Geology Department
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https://www.coloradocollege.edu/academics/dept/geology/

Great Sand Dunes National Park, CO
Photo by Stephen Weaver

Regional Studies Class in Montana

GEOLOGY MAJORS HANDBOOK
Department Philosophy

The courses in the major are designed to provide a foundation for a professional career in the earth sciences, provide the background for graduate school, which has increasingly become a necessary prerequisite to a professional career, provide an opportunity for students majoring in other fields to combine their expertise with geology, and educate students about the physical environment and our place in it, as part of a liberal arts education.

Faculty Research Interests

**Henry Fricke**—Stable isotope and low temperature biogeochemistry, paleoclimatology, paleobiology.

**Visiting Professor Emily Pope** —

**Eric Leonard** — Glacial geology and paleoclimate in the Western Cordillera of the U.S. and Canada, periglacial geomorphology, late Tertiary and Quaternary tectonics of Colorado and Chile.

**Paul Myrow** — Sedimentary structures; bedforms and stratification; sedimentation and biostratigraphy of Neoproterozoic and lower Phanerozoic deposits; Newfoundland, Colorado Rockies and Great Basin.

**Jeff Noblett** — Volcanology, precambrian geology of central Colorado; petrogenesis of igneous and metamorphic rocks.

**Christine Siddoway** — Structural and metamorphic geology of Antarctica and the Colorado Front Range; Gondwana tectonics.

Regional Studies Class in California

Pikes Peak and Garden of the Gods
Photo by Stephen Weaver
Geology Curriculum

Most courses are field-oriented and include day-long field trips in the local Colorado Front Range and multiday, sometimes multi-week, trips through Colorado and into New Mexico, Utah, Arizona, and Wyoming. We thus take advantage of the spectacular and varied geology of the Rocky Mountain, Basin and Range, and Colorado Plateau Provinces and from time-to-time travel further afield throughout the US and Canadian West. Courses use modern field technologies (including GPS, digital mapping and geophysical methods) as well as traditional field approaches. On campus they make use of Geographic Information Systems (GIS) and other computer software.

Introductory geology courses spend a substantial amount of the class time studying natural outcrops, with students learning how the diverse rock types in our region form, and their stratigraphic and structural relationships. Students undertake guided research on a variety of topics.

Students start the major by taking GY 211 Earth as a Chemical System and GY 212 Earth as a Physical System. These courses cover mineralogy, petrology, surface processes, structure, tectonics and geophysics principles within the context of Rocky Mountain geology. The courses are project focused, involving both extensive fieldwork and on-campus data analysis and writing. They serve as prerequisites to the 300-level courses.

Stratigraphy, Sedimentation, Paleontology, and Historical Geology courses cover the nature of sediment and analysis of sedimentary structures to interpret modern and ancient depositional systems; marine invertebrate phyla, ecology, and evolution; and geological evolution of the Earth through time.

Surface processes examine surficial processes and landscape evolution in environments ranging from the desert Southwest to the Colorado alpine. Courses involve students in field project design, data collection and analysis, and GIS work.

Structural Geology and Geophysics explore the architecture of Earth’s lithosphere, from near-surface through subsurface, including mantle depths. Emphasis is upon the application of field instrumentation and methods to investigate mountain-building processes and continental tectonics, using field sites in the nearby Rocky Mountains and beyond.

Petrology and Geochemistry of the Rock Cycle courses examine minerals and rocks in detail, the geochemical principles that govern how elements are partitioned between earth reservoirs, and the conditions of their formation.

Some Recent Student Research Projects

Forrest Corcoran “Exploring the Use of Geophysical Methods to Identify and Characterize the Geometry and Movement of Slope Failures in Regions of High Landslide Susceptibility”

Erica Evans “Fluvial landscapes of the Cretaceous: Insights integrating stable isotope geochemistry, sedimentology and taphonomy”

Aaron Farquhar “Ballistic Analysis Inferring Subsurface Hydrothermal Alteration and Mineralogical Seal Control on Eruptions at Whakaari Volcano, New Zealand”

Grace Guryan “Ground Penetrating Radar Analysis of the East River Floodplain Near Crested Butte, Colorado”

Matt Hess “Applied Seismology: An Investigation of the Water Table Beneath Jacks Valley, United States Air Force Academy, Colorado”

Erin Hightower “Clastogenesis as a Result of Reactivation of Agglutinated Spatter”

Skye Keeshin “Shallow Ice Radar Analysis of the North-Western Ross Ice Shelf: Quantifying Ocean-Cryosphere Interaction”

