

# GEOLOGY

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Matthew J. James

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## Faculty

Matthew J. James  
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## Programs Offered

*Bachelor of Science in Geology*  
*Bachelor of Arts in Geology*  
*Minor in Geology*  
*Minor in Paleontology*  
*Secondary Education Teaching*  
*Credential Preparation*

Geology is the study of the materials, structures, processes, and history of the earth. Philosophically, it allows us to realize our place in the physical universe within the enormity of geologic time. Practically, it leads to understanding of earth processes, the formation of rocks and minerals, and the energy supplies and materials that support our civilization.

The evolution of modern geologic thought was based on field studies and empiricism. A solid foundation in quantitative field and laboratory analysis provides a firm background in the principles of geology. Students take a fundamental curriculum that concentrates on the analysis of rocks and minerals, geologic mapping, and report writing. Required courses in physics, chemistry, and mathematics support understanding of geologic principles.

## Careers in Geology

Within the general field of geology, students may choose from major programs that lead to either the B.A. or B.S. pre-professional degrees. The B.S. and B.A. degrees provide an excellent background for graduate school and for work in geology in such fields as engineering geology, environmental geology, hydrology, and mineral exploration. Many of our geology graduates work for consulting firms with specialties in one or more of these areas. Because of the selectivity involved in choosing a program that meets their own particular interests and goals, students must consult with a departmental advisor about their plan of study and their course load each semester.

## Bachelor of Science in Geology

This plan is intended to give the student basic professional competence in geology. A calculus-based series of support courses is highly recommended for students intending to pursue a more quantitative geoscience career. It provides an excellent foundation for graduate school or a professional career in the geosciences.

Degree Requirements	Units
General education	42*
Major requirements	56
Supporting courses	22

**Total Units Needed For Graduation 120**

Major Core Requirements	Units
GEOL 205/205a Mineralogy	4/1
GEOL 303 Advanced Principles of Geology	4*
GEOL 304 Geologic Mapping and Report Writing	1
GEOL 307 Igneous and Metamorphic Petrology	4
GEOL 308 Igneous and Metamorphic Field	1
GEOL 309 Computer Application in Geology	4
GEOL 311 Sedimentary Petrology	4
GEOL 312 Sedimentary Petrology Field	1
GEOL 313 Paleontology	4
GEOL 317 Structural Geology	4
GEOL 318 Structural Geology Field	1
GEOL 420 Field Geology	4
GEOL 427 Advanced Field Geology	4

**Total Units In the Major Core 47**

## Major Electives

Choose 9 units of upper-division geology electives in consultation with an advisor.

**Total units in major electives 9**

## Required Supporting Courses

CHEM 115AB General Chemistry	10
PHYS 114 Introduction to Physics I or PHYS 210A General Physics	3/4
PHYS 116 Introductory Laboratory or PHYS 209A General Physics Laboratory	1
PHYS 214 Introduction to Physics II** or PHYS 210B General Physics**	3/4
PHYS 216 Introductory Laboratory** or PHYS 209B General Physics Laboratory**	1
MATH 161 Calculus I with Analytic Geometry	4*

**Total Units In Supporting Courses 22/24**

**Total Units In the Major 78/80**

\*The standard 51 units of GE are reduced by 3 units each from GEOL 102, GEOL 303, and MATH 161/165, which are major requirements.

These three classes satisfy requirements in GE categories B1, B3, and B4, respectively.

