

GEOLOGY DEPARTMENT

Professor Eric Grosfils, department chair 2009-10

Professors Grosfils, Hazlett

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Geology is an interdisciplinary science dedicated to understanding the formation and evolution of our planet and the other bodies in the solar system. Geologists probe the deep past to see as clearly as possible how life has evolved, how the continents have shifted and how climates have changed. They apply the tools of chemistry, biology, physics and mathematics in doing so and examine problems that range in scale from microscopic to interplanetary using a variety of approaches including fieldwork, laboratory analysis and computational modeling. In addition to guiding the stewardship of mineral and energy resources vital to society, geologists increasingly strive to reduce the impact that geological hazards (e.g., earthquakes, volcanoes, landslides) have on people and to reduce the adverse effect people have upon the natural environment (e.g., soil erosion, polluted groundwater). An understanding of geology is essential for solving many environmental problems.

Taking advantage of the department's proximity to such features as the San Gabriel Mountains, Sierra Nevada, the Pacific Coast, the San Andreas Fault and the Mojave Desert, students augment their classroom and laboratory experiences by exploring the spectacular geological setting around them. This exploration of the natural world often occurs through formal research projects, recent examples of which include introductory class projects using high-resolution images of the Martian surface and upper-level class projects on the sedimentary record of climate change from the ancient Colorado River delta. Pomona College is affiliated with 17 other colleges in the Keck Geology Consortium: Amherst, Beloit, Carleton, Colgate, College of Wooster, Colorado College, Franklin & Marshall, Macalester, Mt. Holyoke, Oberlin, Smith, Trinity, Union, Washington & Lee, Wesleyan, Whitman and Williams. These schools pool their students, faculty and resources to conduct summer research projects, most of which lead to senior theses at the member colleges. Field work for these projects takes place in many parts of the United States and abroad, allowing students in recent years to conduct research in Alaska, California, Colorado, Hawaii, Idaho, Maine, Massachusetts, Minnesota, Montana, New York, Ohio, Oregon, Pennsylvania, Utah, Virginia, British Columbia, Nova Scotia, Costa Rica, China, Iceland, Ireland, Italy, Jamaica, Mexico and Mongolia. To learn more about the Geology Department and its activities, see www.geology.pomona.edu.

Geology students typically have a wide variety of employment options, as their education prepares them for a diverse array of professional activities. A few examples include environmental consulting, landslide and erosion assessment, sea-floor exploration, planetary remote sensing, volcanic and seismic studies, hydrology, environmental law, mining and teaching. In addition, many students continue their education by entering graduate school to pursue advanced degrees. Irrespective of the professional path they follow, geologists polled in recent surveys ranked near the top of the list among professionals satisfied with their careers, in part because so much of their work provides the opportunity to investigate the outdoors.

Departmental Facilities: The Geology Department is housed in the Edmunds Building and is well-equipped to support a variety of different field-based projects as well as geophysical, hydrogeological, mineralogical, petrological, field-, lab- and computer-based research. Physical facilities include a sample preparation room with rock saws, etc.; a Rigaku

X-ray diffractometer; an X-radiography laboratory; a paleomagnetism laboratory; a laser particle size analyzer; a cathodoluminescence instrument; a carbon coulometer system; a mineral separation lab; an array of stereographic and polarizing microscopes; a GIS-equipped computer classroom; a wet lab; an excellent rock, mineral and fossil collection; a growing collection of NASA and other satellite data; and an array of hydrogeological and geophysical equipment. The Geology Department is also a cooperative member of Pomona's EDX-equipped Scanning Electron Microscopy facility housed in the Physics Department.

Requirements for the Major in Geology

The department offers five major tracks of study and a minor.

General Geology Track Requirements

This track's curriculum is intended for students who wish to pursue their liberal arts education by learning about the geological formation and evolution of the earth. Such study provides students with a sound basis for assessing numerous scientific and social issues. Requirements include:

1. An introductory course: 20A, B, C, D or E
2. A set of seven core courses: 123, 125, 127, 129, 181, 183, 185
3. Two electives
4. 192, a year-long senior thesis
5. Two semesters of college introductory calculus

Students, particularly those interested in pursuing graduate studies or professional careers as geologists, are strongly encouraged but not explicitly required to take a full year of introductory chemistry and physics as well as an approved summer field camp. An excellent way to pursue the latter is through participation in the College's competitive new Frontiers Abroad study abroad program in New Zealand, which includes a five week field camp prior to the start of an academic semester in either Auckland or Christchurch.

