the facility includes: (i) grain and thin-section polishing equipment; (ii) an EMS 150 TES turbomolecular pumped carbon and sputter coater for producing thin conductive coatings used in SEM imaging, EDS and EBSD analysis; (iii) a digital camera-equipped petrographic microscope (Zeiss Axioskop 40) and macroscope (Leica Z6 APO) for transmitted and reflected light observation and imaging of polished thin sections; and (iv) a variety of computer workstations for post-processing and data analysis. For additional information on analytical capabilities and supporting instrumentation, please visit the SEM Lab website.

Thermal Ionization Mass Spectrometry (TIMS) Facility

The IsotopX Phoenix TIMS has nine movable Faraday collectors, an axial Daly photomultiplier, and both 10^11 and 10^12 ohm resistors for the precise measurement of small amounts of Sm-Nd, Sr and other high mass radiogenic isotope systems. The TIMS instrument is supported by a ~800 sq ft class 1000 Clean Laboratory for sample dissolution and column chemistry. The laboratory includes eight class 100 work cubbies and five class 100 laminar flow fume hoods for sample preparation. The laboratory also features a MilliQ water purification system, Analab hotplates and Evapoclean units, three DST 1000 Savillex distillation systems, multiple high precision micro-balances, and additional support equipment.

Isotope Ratio Mass Spectrometry Lab

The ISB lab has a Thermo Delta V plus Isotope Ratio Mass Spectrometer (IRMS) interfaced with a modified Gas Bench (for N2O analyses) and an Elemental Analyzer (for CNS analyses of solid samples). The SIB Lab also has a Class 1000 Clean Room designed for the processing of low-nitrogen samples. In addition to the standard HEPA particulate air filter, this clean room is equipped with an AMC filtration system to remove any airborne nitrogen pollution (e.g., NOx and ammonia).

MORRISSEY COLLEGE OF ARTS AND SCIENCES

Marine Biogeochemistry Lab

The Marine Biogeochemistry Lab, renovated in 2020, is an analytical chemistry laboratory equipped both to prepare for field deployments and to analyze field-collected samples in the lab. Core equipment include Apollo Sci-Tech Dissolved Inorganic Carbon and Total Alkalinity analyzers, an automated potentiometric Winkler titration system for measuring dissolved oxygen, and a 450-liter test tank for lab testing and calibration of autonomous biogeochemical sensors

Coastal Processes Lab

The Coastal Processes Lab is equipped for sediment transport field studies with an assortment of electromagnetic and acoustic current meters (EMCMS, ADCPs, ADVs), CTDs (conductivity, temperature, depth sensors), a dual-frequency echo sounder, optical and acoustic backscaterrance sensors for measuring suspended sediment and its properties (ABS, OBS, LISST), a pump system for *in situ* water sampling, and vacuum filtration manifold for determination of suspended-sediment concentrations. Sediment particle size analyses are carried out with a Micoromeritics Sedigraph III5120 for fines (silt and clay) and standard sieving at quarter-phi intervals for sands.

Geomorphology Lab

The geomorphology lab is a computer-based facility for analysis of changing landscapes.

- Leica TPS1200Total Station with integrated GPS
- Marsh McBirney EM Current Meters Model 2000 (2) portable flow meters

Rock Processing and Preparation Lab

- 2 Bico/Braun Chipmunck rock crushers
- Bico/Braun disc-mill grinder
- Hydraulic vices
- Shatterboxes with sintered alumina and tungsten carbide heads
- Assorted rock saws
- Ro-Tap grain size analysis shaking apparatus (sand and gravel)
- 4 Sonicators
- Froth flotation system

Mineral Separation Lab

- Outotec Wilfley table
- Heavy liquid separation room
- Mineral and rock mounting and polishing
- Frantz magnetic separator
- Handpicking microscopes
- Crushing and sieving apparatus
- New Wave MicroMill drilling device

Departmental Computer Lab

- Installed software: ArcGIS 10.1, Matlab, Mathematica; on campus: SPSS, SAS, Stata, Visual Modflow
- Input data facilities: scanners, OCR
- Output facilities: color laser printers, 44-inch-wideposter plotter—Epson Stylus Pro 9800, other B/W laser printers

WESTON OBSERVATORY

Weston Observatory is a geophysical research and science education center of the Department of Earth and Environmental Sciences. It is located in Weston, Mass., about 10 miles from BC's Chestnut Hill campus. The Observatory, which has been recording earthquakes since 1930, conducts basic research on earthquakes and related processes, provides public information after significant earthquakes occur, contributes to earthquake awareness to help reduce the tragic effects of earthquakes, and educates future generations of geophysicists, geologists, environmental geoscientists, and scientifically literate citizens.