\*\*GEOL 310 may be substituted

**SAMPLE FOUR-YEAR PLAN FOR  
BACHELOR OF SCIENCE IN GEOLOGY**

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**Freshman Year: 29 Units**

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<i>Fall Semester (14 Units)</i>	<i>Spring Semester (15 Units)</i>
GEOL 102 (3)	MATH 161 (4)
CHEM 115A (5)	CHEM 115B (5)
GE (6)	GE (6)

**Sophomore Year: 28 Units**

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<i>Fall Semester (15 Units)</i>	<i>Spring Semester (13 Units)</i>
GEOL 303 (4)	GEOL 313 (4)
GEOL 304 (1)	GEOL 314 (1)
GEOL 205 (4)	GEOL 311 (4)
GEOL 309 (4)	GEOL 312 (1)
GE (2)	GE(3)

**Junior Year: 29 Units**

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<i>Fall Semester (14 Units)</i>	<i>Spring Semester (15 Units)</i>
PHYS 114 (4)	GEOL 307 (4)
PHYS 116 (1)	GEOL 308 (1)
GEOL 317 (4)	GEOL 310 (4)
GEOL 318 (1)	GEOL 323 (3)
GE (4)	GE (3)

**Senior Year: 30 Units**

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<i>Fall Semester (15 Units)</i>	<i>Spring Semester (15 Units)</i>
GE (12)	GEOL 420 (4)
Geology Elective (3)	Geology Elective (3)
	GE(8)

**Senior Summer: 4 Units**

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GEOL 427 (4)

**Total Semester Units:: 120**

**Bachelor of Arts in Earth Science**

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**MAJOR REVISION COMING SOON!**

## Minor in Paleontology

The Minor in Paleontology offers students from any major on the SSU campus a cross-disciplinary concentration in the study of ancient life on Earth. Paleontology is by its very nature an interdisciplinary field of study, blending both laboratory and field studies of modern organisms and extinct organisms. Some paleontologists approach the field from a geological perspective, and others approach it from a biological perspective. For a Minor in Paleontology, students must complete 20 units as described below.

### Minor Core Requirements

Courses	Units
GEOLOGY 102 Our Dynamic Earth	3
GEOLOGY 413 Paleontology	4
BIOL 121 Diversity, Structure and Function, or BIOL 122 Genetics, Evolution, and Ecology	4
<b>Total units in the minor core</b>	<b>11</b>

### Minor Electives

In addition to the Minor Core, choose 9 units of electives from other paleontology courses and/or courses with an emphasis on interpreting the history of life on Earth, and at least 1 unit that is a field course (marked by asterisk below). All SSU majors may select the Minor in Paleontology, and if you are majoring in either Biology or Geology, at least 3 upper division elective units must be from outside your home department. Additional courses may be counted toward the minor with approval of one of the Minor Advisors above. The 9 elective units must include at least one 4-unit upper division course with a laboratory from the following list:

Courses	Units
ANTH 301 Human Fossils and Evolution	4
†ANTH 415 Forensic Anthropology	4
†BIOL 220 Human Anatomy	4
†BIOL 322 Invertebrate Biology	4
†BIOL 327 Vertebrate Biology	4
†BIOL 328 Vertebrate Evolution and Morphology	4
BIOL 310 Dinosaurs	3
GEOG 370 Weather and Climate	4
GEOG 372 Climate Change	4
GEOLOGY 105 The Age of Dinosaurs	3
†GEOLOGY 303 Advanced Principles of Geology	4
§GEOLOGY 304 Geologic Mapping and Report Writing	1
†GEOLOGY 326 Stratigraphy and Earth History	4
§GEOLOGY 314 Paleontology Field Course	1
GEOLOGY 302 Geology of Climate Change	3
§GEOLOGY 496 Burgess Shale Paleontology	3
<b>Total elective units in the minor</b>	<b>9</b>

§ Field courses – one course is required for the minor

† 4-unit laboratory courses – one course is required for the minor

### Minor in Geology

Completion of a minimum of 20 units from Geology Department courses will constitute a minor in geology. Six of the 20 units must be upper-division. Students should consult with an advisor in the Geology Department regarding required courses.

### Minor in Paleontology

#### Program Coordinator

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#### Advisors

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Karin E. Jaffe / Anthropology Department (707) 664-2944,  
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Some of these elective courses above might have additional prerequisites not listed here. Refer to the University catalog for additional information.

