

# Independent Research Projects in Geosciences



**The Department of Geosciences  
Princeton University**

Specializations in: Climate Science,  
Geochemistry, Geomicrobiology,  
Geology, Geophysics

**Department of Geosciences**  
**Junior and Senior Independent Research Projects (2024-25)**

**Jie Deng (Geophysics and Machine learning; <https://deng.princeton.edu/>)**

**Research Projects:**

- 1) Atomistic modeling of Earth and planetary materials
- 2) Machine learning interatomic potential construction and application
- 3) Crystal structure prediction at exoplanetary conditions and website development

**Examples of JP/STs from last 2 years:**

*Ethan Sontarp: Speciation of hydrogen in silicate melts: implications for water solubility in terrestrial magma oceans*

**# of students accepting = 2**

**Curtis Deutsch (Climate Science & Geochemistry; <https://geosciences.princeton.edu/people/curtis-deutsch>)**

**Examples of JP/ST:**

*Isabella Checa: Southern Ocean Air Sea Fluxes (JP)*

*Ben Buchovecky: Predictability of Southern Ocean Net Primary Productivity (JP)*

**# of students accepting = 2**

**Thomas Duffy (Mineralogy and Geophysics; <https://duffy.princeton.edu/>)**

**Research Projects:**

- 1) Composition and structure of the Earth's interior
- 2) Ultrahigh pressure mineralogy and structure of exoplanets
- 3) Physics and chemistry of minerals

**Examples of JP/STs from last 2 years:**

*Jason Gu: Mineralogy and structure of large, rocky exoplanets*

*Anna Pinkerton: High pressure stability of euclase ( $\text{BeAlSiO}_4(\text{OH})$ )*

*Hanna Szabo: Variation of compressional to shear velocity ratio in crustal minerals: A new analysis*

*Laurie Zielinski: Evaluation of portable sequentially shifted excitation Raman spectroscopy for applications in art and archaeology*

**# of students accepting = 2**

**Stephan Fueglistaler (Climate Science; <https://fueglistaler.princeton.edu/>)**

**Research Area:** Climate Science

**Examples of JP/STs:**

*Lauren Owens: Recent Temperature Anomalies (JP)*

*Jaeda Woodruff: Clouds and Sea Surface Temperature (JP)*

*Laeo Crnkovic-Rubsamen: Drying with Global Warming (JP)*

*Sam Bartusek: The role of overshooting convection for the heat and water budget of the tropical tropopause layer" (ST)*

**# of students accepting = 0**

**John Higgins (Isotope Geochemistry; <https://carboncycle.princeton.edu/>)**

**Research Projects:**

- 1) *What drove Earth's largest  $\delta^{13}\text{C}$  excursion?*
- 2) *Modern analogues for snowball Earth cap dolostone?*
- 3) *Investigating Earth's  $\text{CO}_2$  thermostat*
- 4) *Records of ancient seawater chemistry from deep-sea pore fluids*

**Examples of JP/STs:**

*Ketevan Shavdia: Tracing Ancient Climate Signals: A Multifaceted Analysis of Ice Core and Foraminifera Data Over Millions of Years (JP)*

*Isabel Rodrigues: A minimally invasive onsite identification method for lead-lined water service lines: A case study in Trenton, NJ (ST)*

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**Adam Maloof (Earth History, Sedimentology; <https://maloof.princeton.edu/>)**

**Research Projects:**

- 1) How is climate recorded in the geometry of dendritic channel networks?
- 2) The extinction of the Dinosaurs recorded in a Bolivian lake
- 3) How do modern carbonates record information about sea water chemistry?
- 4) A new climate record from Grottes de Betharram, France

**Examples of JP/STs:**

*Stacey Edmondson: Were Shallow Carbonate Geochemistry and Production Different During the Last Interglacial Period? (ST)*

*Alex Cox: Do the Morphologies of Earth's Most Ancient Fossils Record Information about Water Depth and the Environment" (ST)*

*Ona Underwood: Mercury concentration across the K-Pg boundary in Spain and Bolivia (JP)*

**# of students accepting = 2**

**Satish C. B. Myneni (Environmental geochemistry; <https://myneni.princeton.edu>)**

**Research Projects:**

- 1) "Soil farming" for increased carbon sequestration and sustainable soil development
- 2) Environmental geochemistry of toxic substances, human health, and associated policies
- 3) Projects related to any of the recent JP/STs listed below.