Today's advances in geophysical instrumentation, coupled with advances in internet communication and social media, make it possible to explore earthquakes and the earth's interior in unprecedented ways. Inspired by its early roots in the late 1920s, which formed the foundation of a modern high-tech networked observatory of the 21st century, Weston Observatory shares in that spirit of exploration. The facilities at the Observatory offer students opportunities to work on research projects in geophysics and related research areas. For more information, visit www.bc.edu/bc-web/schools/mcas/sites/weston-observatory.html.

BOSTON AREA CONSORTIUM

The Boston Area Consortium allows graduate students to cross-register for courses at Boston University, Brandeis University, and Tufts University.

STUDENT LIFE AND CAMPUS RESOURCES

Boston College is located on the edge of one of the world's most vibrant cities. Just six miles from downtown Boston—an exciting and dynamic place to live and learn—Boston College is an easy car or "T" ride away from a booming center for trade, finance, research, and education.

Home to some of New England's most prestigious cultural landmarks, including the Museum of Fine Arts, the Isabella Stewart Gardner Museum, Boston Symphony Hall, and the Freedom Trail, Boston provides a rich environment for those passionate about art, music, and history. For sports fans, Boston hosts a number of the country's greatest sports teams: the Celtics, Patriots, Bruins, and, of course, Fenway Park's beloved Red Sox. Found within a short drive from Boston are some of New England's best recreational sites, from the excellent skiing in New Hampshire to the pristine beaches of Cape Cod.

Boston also offers a wide range of family friendly attractions, including the Children's Museum, New England Aquarium, Franklin Park Zoo, and the Museum of Science. There are roughly 50 universities located in the Boston area, and the large student population adds to the city's intellectually rich and diverse community. Events, lectures, and reading groups hosted by world-renowned scholars abound on area campuses, providing abundant opportunities to meet and network with other graduate students and faculty throughout the Boston area.

The University

Boston College is a Jesuit university with 15,000 students, 880 full-time faculty, and more than 190,000 active alumni. Since its founding in 1863, the University has known extraordinary growth and change. From its beginnings as a small Jesuit college intended to provide higher education for Boston's largely immigrant Catholic population, Boston College has grown into a national institution of higher learning that is consistently ranked among the top universities in the nation. Boston College is ranked 36th among national universities by *U.S. News & World Report*.

Today, Boston College attracts scholars from all 50 states and over 80 countries, and confers more than 4,300 degrees annually in more than 50 fields through its eight schools and colleges. Its faculty members are committed to both teaching and research and have set new marks for research grants in each of the last 10 years. The University is committed to academic excellence. As part of its most recent strategic plan, Boston College is in the process of adding 100 new faculty positions, expanding faculty and graduate research, increasing student financial aid, and widening opportunities in key undergraduate and graduate programs.

The University is comprised of the following colleges and schools: Morrissey College of Arts and Sciences, Carroll School of Management, Connell School of Nursing, Lynch School of Education and Human Development, Woods College of Advancing Studies, Boston College Law School, School of Social Work, and Clough School of Theology and Ministry.

General Resources

HOUSING

While on-campus housing is not available for graduate students, most choose to live in nearby apartments. The Office of Residential Life maintains an extensive database with available rental listings, roommates, and helpful local real estate agents. The best time to look for fall semester housing is June through the end of August. For spring semester housing, the best time to look is late November through the beginning of the second semester. Additionally, some graduate students may live on campus as resident assistants. Interested students should contact the Office of Residential Life.

STUDENT LIFE AND CAMPUS RESOURCES

JOHN COURTNEY MURRAY, S.J., GRADUATE STUDENT CENTER

One of only a handful of graduate student centers around the country, the Murray Graduate Student Center is dedicated to the support and enrichment of graduate student life at Boston College. Its primary purpose is to build a sense of community among the entire graduate student population and cultivate a sense of belonging to the University as a whole. Its amenities include study rooms, a computer lab, two smart televisions, kitchen, deck and patio space, complimentary coffee and tea, and more. Throughout the year, the center hosts programs organized by the Office of Graduate Student Life and graduate student groups. The Murray Graduate Student Center also maintains an active job board (available electronically), listing academic and non-academic opportunities for employment both on and off campus.

