Geology At Union College

Department Brochure

The World is Your Classroom

Geology is the science of the Earth: the materials it is made of, the history of how it got the way it is today, the processes that shape it, and the effects of those processes on people. With Geology as your major, the whole planet is your field of exploration: from the Arctic to Antarctica, from the Earth's hot core to its turbulent atmosphere, from the ocean depths to the moons and other planets of our solar system, and from the rich history of life to the discovery of new mineral resources.

In Geology you are not confined by the walls of a classroom or laboratory. In fact, you can't do geology without observing rocks, processes, and structures first-hand, observing landscapes and weather patterns, and probing the Earth with sensitive instruments. That is why geology students typically wear jeans, a comfortable shirt, and hiking boots. Indoor work involves extracting detailed information from samples, making interpretations for regions that we cannot see directly, and building models for how our planet works.

Geology majors don't have to abandon their interests in other areas, including archeology, biology, economics, chemistry, politics, physics, history, or engineering. Geology is an open-ended science that needs people with a wide variety of expertise and experience. Geophysics, geochemistry, geologic hazards, global climate change, and paleontology are just a few areas of specialization.

Geology opens the door to a wide range of careers. Geology not only includes study of Earth's present and past, but the application of geologic science to benefit our society through understanding climate change, exploration for and extraction of vital natural resources, land use planning, teaching at all levels, and preservation of the environment. Union Geology graduates include some who hold high positions in business and government, including executives with major companies, directors of state geological surveys, and heads of respected academic geology departments. Others have used Geology as a springboard to careers in law, medicine, finance, computer services, and software development. The knowledge and skills gained with a Geology degree are widely applicable.

Our program offers a solid foundation in geologic science that enables students to be competitive in the job market and successful in graduate or professional school. Union is a liberal arts and engineering college with a long tradition of strength in the sciences, and a commitment to graduating well-rounded scientists with substantial field, laboratory, and writing experience. Our graduates know their stuff: "You guys prepped us really well!", said Geology major Alex Bartholomew while taking a field course in Wyoming with 50 other geology students from all over North America. Our graduates know how to organize a project, do the work, and carry it through to a written conclusion.

Excellent Teaching

Union Geology students have a distinct advantage: professors not only teach all classes and labs, they are also active research scientists. The Geology faculty know their subject, are enthusiastic, and know how to make classroom and lab instruction lively, interesting, and engaging. The faculty are as committed to research as their peers at large universities, but here the faculty emphasize involving undergraduate students and bringing cutting-edge insights from their original research into the classroom. In the setting of a 2,000-student college, Geology majors can have almost daily contact with their Geology professors.

Geology field trips are always exciting, and whenever possible the Geology Department brings its students into the field through course work and field trips. One field-based course on lake sedimentology and climate records starts out in January on the ice of frozen lakes. We supply proper clothing and equipment to make this a safe and enjoyable experience. Sediment cores and other measurements taken on site are then analyzed in the lab to yield a record of climate change in the Union College area extending back 15,000 years. Another regular course on carbonate sedimentology starts out by examining ancient carbonate rocks in the Union College area. The course ends with a week-long working field trip to a research station in the Bahamas. There, students examine fossil reefs above high tide level that are only thousands of years old, then dive to see modern reefs forming today. They explore partially submerged coastal caves, and take sediment cores from lakes and lagoons for records of climate change. These courses, and others, routinely draw the highest praise from students.

Student-Faculty Research Opportunities

At many colleges and universities, student research with faculty is usually restricted to graduate students or, at best, seniors. At Union College, undergraduate research, even for freshmen, is encouraged as a valuable, real-life component of learning. Through faculty-student research, many of our undergraduate students travel to areas that span the globe from the Olympic Mountains of Washington State to Newfoundland, from the Andes Mountains of Peru and Ecuador to the Russian far east, and from New England to New Zealand.

Union College is a national leader in fostering undergraduate research. Its students regularly present their work at the National Conference on Undergraduate Research (NCUR), and at Union College's Steinmetz Symposium on Student Creative, Scholarly, and Research Achievements. In addition, Union Geology majors routinely present their research at regional, national, and even international professional conferences. Students are usually first authors on their presentations, and many become coauthors on the full papers published in scientific journals.

Professors are Working Geologists

As professional scientists, Union's Geology faculty are teachers who are always learning; explorers and detectives of the natural world, eager to tell others about our fantastic planet and to lead them through the processes of discovery. Each examines our world using different methods.

John I. Garver (Ph.D., University of Washington, 1989) studies the evolution of mountain ranges across the planet. "One of my main goals is to understand mountains and mountain-building events," he says. He uses fission-track analysis (microscopic tracks in crystals left by the radioactive decay of uranium) and other methods to chronicle the formation of mountain ranges in eastern Russia, France, New Zealand, Washington state, Peru, Canada, and elsewhere. The object is to understand the timing and geometry of current and past tectonic events.