**Examples of JP/STs from last 2 years:**

*Rachel Kulchar: As and Pb partitioning in bioapatite, links to human toxic metal exposure (JP & ST)*

*Teddie Lloyd Buckley: Heavy metal contamination in soils of Bronze Age (JP&ST)*

*Spencer Koonin: Volatiles from coal beds exposed to volcanic activity at the KT boundary (ST)*

*Jacob Stoebner: Chemistry of organic molecules from pristine and agriculture lands (JP&ST)*

*Jellyxa Rogell: Fugitive green pigments of ancient Maya Civilization (JP&ST)*

*Anais Mobarak, Charlotte Selover: Role of minerals in organic C-cycle (JP&ST)*

**# of students accepting = 2**

**Elizabeth Niespolo (Geochronology/Geology), <https://sites.google.com/site/eniespolo/>**

**Research Projects relevant to JP/ST topics:**

- 1) Trace-element geochemistry in biominerals
- 2) U-series dating of carbonates
- 3) Geology of the Eastern African Rift System
- 4) Archaeological provenience studies

**Examples of JP/STs from last 2 years:**

*Rio Baran (JP): Feasibility of Uranium Series Dating on Elephant Bird Eggshells*

*Anna Pinkerton (ST): Petrochronology of intrusive rocks at Mpala Research Center, Kenya*

**# of students accepting = 1**

**Michael Oppenheimer (Climate Science and Public Policy; <https://oppenheimer.scholar.princeton.edu/>)**

**Research Projects:**

- 1) Climate Change and Human Migration
- 2) Coastal Impacts of Climate Change
- 3) US and International Climate Adaptation Policy
- 4) The Process of Scientific Assessment

**Example of JP/STs supervised from last 2 years:**

*Isabella Checa: US Government Climate and Economic Justice Screening Tool – what risks are represented? (JP)*

*John (Wesley) Wiggins: Sea-Level Rise on the Eastern Shore of Maryland: Vulnerability, Adaptation, and Environmental Justice (ST)*

**# of students accepting = 1**

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**Laure Resplandy (Climate Science; <https://resplandy.princeton.edu/>)**

*My group studies how climate and ocean circulation influence marine biogeochemistry and ecosystems, and how these changes can in turn impact the climate itself.*

**Research Projects:**

- 1) *Influence of human activity on Indian Ocean biological productivity and coastal dead zones*

**Examples of JP/STs:**

*Zane Smith: The Deviation of Full from Subsampled Model Trends Of Ocean Oxygen Concentration (JP)*

*Benjamin Buchovecky: The Effect of an Amplified Hydrological Cycle on Dissolved Oxygen in the Ocean (JP)*

*Benjamin Getraer: Comparison of GRACE Derived Greenland Mass Wasting To Near Surface Temperature from MERRA-2 Reanalysis (ST)*

*Keely M. Walsh: "Primary Productivity in the Gulf of Alaska in a High-Resolution Global Climate Model" (ST)*

**# of students accepting = 1**

**Allan Rubin (Geophysics; <https://rubin.princeton.edu/>)**

**Research Area:** Geophysics, combines seismic and geodetic observations with numerical models, with the goal of improving our understanding of brittle deformation of the crust. Applications are primarily to regions of active volcanism and faulting.