**Total units for the paleontology minor**

**20**

## **Secondary Education Teaching Credential Preparation**

Geology students must demonstrate competence in the natural sciences by passing the subject matter examination required by the California Commission on Teacher Credentialing. One part of the examination will test breadth of knowledge in biology, chemistry, physics, astronomy, and geology. Another part of the examination will test depth of knowledge in a particular area, such as geology. The BA or BS degree in geology is recommended to prepare for the part of the examination that tests depth of knowledge in geology. For recommended course selection to help prepare for the part of the examination that tests breadth of scientific knowledge, please see the Teaching Credential section of the SSU catalog.

For more information, please contact Professor Dan Karner, Darwin Hall 124, 707 664-2334.

## **Geology Courses (GEOL)**

Classes are offered in the semesters indicated. Please see the Schedule of Classes for most current information and faculty assignments.

### **102 OUR DYNAMIC EARTH: AN INTRODUCTION TO GEOLOGY (3) FALL, SPRING**

Lecture, 2 hours; laboratory, 3 hours. A study of the minerals, rocks and landforms that make up our earth in the context of the dynamic forces that form them and the external forces that break them down. Emphasis on local geology, including earthquakes and other environmental aspects. Laboratory study of minerals, rocks, and maps. Required one-day weekend field trip. Fee required. Satisfies GE, category 131 (Physical Sciences) and GE laboratory requirements.

### **105 THE AGE OF DINOSAURS (3) FALL, SPRING**

Lecture, 3 hours. The life and death of dinosaurs as evidenced by the fossil record will be studied to show how geology and biology combine in the discipline of paleontology. The evolution of dinosaurs over a 150 million-year time span sets the stage to investigate several interesting and ongoing controversies surrounding dinosaurs, including: why dinosaurs became extinct, the metabolism of dinosaurs, and the relationship between birds and dinosaurs. Satisfies GE, category 31 (Physical Sciences).

### **107 INTRODUCTION TO EARTH SCIENCE (3) FALL**

This course studies the operation of the Earth system and its solar system home. It introduces the fundamental aspects of 4 major areas: astronomy; geology, including plate tectonics, and the planetary history of the Earth and its moon; physical oceanography; and weather and climate. There is no lab. The course is designed to prepare students for the earth science and astronomy parts of the CSET examination. The prerequisite is that a student must be enrolled in the AMCS, Libs, CALS, or ENSP credential program. This class is not allowable as a prerequisite for upper-division Geology courses.

## **110 NATURAL DISASTERS (3) FALL, SPRING**

A course to examine the interaction between natural processes and human activities, and the often costly and fatal results. Course emphasis will be on the principles underlying natural disasters such as earthquakes, volcanic eruptions, landslides, floods, severe weather, coastal processes, asteroid impacts, fires, great dyings, and population growth. Many examples will be drawn from the northern California area. Extensive Internet work for current information. Course content may vary with instructor. Satisfies GE, category B3 (Physical Sciences, Specific Emphasis).

## **120 REGIONAL FIELD GEOLOGY (3) SPRING**

The heart of geology is in the field. This course is an examination of rocks, minerals, and landforms, and the processes that form them. A 10-day field trip taken during spring vacation, where the natural world becomes our classroom. Prerequisites: GEOL 102 or concurrent enrollment; students must be in good physical condition.

## **205 MINERALOGY (4) FALL**

Lecture 3 hours; laboratory, 3 hours. Principles of crystal chemistry, crystallography, properties, and origin of common rock-forming minerals. Laboratory sessions emphasize hand specimen and petrographic mineral identification and characterization. Prerequisites: completion of or concurrent enrollment in GEOL 303 and CHEM 115A/116A.

## **205a MINERALOGY (1) FALL**

Supplementary course to be held concurrently with GEOL 205. For students who already have taken a mineralogy course but have not taken optical mineralogy. Consists of the lecture and laboratory portion of GEOL 205 relevant to optical mineralogy.