Kurt Hollocher (Ph.D., University of Massachusetts at Amherst, 1985) works on rocks in the deep, eroded cores of mountain belts to see what the igneous and metamorphic rocks there can tell us about the tectonic development of the original mountains. The mountains and the processes that made them are gone today, but old rocks can shed light on where and how the mountains developed in a plate tectonic context. He also works on the chemistry of natural surface and ground waters to understand how they formed and to track contaminants.

	**Jaclyn Cockburn** (Ph.D. Queen's University, Kingston, 2007). Research interests are in past and contemporary cold region landscape processes, specifically, how climate variability has modified or changed these processes and how our knowledge of past processes are informed through the use of paleoenvironmental proxies. Also interested in the formation of clastic varve records and the isolation of the different process signals (e.g., climatological, hydrological, geomorphological) from these records. How these high resolution sedimentary records can be used to evaluate landscape changes (e.g., permafrost degradation or destabilization) through time. High resolution records will help us understand how surface processes in the past have responded to climate change and how they might change in the future.
	**Holli Frey** (Ph.D. University of Michigan, 2005). Evolution of continental magmatic systems and the origin of continental crust. Emphasis is on field-based research in Mexico, using geochronology, GIS, and geochemistry to address first order questions: How and over what time frame do stratocones grow? Is episodic stratocone growth unique to the tectonic setting of western Mexico? What is the cause of the observed long dormant periods? Are magma chambers beneath stratocones ephemeral, or are the magmas slowly undergoing differentiation? How does the geochemistry of the lavas change over time and what constraints does that place on petrogenetic models?
	**Donald Rodbell** (Ph.D., University of Colorado, 1991) is interested in documenting the geologic record of global climate change. His focus is on the timing of fluctuations of mountain glaciers during the last 2 million years in the Andes Mountains of Peru and Ecuador, and on the geologic record of El Nino preserved in lake deposits in the tropics. Recently, he has applied these techniques to lake deposits in the northeastern U.S. These records provide important information on natural cycles of climatic change on which human effects have been superimposed.
	**George Shaw** (John and Jane Wold Professor of Geology; Ph.D., University of Washington, 1971) works on the gooey remains of volcanic ash layers (bentonites) in North America that are up to 500 million years old. He analyses mineral grains in the bentonites to correlate the layers across long distances, and to better understand the processes within the original volcanoes. He also studies materials at high pressures and temperatures to better understand the Earth's deep interior, and works on the hydrogeology and cave systems of central New York State.
	**Robert Finks** (Research Professor, retired from Queens College). Paleontologist specializing in Paleozoic reefs, particularly sponges. Also interested in planetary geology.

William Neubeck (Certified Professional Geologist, M.A., State University of New York at Binghamton, 1979) spent over ten years as an environmental consultant in the fields of hazardous waste and hydrogeology prior to joining the Geology Department. As Geology Department Technician he combines his earth science training and professional experience with electronics, plumbing, metal working and carpentry to keep everything functioning.

Up-to-Date Equipment

The equipment used by Geology majors is among the most up-to-date and sophisticated available anywhere in the world. This equipment is used both in regular courses and for student and faculty research work. In includes a pontoon boat, imaging sonar, sampling equipment, and a wide variety of field and analytical equipment.

A prime example is our inductively coupled plasma mass spectrometer (ICP-MS). In 1989 Union was the first undergraduate college in the world to obtain such an instrument. We have recently replaced it with a new instrument that can determine the abundances of elements in rocks, minerals, and water at concentrations of one part per trillion or less. Our students have used this instrument for a variety of projects, including the origin of magmas, the chemistry of mineral springs, correlation of volcanic ash beds, evaluating the tectonics of ancient sedimentary basins, and tracing the migration of toxic metals from landfills. Even at colleges and universities that have such instruments, only rarely do undergraduates have ready access to, and opportunities to use, this kind of equipment.

Extensive Specimen Collection

Union College has been building its rock, mineral, and fossil collection for 200 years, and it now contains about 10,000 specimens. The mineral collection ranks as one of the best small college collections in the country and is a resource for both teaching and research.

Geoscience at Union!

In the Union Geology Department students do and learn modern geologic science. They collect cores and study the actual geologic records of global warming, El Niño, and other aspects of climate change. They collect and analyze water and rocks to solve current geologic problems including ground water movement and contamination. They use remote sensing to interpret ice cover changes in Alaska over the past three decades, and land use changes in New York State. They use geophysical equipment to learn about parts of the Earth hidden from view. They map outcrops to determine fault movement and hurricane frequency in rocks nearly half a billion years old. Learning geology by doing it, using modern methods and instrumentation: this is Union Geology!

Pick up any newspaper and read about earthquakes, landslides, floods, drinking water, groundwater contamination, mineral and fuel resources, volcanoes, and global warming. Geology is all around us, it is always new, it affects everyone, it is fun to do, and opportunities abound. The Union Geology Department is small but strong. Our students do geologic science by working closely with their faculty; all learning about our fascinating planet: this is Union Geology, and this is what geologic science is all about!

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