**Examples of JP/STs:**

*Jakob Kintzele: Fracture transport of ocean water in Europa's cooling ice shell (ST)*

*Jakob Kintzele: Flexing Tiger Stripes on Enceladus (JP)*

**# of students accepting = 1**

**Blair Schoene (Geology, geochronology, Earth history; <https://geosciences.princeton.edu/people/blair-schoene>)**

**Research Projects:**

- 1) Geochronology of Igneous and metamorphic processes in the Earth's crust
- 2) High-temperature geochemistry and isotope geochemistry
- 3) Mass extinctions and volcanic events

**Examples of JP/STs from last 2 years:**

*Hanna Szabo: Geochemistry of granitoids exhibiting megacrystic K-feldspar & Potassium isotope measurements of K-feldspar in the Tuolumne batholith (JP & ST)*

*Isabel Koran: ~1.1 billion year post-mountain building cooling of rocks in the New Jersey Highlands & isotope geochemistry and geochronology Iron-Oxide-Apatite ore deposits in New Jersey (JP&ST)*

**# of students accepting = 2**

**Daniel Sigman (Biogeochemistry, Paleoclimate; <https://sigman.princeton.edu>)**

**Research Projects:**

- 1) Isotopic reconstruction of marine and terrestrial biogeochemistry and ecology in the past
- 2) Carbon and nitrogen cycling in the surface ocean, including in seaweed platforms
- 3) Development of new isotopic methods using microbiology

**Examples of JP/STs:**

*Margaret Lynch: Diatom nitrogen isotope changes since the last ice age in the Atlantic sector of the Antarctic Ocean*

*Ona Underwood: Nitrogen isotopes in foraminifera record the closing and opening of Bering Strait over the past 50,000 year"*

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**Frederik Simons (Geophysics; website: <https://www.frederik.net>)**

*All my projects involve computer programming.*

**Research Projects:**

- 1) Geophysics, geodesy, geomagnetism, seismology; structure and evolution of (planetary) lithospheres; seismic waveform analysis and tomography; topography and gravity anomalies; satellite measurements and inverse problems; oceanic instrumentation; earthquake early-warning studies; wavelet analysis; image analysis; spectral analysis; sea level variation; inferential statistics.

**Example of JP/ST's:**

*Yuri Tamama: The Sounds of Silence: Cultural Noise on Princeton University Campus Dining During the 2020 Coronavirus Lockdown (JP)*

*Amy Amatya: Mermaid Float Course Prediction Using Historic Argo Trajectory Data (JP)*

*Tyrone Zhang: Evaluating Forecasting Methods for Precipitation Using Weather Data Collected on Top of Guyot Hall (ST)*

**# of students accepting = 2**

**Jeroen Tromp (Seismology; <https://tromp.princeton.edu/>)**

**Research Area:**

Theoretical & Computational Seismology. Research topics include: surface waves, free oscillations, body waves, seismic tomography, numerical simulations of 3-D wave propagation, and seismic hazard assessment.

**Examples of JP/STs:**

*Yuri Tamara: Antipodal focusing on Mars (JP)*

*Yuri Tamara: Convergence of Seismic Waves at the Antipode Generated by Impacts on Mars (JP)*

**# of students accepting = 1**

**Gabe Vecchi (Climate Science; <https://vecchi.princeton.edu/>)**

**Research Area:**

Climate science; extreme weather events; hurricanes; mechanisms of precipitation variability and change; ocean-atmosphere interaction; detection and attribution

**Examples of JP/STs:**

*David Ban: Sensitivity of the August 2022 South Korea extreme rainfall event to global warming using WRF model simulations (JP)*

*Grace Liu (Computer Sciences), Modeling and predicting hurricane frequency with machine learning (JP)*

*Laeo Crnkovic-Rubsamen: West Pacific Typhoon Tracks (ST)*

*Ben Buchoveky: Impact of Carbon Fertilization on the Position of the Intertropical Convergence Zone (ST)*

**# of students accepting = 2**

**Bess B. Ward (Biological/Chemical Oceanography; <http://nitrogen.princeton.edu>)**

**Research Projects:**

- 1) Nitrous oxide production and consumption in the ocean
- 2) Nitrogen cycling in aquatic environments
- 3) Molecular biological investigations of microbial biogeochemistry