## **301 NATURAL HISTORY OF THE HAWAIIAN ISLANDS (3) FALL, SPRING**

Lecture, 3 hours. The origin and evolution of the flora and fauna of the most isolated archipelago in the world; geologic history and context of volcanic oceanic islands; conservation biology efforts to save the rare and endangered species of Hawaii. Satisfies GE, category B3 (Physical Sciences Specific Emphasis). Prerequisite: GEOL 102, or BIOL 115 or 123.

## **302 GEOLOGY OF CLIMATE CHANGE**

Lecture, 3 hours. Climate changes on time scales of days to millions of years. We will review methods by which the amplitude and pacing of natural climate changes are measured, use data analysis to assess the significance of past climate variability, and consider interpretations and theories proposed to explain Earth's climate. Prerequisite: Geology 303 or instructor consent.

## **303 ADVANCED PRINCIPLES OF GEOLOGY (4) FALL**

Lecture, 3 hours; Laboratory, 3 hours. This course bridges introductory-level content of lower division physical geology courses with the advanced understanding needed to maximize the learning experience in upper division majors courses. Challenge exam is available for students. Prerequisite: GEOL 102, 105, 107, 110, 120, GEOG 204, ENSP 303, 309, BIOL 310, ANTH 201 or equivalent.

**304 GEOLOGIC MAPPING AND REPORT WRITING (1)  
FALL**

Field studies and report preparation done in conjunction with GEOL 303. Required weekend field trips. Prerequisites: concurrent enrollment in GEOL 303; students must be in good physical condition.

**306 ENVIRONMENTAL GEOLOGY (3) FALL, SPRING**

Lecture, 3 hours. Study of geological principles and processes as they relate to our natural environment emphasizing interaction between human activities and the geological environment. Major topics include the nature and behavior of rocks and soils; earthquakes and their associated hazards; landslides, slope stability, and building construction; groundwater and pollution; stream processes and flooding; shoreline processes and coastal development; engineering geology and construction of highways and dams; and development of natural resources, conservation, and ecology. Specific content varies year to year, depending on instructor. Prerequisite: GEOL 102 or consent of instructor.

**307 IGNEOUS AND METAMORPHIC PETROLOGY (4)  
SPRING**

Lecture, 2 hours; laboratory, 6 hours. A study of the origin, properties, classification, and occurrence of igneous and metamorphic rocks. Laboratory exercises in the classification and description of minerals, textures, and structures of the more common rock types. Laboratory work will emphasize both hand specimen analysis and microscopic petrography. Prerequisites: GEOL 205 and completion of or concurrent enrollment in CHEM 115B/116B.

**308 IGNEOUS AND METAMORPHIC PETROLOGY  
FIELD COURSE (1) SPRING**

Field studies done in conjunction with GEOL 307. Required weekend field trips. Fee required. Prerequisites: GEOL 304 and concurrent enrollment in GEOL 307. Students must be in good physical condition.

**309 COMPUTER APPLICATIONS IN GEOLOGY (2)  
FALL**

This course aims to provide our majors with some fundamental skills for manipulating and representing geological data using computer applications. Applications include using spreadsheets, converting field maps and data into a GIS format, creating figures in Adobe Illustrator, using basic functions in Mathematica, and generating histograms and rose diagrams. Prerequisites or co-requisite: GEOL 303, 304.

**310 GEOPHYSICS (3) SPRING, ODD YEARS**

This course will cover the basic theories underlying various geophysical methods, field procedures and data collection, and how to interpret geophysical data. Topics include seismic reflection and refraction, paleomagnetism, gravity and magnetic surveying, and how geophysical methods have augmented our overall understanding of the earth's structure and earth processes. Prerequisites: GEOL 303

**311 SEDIMENTARY PETROLOGY (4) FALL**

Lecture, 3 hours; laboratory, 3 hours. The description, classification and origin of sedimentary rocks. Discussion of weathering and origin of sediment; sediment transportation and sedimentary structures; clastic and nonclastic classification; and petrology. Hand specimen and thin section petrography and other techniques for studying sedimentary rocks will be used in the laboratory. Prerequisites: GEOL 303.