Charles Russell “CRN Dating and Numerical Modeling to Investigate Climate During the Last Glacial Maximum, and the Subsequent Deglaciation, Sawatch Range, Colorado”

Everett Smith “Experimental Investigations of Surface-Wave-Modified Turbidity Current Dynamics”

Cole Thompson “Mode of Emplacement of Tava Quartzite Injectites: Using Dike Geometries and Detrital Zircon Provenance Analysis”

Tristan White “Geochronology of Cambrian rocks of Thailand and Myanmar”
**Geology Department Requirements for the Major**

**GEOLOGY COURSES** — All majors must pass courses listed in categories A through F below with a grade of C–/S or above:

A. Entry-level (1 unit):
   - GY130 Introductory Geology or GY140 Physical Geology

B. 200-level (2 units):
   - GY211 Earth as a Chemical System
   - GY212 Investigating Earth as a Physical System

C. 300-level (6 units):
   - GY305 Stratigraphy and Sedimentation
   - GY320 Surface Processes and Geomorphology
   - GY335 Geochemistry of the Rock Cycle
   - GY310 Igneous Petrology or GY313 Metamorphic Petrology
   - GY308 Introductory Geophysics
   - GY315 Structural Geology

D. Elective in Geology (1 unit):
   - Courses must be at the 200 or 300 level, GY207 and GY307 excluded. GY 400 or 445 may count toward this requirement if another class is used to satisfy the Capstone requirement (E).

E. Capstone (1 unit):
   - One of: GY400, GY445 Regional Studies, or GY405 (senior project or senior thesis) [Note: a single course may not be used to satisfy both D and E.]

F. Other Required Courses:
   - All majors must also pass the following with a grade of C–/S or above:
     - PC 141 – Introductory Physics I or PC 241 – Introductory Classical Physics I
     - CH 107 – General Chemistry I
     - MA 117 or BY 220 or EV228 – Probability and Statistics
     - MA 126 – Calculus I

15 UNITS TOTAL

Geology majors, and especially those intending to go on to graduate school in geology, are strongly urged to take additional courses in geology, environmental science, mathematics & computer science, chemistry, physics, and biology; to take GY400 Senior Seminar in Geology, and to attend a summer geology field camp offered by a university.

AP credit may not be counted towards the supporting science requirement. Students with AP credit or who have tested out of any of the above courses in PC, CH, or MA must take the next higher course in the department's sequence.

**Senior Thesis**

A number of sophomore and junior majors undertake research projects in conjunction with faculty members and may receive GY207 or GY307 credit for that work, depending on the coursework background they have coming into the project. Most senior majors undertake an independent research project. They can receive GY405 credit, and use the project to fulfill their major “capstone” requirement if the project involves a significant amount of original work. If the project involves literature review only it can receive GY307 credit, but not GY405 credit, and will not satisfy the capstone requirement. (See “Research in Geology: A Primer” on the Geology webpages.)

Students must stay informed about research-related deadlines to ensure that all are met. Deadlines are covered during the fall major’s meeting, and posted on the department website, including the research proposal deadline on the first day of Block 3 (ordinarily) and abstract deadline for Geology Day presentations (in Block 7), among others. Aspects of the research effort that students should anticipate include:

- Working with their faculty advisor on a draft proposal in advance of the Block 3 proposal deadline. Proposals that have not been reviewed by the faculty advisor will not be accepted.
- Having two department faculty members read the proposal to judge the quality of the proposal and feasibility of the proposed work, and to determine whether the student may proceed with the research project.
- Draft of complete thesis due to advisor by the end of Block 6

**Graduation with Distinction in Geology**

‘Distinction in Geology’ is a recognition by department faculty of extraordinary academic achievement on the part of a senior geology major, one that is noted on a student’s academic transcript and diploma. Because there are no special requirements to be considered for distinction, all seniors are eligible. It should be realized, however, that ‘distinction’ implies unusually strong performance, and not all seniors will be awarded this honor. In fact, it may only be awarded to one or two students a year. There is no checklist of achievements that guarantees a student will be awarded distinction; instead faculty consider the academic goals students have set for themselves, how well the goals have been met, and the individual initiative displayed in achieving the goals. Goals that have traditionally helped students in this regard include:

- taking more than the required number of courses in the major and maintaining a high grade point average (or showing a marked improvement in grades over time)
- taking a number of courses in an important related field (e.g. math, computer science, chemistry, physics, biology, environmental science) and maintaining a high grade point average (or showing a marked improvement in grades over time)
- successfully undertaking a senior project, including a Geology Day presentation
- successfully completing a senior thesis
Undergraduate research and funding opportunities

Geology majors have the possibility of doing independent research work throughout their college careers, and the Department encourages all of our majors to get involved in one or more research projects. Research involving both literature review and original work introduces a student to a dynamic community of Earth scientists who act as colleagues, collaborators, peer reviewers, and intellectual resources. Original research also provides an opportunity for students to demonstrate their creativity and self-motivation, and can thus provide an advantage when applying for jobs, internships, and graduate school.