**Examples of JP/STs from last 2 years:**

*Samuel Cryan: Global distribution of SAR11 in marine metagenomes (JP)*

*Samuel Cryan: Presence and abundance of SAR-11 nar genes in oxygen minimum zones (ST)*

*Levy Nathan: Investigating spatial and temporal patterns of water parameters in the Chesapeake Bay (JP/ST)*

*Galen Cadley: Novel nitrite oxidizing bacteria found in the oxygen minimum zones of expanding OMZs (JP/ST)*

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**Xinning Zhang (Geobiology; [http:// https://zhang.princeton.edu](http://https://zhang.princeton.edu))**

**Research Projects:**

- 1) Biological nitrogen fixation and the microbiology of trace gases in soils and wetlands
- 2) Characterizing biogeochemistry and microbial communities in aerobic biodigestion of food waste, fiber-based and bioplastic disposable dining ware to improve soil fertility and limit greenhouse gas emissions
- 3) Princeton University, which has prioritized composting as part of its sustainability plan with the Sustainable Composting Research at Princeton ( SCRAP lab), is exploring various methods, from in-vessel biodigestion to more traditional outdoor piles, to optimize the composting process for the campus community. In collaboration with Princeton's SCRAP lab.

**Examples of JP/STs:**

*Calvin Rusley: Effect of Fe addition and oxygen exposure on methane release from temperate wetland soil (ST)*

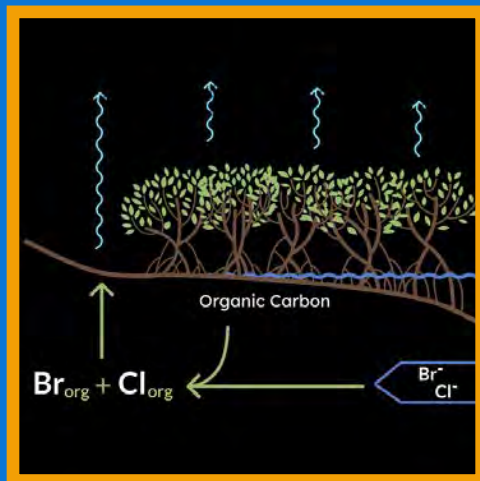
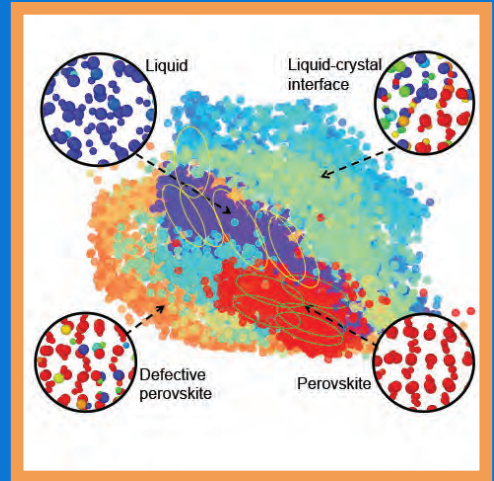
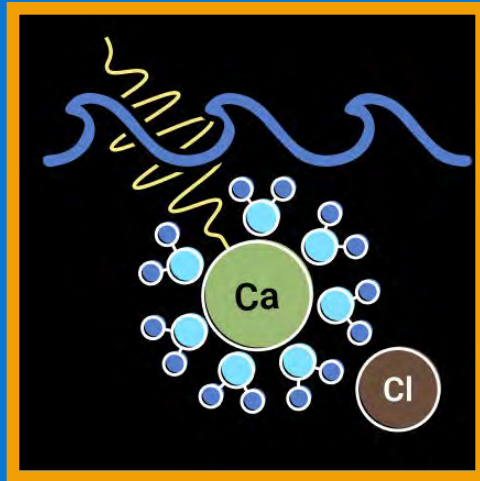
*Isabel Barroso Rodrigues: "Biochar as a Potential GeoEngineering Solution to Curb Methane Emissions in Peat Affected by Climate Change" (JP)*

**# of students accepting = 2**





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HMEI Summer Internship Program  
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