**312 SEDIMENTARY PETROLOGY FIELD COURSE (1) FALL**

Field studies done in conjunction with GEOL 311. Required weekend and weekday field trips. Prerequisites: concurrent enrollment in GEOL 311. Students must be in good physical condition.

**313 PALEONTOLOGY (4) SPRING**

Lecture, 3 hours; laboratory 3 hours. The study of fossils in their geological context. Topics include taxonomy, morphology, evolution, biogeography, extinction, and biostratigraphy of the main groups of invertebrate, vertebrate, and plant fossils. Laboratory work will include becoming familiar with stratigraphically important fossil groups and the use of fossils in solving both geological and biological problems. Prerequisite: GEOL 303 for majors, GEOL 102 for non-majors.

**314 PALEONTOLOGY FIELD COURSE (1) SPRING**

Field studies done in conjunction with GEOL 313. Required weekend field trips. Prerequisites: GEOL 303 for majors, GEOL 102 for non-majors, and concurrent enrollment in GEOL 313. Students must be in good physical condition.

**317 STRUCTURAL GEOLOGY (4) FALL**

An introduction to deformational processes within the earth's crust and the geological structures that result from these processes. We will examine deformation running the gamut of scales (from atomic scale to tectonic scale). The laboratory portion of this course will focus on methods of structural interpretation. Prerequisites: GEOL 303, 304, and 309.

**318 STRUCTURAL GEOLOGY FIELD COURSE (1) FALL**

Field studies done in conjunction with GEOL 317. Required weekend field trips. Prerequisite: GEOL 317 or concurrent enrollment. Students must be in good physical condition.

**320 BASIN ANALYSIS (4) FALL**

Origin and evolution of sedimentary basins; tectonic settings and significance, subsidence and thermal histories, basin-scale depositional systems, paleocurrent, provenance, and paleogeographic analysis, basin types, paleoclimatic influences, resources. Prerequisite: GEOL 311

### **323 HYDROLOGY (3) SPRING**

Lecture, 3 hours. Water as a natural resource, the hydrologic cycle, distribution of water on the earth. Atmospheric water, soil water, runoff, and groundwater as related to water supply and use. Applications to problems of flood control, water management, and water pollution, with special emphasis on California and Sonoma County. Prerequisites: GEOL 102 or consent of instructor; MATH 106 or 107.

### **326 STRATIGRAPHY AND EARTH HISTORY (4) SPRING, ODD YEARS**

Lecture, 3 hours; laboratory, 3 hours. The principles of stratigraphy and historical geology will be discussed, with special emphasis given to the application of these principles to the geologic development of North America. The geologic history of California will be treated in detail. The use of sedimentary rocks, fossils, and structural and tectonic principles will be discussed, especially as they relate to our understanding of historical geology. Laboratory work will include a study of sedimentary rocks and their properties, fossils and their occurrence and distribution, the construction and interpretation of various types of stratigraphic maps, and detailed studies of selected maps representative of the various geologic provinces of North America. Required field trip. Prerequisite: GEOL 303 or consent of instructor.

### **395 COMMUNITY INVOLVEMENT PROGRAM (1-4) FALL, SPRING**

CIP involves students in community problems such as tutoring, aiding in school science classes, and advisement of county agencies. A total of 6 units of CIP credit may be applied toward a degree. May be taken by petition only. Not applicable to the geology major.

### **396 INTERNSHIP IN GEOLOGY (1-4) FALL, SPRING**

Professional geologic work for a geologic firm or agency. Forty-five hours of work per unit. Not applicable to the geology major. Prerequisites: GEOL 303 and consent of instructor.