Environmental Earth Science (E.E.S.) Track Requirements

This broad but still scientifically rigorous track is intended for students who wish to acquire a geological basis for understanding environmental problems, but is not intended for students who plan to pursue a career in geology. It is a more science-intensive complement to the geology option in the Environmental Analysis Program and is designed to support careers in environmental policy, law, teaching, consulting or, with supplementary graduate training, environmental research. Requirements include:

1. An introductory course: 20A, B, C, D or E
2. Three intermediate-level courses (take three of four): 123, 125, 127 and 129
3. Two upper-division courses (take two of three): 181, 183, 185
4. 110 or 115 or 120
5. MATH 30
6. BIOL 40 and 41E, or JS BIOL 44 and JS BIOL 146
7. CHEM 1A,B or 51 or JS CHEM 14, 15 or JS CHEM 29
8. One upper-division course in chemistry or biology: BIOL 104 or 112, or CHEM 110
9. One pertinent elective to be selected by the student. This elective need not be from the geology curriculum, but must relate in some clear way to the student's senior thesis goals and must be approved by the student's major advisor. Relevant courses from any of The Claremont Colleges may be applied.
10. 192, Senior Thesis in Geology

Earth, Planetary and Space Science Track Requirements

This track, which blends geology and physics/astronomy, facilitates interdisciplinary exploration of the space sciences with a focus on understanding the formation and evolution of our planet, other solar system bodies, stars and the galaxies of our universe. The curriculum below is specifically intended for students who wish to pursue graduate studies and professional careers in planetary geology; a similar track with a slightly different space science emphasis (i.e., disciplinary focus) is offered by the Physics Department. Requirements include:

1. Introductory Courses: 20 (20B recommended); ASTR 1, 51 or 62; PHYS 51A,B; MATH 30, 31 and 32
2. Disciplinary Focus in Geology: 110; plus any two courses from 123, 125, 127 or 129; plus one course from 181, 183 or 185; ASTR 101; plus one other astronomy credit of the student's choice
3. Independent Study: 199 or ASTR 199, advanced study topic to be selected in consultation with Mr. Grosfils, Mr. Penprase or Mr. Choi
4. 192, Senior Thesis in geology

Public Policy Major in Geology Track Requirements

This track is intended, as is E.E.S., for students with minimal interest in pursuing a career in geology. However, it differs from E.E.S. and the environmental analysis-geology paths in having a much stronger public policy focus and a lighter science course load. See the Public Policy Analysis Program section of this catalog for information about requirements.

Geochemistry Track of Chemistry Major Requirements

This track's focused curriculum is intended for students who wish to pursue graduate studies and professional careers as geochemists. Refer to the Chemistry Department section of this catalog for further information.

Requirements for a Minor in Geology

The Geology Minor consists of six courses.

1. An introductory course from GEOL 20A, B, C, D or E
2. Two intermediate-level courses (take two of four): 123, 125, 127, 129
3. Three additional geology courses from those numbered 100 and above (not to include 192 or 199 without permission of the department faculty)

These six courses include an introduction to the science and several core classes, giving each student the flexibility to design a minor tailored to individual needs and interests. Students whose major requires a significant number of geology courses cannot also minor in geology. Examples include students who pursue the geochemistry track through the Chemistry Department or those with a special concentration in environmental analysis with a geology emphasis.

Courses

Geology (GEOL) courses satisfy Area 4 of the Breadth of Study Requirements.

Introductory Level Courses

Note: No more than one section of GEOL 20 may be taken for credit.

20A. Introduction to Geology: Geohazards. *Mr. Lackey.* Environmental response to natural and anthropogenic forces may result in various geologic hazards, including earthquakes, volcanic activity, landslides, coastal erosion, floods and groundwater pollution. This course includes an introduction to basic geological concepts, with a focus on current hazardous regions, historical events, impact on humans and forecasting abilities. Field trips. Fall 2010; offered alternate years.

- 20B. Introduction to Geology: Planetary Geology.** *Mr. Grosfils.* Comparative study of Mars and Earth provides exciting opportunities to gain insight into physical geological processes. In this class we explore how the operation of a similar array of geological processes (e.g., impact cratering, volcanic, tectonic, hydrological) can yield such strikingly beautiful yet mutually alien surfaces over the course of solar system history. Field trips. Fall 2009; offered alternate years.
- 20C. Introduction to Geology: Environmental Geology.** *Staff.*
- 20D. Introduction to Geology: Paleontology and the Evolution of Earth's Biosphere.** *Mr. Gaines.* Life on Earth originated during changes on a young planet and Earth change has driven biological innovations and crises over the last four billion years. Likewise, evolving organic processes have dramatically changed Earth both physically and chemically. Topics include origins of life, evolutionary breakthroughs, mass extinctions, biogeochemical cycles and fundamental principles of geology and paleontology. Spring 2010; offered alternate years.
- 20E. Oceanography.** *Ms. Reinen.* Investigation of geological, physical, chemical and biological processes operating in the oceans. Topics include marine geology, plate tectonics, seawater chemistry, tides, currents, coastal processes, marine life and human interactions with the oceans. Field trips. Spring 2011; offered alternate years.