MCMULLEN MUSEUM OF ART

Serving as a dynamic educational resource for the national and international community, the McMullen Museum of Art showcases interdisciplinary exhibitions that ask innovative questions and break new ground in the display and scholarship of the works on view. The McMullen regularly offers exhibition-related programs, including musical and theatrical performances, films, gallery talks, symposia, lectures, readings, and receptions that draw students, faculty, alumni, and friends together for stimulating dialogue. Located on the Brighton campus, the McMullen Museum is free to all visitors.

CONNORS FAMILY LEARNING CENTER

Working closely with the Graduate School, the Connors Family Learning Center sponsors seminars, workshops, and discussions for graduate teaching assistants and teaching fellows on strategies for improving teaching effectiveness and student learning. Each fall, the Learning Center and the Graduate School hold a one-and-a-half day "Fall Teaching Orientation" workshop designed to help students prepare for teaching. The center also hosts ongoing seminars on college teaching, higher learning and academic life; assists graduate students in developing teaching portfolios; and provides class visits and teaching consultations, upon request. Through these and other activities, the Connors Family Learning Center plays an important role in enhancing the quality of academic life at Boston College.

MARGOT CONNELL RECREATION CENTER

The Margot Connell Recreation Center redefines the future of fitness and recreation at Boston College. The 244,000-square-foot, four-story structure offers our community an inspired space to play, pursue sports, gather with friends, and work out. This facility includes a fitness center, rock climbing wall, jogging track, aquatics center, wood-floor basketball courts, tennis courts, multi-activity courts, multi-purpose rooms for spin, yoga, and fitness classes, and so much more.

BOSTON COLLEGE CAREER CENTER

The Boston College Career Center works with graduate students at each step of their career development. Services include self-assessment, career counseling, various career development workshops, resume, and cover letter critiques, and practice interviews. In addition to extensive workshop offerings, Career Center staff members are available throughout the year for one-on-one advising about any aspect of the career path. The Career Resource Library offers a wealth of resources, including books, periodicals, and online databases.

ADMISSION AND FINANCIAL INFORMATION

The application deadline for fall admission for both the Ph.D. and M.S. programs is January 2. Visit bc.edu/mcgs for detailed information on how to apply.

Application requirements Include:

Application Form:	Submitted online, via the MCGS website.
Application Fee:	$75, non-refundable.
Official Transcripts:	Demonstrating coursework completed/degree conferral from all post-secondary institutions attended.
Three Letters of Recommendation:	From professors or supervisors. It is highly advisable that at least one letter be from an academic source.
Statement of Purpose:	A brief (1-2 page) discussion of an applicant's preparation, motivation and goals for their proposed course of study.
Proof of English Proficiency: (*international only*)	Official TOEFL/IELTS reports accepted.

Financial Assistance

DEPARTMENT FUNDING

The Department of Earth and Environmental Sciences offers five years of funding to all qualified Ph.D. students contingent upon satisfactory academic performance and progress toward completion of their degree. The department is also able to offer some financial assistance to M.S. students, generally spanning two years. Many students function as teaching assistants within the department and receive a stipend in exchange for their services, while others function as research assistants, funded through faculty grants. Research assistantships are also available during the summer depending on research area and the extent of current funding. The department awards tuition scholarships to qualified students.

FEDERAL FINANCIAL AID

Graduate students can apply for federal financial aid using the FAFSA. The loans that may be available to graduate students are the Federal Direct Unsubsidized Stafford Loan and Perkins Loan, based on eligibility. If additional funds are needed, student may apply for a Grad Plus Loan. For more information, see the Graduate Financial Aid website at bc.edu/gradaid or contact the Graduate Financial Aid Office at 617-552-3300 or 800-294-0294.

OFFICE FOR SPONSORED PROGRAMS

The Office for Sponsored Programs (OSP) assists both faculty and graduate students in finding sources of external funding for their projects and provides advice in the development of proposals. OSP maintains a reference library of publications from both the public and private sectors listing funding sources for sponsored projects. In the recent past, graduate students have received research support from prominent agencies, corporations and organizations such as the Fulbright Commission, the Guggenheim Foundation, the National Science Foundation, the American Political Science Association, the American Chemical Society, and the American Association of University Women.

BOSTON COLLEGE
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