### **406 X-RAY MINERALOGY (Z) FALL, ODD YEARS**

Lecture, 1 hour; laboratory 3 hours. Introduction to the use of x-ray diffraction techniques. Prerequisites: CHEM 115A/116A and GEOL 305 or concurrent enrollment, and consent of instructor.

### **420 FIELD GEOLOGY (4) SPRING**

This course is a synthesis of the geology-major, core courses. This course aims to hone our students' abilities to make valid geologic field interpretations through detailed field mapping and report writing. Twelve days of fieldwork are required. Prerequisites: GEOL 309, 308, 311, 312, 317, and 318. Students must be in good physical condition.

### **422 GEOCHEMISTRY (3) SPRING, ODD YEARS**

Lecture, 3 hours. Introductory cosmochemistry and origin of the elements; meteorites; the earth as a chemical system, chemistry of processes at the surface of the earth; mineral crystal chemistry; introduction to geochronology and stable isotope variations in nature; thermodynamics and its geological application; geochemical prospecting. Prerequisite: GEOL 303, CHEM 115AB/116AB, MATH 161, or consent of instructor.

### **425 ECONOMIC GEOLOGY (4) SPRING, ODD YEARS**

Lecture, 3 hours; laboratory, 3 hours. Classification, origin and alteration of metallic ore deposits. Laboratory sessions on hand sample identification of ore and alteration minerals and petrographic analysis of selected ore suites. Prerequisites: previous or concurrent enrollment in GEOL 307 and CHEM 11513/11 6B.

### **426A (FALL)/426B (SPRING) SENIOR THESIS (3/3)**

A senior thesis is an opportunity for students to engage in primary research. Students must write a proposal, defining the scope of their project. Thesis projects must be a two-semester project. Students will be required to present their projects at the Geology Colloquium. Prerequisite: thesis-advisor consent

#### **Department Policy On Senior Theses**

1. The student must have a 3.00 or higher departmental grade point average.
2. The student must have demonstrated ability to work independently and do quality work in both the lecture and the field classes.
3. The student must submit a detailed proposal of work, a schedule, and the expected results.
4. The student must have a faculty sponsor who is willing to advise the project and will set up a schedule of meetings for this purpose.
5. Two copies of the final paper/report will be filed with the department office before a grade will be assigned.
6. The student must be presented at the department colloquium.

### **427 ADVANCED FIELD GEOLOGY (4) SUMMER**

A minimum of five weeks of detailed mapping in igneous, metamorphic, and sedimentary rocks, and the preparation of field reports and geological maps. Students may also complete this course at another university, but should do so only in consultation with the Geology Department. Students must demonstrate equivalence in terms of field hours and course content to GEOL 427. Prerequisite: senior standing in geology. GEOL 420 strongly recommended.

#### **495 SPECIAL STUDIES (11 -4) FALL, SPRING**

Individual study, under guidance of an advisor of an advanced field, laboratory, or literature problem. Students must qualify and adhere to the department policy on independent study as outlined below. Prerequisite: approval of advisor.

#### **496 SELECTED TOPICS IN GEOLOGY (1-3)**

An intensive study of an advanced topic in geology. May be repeated for additional credit with new subject matter. Prerequisite: adequate preparation for topic under consideration. Additional fee may be required.

#### **498 GEOLOGY PRACTICUM (1 -4)**

Application of previously studied theory through supervised instructional work experience in geology, generally as a teaching assistant in geology laboratory classes. Intended for professional growth. May be repeated for up to a total of 4 units. Not applicable for the geology major or minor. Prerequisites: upper-division standing in geology and consent of instructor. Student needs to have passed the course that he/she will be a teaching assistant in with a grade of B or better. To be a teaching assistant in GEOL 102 laboratory student needs to have received a grade of B or better in GEOL 303.