The department provides a significant amount of support for geology majors interested in doing research in geology or internships with professional geology opportunities (including industry, government, museum, or university locations). Talk with your advisor or the staff assistant about these awards and the timing of applications (also covered during the spring Majors Meeting):

- Buster funds provide scholarships for independent research.
- Witter funds provide grants for internships in professional geology settings.
- McKenna Scholarships support two students annually in a research project. In the Rocky Mountains.
- Hannigan and Creager awards, and many gifts from our alumni support field work for research.
- The Keck Geology Consortium (CC and over a dozen geology departments in other liberal arts colleges) runs group summer research projects that allow one or two CC students to work with faculty and students from other schools on research projects.

Recommended Sequence of Courses

- First-Year: GY140 Physical Geology, one elective (esp. GY205 Historical), Chemistry 107, Calculus or Prob/Stats.
- Sophomore year: Above plus GY211, 212 & PC141 or 241, and the second math. Preferably one or more of the required 300-level classes.
- Junior year: 4-5 of the six required 300-level courses and any supporting science. If planned carefully this may allow for a semester abroad.
- Senior year: The remaining required courses, Senior Capstone, research, and thesis blocks.

Important Dates for Geology Majors

- Declare as soon as possible so you’re on the geology listserve for announcements
- Ask one of the geology professors to be your advisor before declaring.
- Majors meeting in the fall and one in the spring
- Geology Day is generally during 7th block; a day for majors who have completed research to present that research to their peers. Attendance is required for all majors.
Off-campus credits and study abroad

In general, no more than two geology courses taken off-campus may substitute for classes taught at Colorado College and thus satisfy requirements of the geology major. In order for substitutions to take place, students must submit a written request to the chair of the department for consideration by the full department. Students may take the non-geology required courses off-campus (e.g. physics).

The department encourages majors to study abroad for a semester, especially in a place where they could learn the local geology. Currently, one of the best programs for this is the New Zealand Frontiers Abroad five-week field course, combined with a semester at the University of Canterbury with one or two geology classes included in your schedule. The ACM spring semester in Costa Rica is focused on independent research and a few geology students have done well there (Spanish required). Upper-level geology courses are taught in English in programs including those at Edinburgh, DIS Denmark, and in Australia; advanced Spanish speakers will find some opportunities to take upper-level geology classes in Latin America or Spain. Generally the department will accept one class as a substitute for one of the required six 300-level courses, if its syllabus is equivalent to what we teach, and will also accept one elective. These decisions must be approved before you go and will be based on items such as a syllabus for the course that you can provide to the department.

Examples of jobs alumni get after receiving a Geology degree from Colorado College

Whitewater rafting and fly fishing business
Renewable energy
Department of Energy
Teaching
Exploration Geologist
Real Estate
Professor
Artist

Some universities where Geology alumni pursue graduate degrees:

Arizona, University British Columbia, Cal Tech, University of Southern California, Columbia, Colorado School of Mines, Colorado State University, Colorado University, Harvard, MIT, University of New Mexico, New Mexico Tech, Ohio State, Stanford, Vanderbilt, University of Washington, University of Wyoming, Yale
GY 308 - Introductory Geophysics
Applications of physics to the study of Earth structure from crust to core. Seismology, magnetics, gravity, and geodesy. Explores history of Earth's formation, current geologic and tectonic problems, and uniqueness of interpretation issues. Prerequisite: Mathematics 125 or Mathematics 126, Physics 141 or Physics 241, and Geology 210 or Geology 212 or consent of instructor. 1 unit

GY 310 - Igneous Petrology
Classification, modes of occurrence and origin of igneous rocks. Prerequisite: Geology 210 or Geology 211 and Chemistry 107. 1 unit

GY 315 - Structural Geology
A study of the geometry and origin of rock structures from microscopic to continental scale. Mechanical behavior of rocks, stress and strain, plate tectonic context of rock deformation. Prerequisite: Geology 210 or Geology 212 and Physics 141 or Physics 241. (Meets the Critical Perspectives: Scientific Investigation of the Natural World requirement.) 1 unit