Intermediate Level Courses

- 110. Looking at the Earth: Using GIS and Images from Space to Explore our Environment.** *Mr. Grosfils.* Introduction to GIS and interpretation of satellite images, with laboratory. How and why are these powerful modern tools used to learn about the Earth's environment—including geological, biological, hydrological and human components? An understanding of basic physical principles, integrated with extensive hands-on work emphasizing digital analysis, paves the way for a project in which students explore a complex environmental problem. Each spring.
- 115. Hydrogeology.** *Ms. Reinen.* Introduction to groundwater geology. Includes the hydrologic cycle, surface and groundwater chemistry, geology of hydrologic systems and methods used for characterization of finite water resources, with special emphasis on problems inherent to Southern California. Field trip. Prerequisites: One course from 20 series and MATH 30. Spring 2010; offered alternate years.
- 120. Introduction to Geochemistry.** *Mr. Lackey.* The course provides an overview of the field of geochemistry while introducing the tools and theory to address modern geologic problems and to fingerprint past geochemical processes preserved in the rock record. Topics range from low-temperature aqueous systems to high-temperature igneous and metamorphic systems. Prerequisite: A course in the 20 series. Fall 2009; offered alternate years.
- 121. Volcanology.** *Mr. Hazlett.* An introduction to volcanic systems and how they relate to their plate tectonic setting. Topics of study will include volcano types, eruptive products, lifespan and how humans interact with these not so gentle giants. Field trips. Prerequisite: A course in the 20 series. Fall 2009.
- 123. Neotectonics of Southern California with Laboratory.** *Ms. Reinen.* Investigation of active Southern California tectonics, with emphasis on seismology (earthquakes) and paleoseismology, records of earth movement and tectonic geomorphology. Field trip(s). Prerequisite: One course from the 20 series. Each spring.
- 125. Earth History with Laboratory.** *Mr. Gaines.* Earth system evolution through geologic time. Earth's dynamic history is explored through examination of key intervals of change: topics include origin of Earth, development of continents, origin and evolution of life, Earth crises and mass extinctions and climate change. Lab component emphasizes interpretation of geologic history from the rock record. Field trips. Prerequisite: A course in the 20 series. Each spring.

- 127. Mineralogy with Laboratory.** *Mr. Lackey.* Minerals are the building blocks of the solid Earth. The interrelation of chemical, structural and optical properties is emphasized for identifying minerals in the field and lab and understanding their geologic significance. The course makes use of optical and electron microscopy, X-ray diffraction and computer visualization techniques. Field trips. Prerequisite: A course in the 20 series. Each fall.
- 129. Geophysics with Laboratory.** *Mr. Grosfils.* Introduction to geophysical techniques and their application to geological investigation of the subsurface at a variety of scales. Computer applications, hands on field training and interactive discussions provide insight into the principles of seismic, gravity, magnetic and other key geophysical methods. Prerequisite: MATH30 and one course from the GEOL 20 series. Letter grade only. Each fall.

Upper-Level Courses

- 152. Climate Change.** *Mr. Gaines.* An integrated perspective of Earth's dynamic climate through time. Students will explore the linkages of physical, chemical, biological and geological factors which regulate the Earth's intricate climate system. Special emphasis to be placed on the geologic record of Earth's climate and evaluation of anthropogenic influences on climate. Prerequisite: 125. Spring 2011; offered alternate years.
- 160. Geomodeling.** *Mr. Grosfils.* Introduction to the use of numerical models for exploring geological processes, with a strong emphasis placed on the finite element method and a selected array of volcanological problems. Prerequisites: MATH 30 and one of 123, 125, 127, 129. Letter grade only. Fall 2010; offered alternate years.
- 181. Igneous and Metamorphic Petrology with Laboratory.** *Mr. Lackey.* Igneous and metamorphic rocks and the processes by which they originate, are evaluated from thermodynamic, geochemical and petrographic perspectives. Topics include magma formation, diversification and crystallization, pressure-temperature-fluid histories of metamorphic rocks and petrofabric analysis. Emphasis is placed on how to recognize petrologic associations and relate them to tectonic setting. Includes field trips and lab section. Prerequisites: 127, plus pre- or co-enrollment in 123 or 125. Each spring.
- 183. Sedimentology with Laboratory.** *Mr. Gaines.* Origin and interpretation of sedimentary rocks with focus on interpretation of ancient depositional environments, sedimentary petrology and actualistic study. A major independent research project, conducted throughout the semester, is included. Field trips. Prerequisites: 125 plus pre- or co-enrollment in 123 or 127. Each fall.
- 185. Structural Geology with Laboratory.** *Ms. Reinen.* A study of the geometry and origin of rock structures from microscopic to continental scale. Topics include stress, strain, deformation mechanisms and the large-scale forces responsible for crustal deformation. Field trips. Prerequisites: 123 plus pre- or co-enrollment in 125 or 127. Each fall.
- 192. Senior Project.** *Staff.* Field-, laboratory- or library-based geological research to address an original question undertaken by arrangement with a faculty supervisor during the senior year. Students conducting field or laboratory research generally start their work in the summer prior to their senior year. Half-course each semester. Grade and credit awarded at the end of the second semester. (Students may complete the thesis in one semester by permission.) Letter grade only. Each semester.
- 99/199. Reading and Research.** *Staff.* Special work in certain advanced subjects not treated in other courses of the department. Available to interested students by arrangement with a faculty supervisor. Prerequisite: permission of instructor. 99, lower-level; 199, advanced work. Course or half-course. May be repeated. Each semester.