GY 320 - Surface Processes and Geomorphology
Mechanical and chemical processes involved in the development of landforms. Discussion of weathering and soils, mass movement, fluvial, and glacial/periglacial processes and landforms, tectonic geomorphology, and landscape evolution. Course involves significant components of laboratory and field work. Prerequisite: Geology 210 or Geology 212 and Physics 141 or Physics 241. (Meets the Critical Perspectives: Scientific Investigation of the Natural World requirement.) 1 unit

GY 321 — Glacial Geology
An introduction to glaciology and glacial geomorphology. Course also examines the nature, history, and causes of Quaternary glaciation. Prerequisite: Geology 320 or consent of instructor. 1 unit

GY 335 - Geochemistry of the Rock Cycle
Atomic-scale to lithospheric-scale investigation of geologic processes that occur as a result of chemical reactions, and the evidence of these reactions in the rock record. Includes study of chemical behavior of common and rare elements in the earth, and of isotopes of these elements. Theoretical concepts are reinforced by collection and analysis of geochemical data by students, critical reading of journal articles, and by scientific writing summary papers and research proposals. Prerequisite: Geology 210 or Geology 211 and Chemistry 107. 1 unit

GY 405 - Research Topics in Geology:
Student participation in original research. The particular topic, chosen in conjunction with a faculty member, to be included in the course title whenever offered. (May be taken either as a block course or as an extended format course with 1/2 unit of credit per semester.) Prerequisite: consent of instructor. 1 unit

GY 445 - Regional Studies in Geology
An in-depth study of a geological region that requires students to apply fundamental knowledge and skills acquired through the course of their college education. Involves in-depth study of primary rock relationships in a field setting, critical reading of published geological literature, and interpretation and synthesis in oral/written formats. Prerequisite: Senior Geology major and consent of instructor. 1 unit

GY 115 — Oceanography
Basic principles of physical and chemical oceanography. (Meets the Critical Perspectives: Scientific Investigation of the Natural World requirement.) 1 unit

GY 140 - Physical Geology
The fundamentals of physical geology: igneous, metamorphic, and sedimentary rocks; basic mineralogy; structural geology; mapping; and examination of local stratigraphic units. (Meets the laboratory/field requirement for the natural sciences.) Prerequisite: No credit after Geology 130. (Meets the Critical Perspectives: Scientific Investigation of the Natural World lab or field requirement.) 1 unit

GY 205 - Historical Geology
Historical development of the Earth and life history emphasizing the major tectonic and stratigraphic patterns and the feedback between the physical Earth and biological evolution. Prerequisite: Geology 190 or 140. (Meets the Critical Perspectives: Scientific Investigation of the Natural World requirement.) 1 unit

GY 211 - Earth as a Chemical System
Study of the earth as a chemical system where a limited number of elements react over a range of geologic conditions to form igneous, sedimentary and metamorphic rocks characterized by unique mineral assemblages. Topics covered include processes driving rock-forming reactions, where they take place, and why certain minerals are associated with each rock type. Also included is a study of the chemistry, crystallography and identification of silicate and other common minerals based on their physical, optical and diffractive properties. Field and lab projects enable students to build upon their knowledge of Rocky Mountain geology. Prerequisite: Geology 130 or 140; CH 107. (Meets the Critical Perspectives: Scientific Investigation of the Natural World requirement.) 1 unit

GY 212 - Investigating Earth as a Physical System
Studies of rock deformation, landscape formation and earth structure are used as a framework for developing skills in hypothesis formation, project design, data analysis and scientific writing. These skills serve as a foundation for work in higher-level Geology courses and on independent research projects. Prerequisite: Geology 130 or 140; Physics 141 or 241. No credit if taken after Geology 210. (Meets the Critical Perspectives: Scientific Investigation of the Natural World requirement.) 1 unit

GY 240 - Plate Tectonics
History of Plate Tectonics and its formulation, paleomagnetic record of ocean crust, geodynamics and tectonic theory, active tectonics, current frontiers. Prerequisite: Geology 130 or 140 and one 200-level GY course. 1 unit

GY 250 - Studies in Geology:
Geological topics, such as Advanced Environmental Geology, Hydrology, Mineral Resources Problems and Policies, and Colorado Alpine Environments, offered in different years. (May meet the laboratory/field requirement for natural sciences.) Prerequisite: Geology 130 or 140. 1 unit

GY 305 - Stratigraphy & Sedimentation
Transport and deposition of sediment, modern and ancient depositional systems, basin analysis, and correlation of sedimentary rocks. Field work emphasizes analysis of sedimentary structures and facies models for paleoenvironmental interpretation. Prerequisite: Geology 210 or Geology 211. 1 unit
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<td>GY211 Earth as a Chemical System w/Pope</td>
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<td>GY300 Invertebrate Paleontology w/Wilson</td>
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