Geological Sciences

In the College of Sciences

OFFICE: Geology/Mathematics/Computer Science 237
TELEPHONE: 619-594-5586 / FAX: 619-594-4372
E-MAIL: department.office@geology.sdsu.edu
http://www.geology.sdsu.edu

Faculty
Chair: Kimbrough
The Rollin and Caroline Eckis Chair in Seismology: Day
Professors: Day, Girty, Kimbrough, Olsen, Rockwell
Associate Professors: Frost, Pietruszka, Schellenberg, Thorbjarnarson
Assistant Professor: Ma
Lecturers: Camp, Robinson, SacramentoGrilo

Offered by the Department
Doctor of Philosophy degree in geophysics.
Master of Science degree in geological sciences.
Minor in geological sciences.
Minor in oceanography.

The Rollin and Caroline Eckis Chair in Seismology

A gift from Rollin and Caroline Eckis, combined with matching funds from the Atlantic Richfield Company and contributions from SDSU faculty and staff, established The Rollin and Caroline Eckis Chair in Seismology at SDSU. The late Rollin Eckis was former president of Richfield Oil Company and vice chairman of the board of Atlantic Richfield Company.

The first appointee to the chair, Dr. Steven M. Day, conducts research on the mechanics of earthquakes and earthquake hazards.

The Major

Geology is the study of the earth, its composition, its history, and its constantly changing character.

Geologists study the origin and evolution of our planet; the chemical and physical properties of minerals, rocks, and fuels; the structure of our mobile crust – its newly forming ocean floors and its ancient, drifting continents; the history of life; and human adaptation to earthquakes, volcanic eruptions, landslides, and floods. The subject matter of geology ranges from dinosaurs to the prediction of earthquakes.

Students who are curious about the planet on which we live, challenged by problems which involve the earth, and intrigued by the potential of a subject which combines both the arts and sciences, should consider geological sciences as a major.

The employment outlook is favorable, particularly with engineering, hydrogeology, toxic waste disposal firms, energy companies, and as school teachers.

A geology graduate may be employed as one of the following professionals: hydrologist, geophysicist, geochemist, environmental scientist, oceanographer, teacher, research technician, geological surveyor, paleontologist, energy and resource explorer, and resource planner.

Geologists are primarily employed by private corporations, including petroleum, mining, construction, quarry, hydrology, and engineering geology companies and by government agencies, such as the U.S. Geological Survey, the U.S. Bureau of Reclamation, the California Department of Conservation, and regional planning offices. Students with graduate degrees are sought for teaching positions in secondary schools, community colleges, and universities.

Impacted Program

The geological sciences major and emphases are impacted programs. To be admitted to the geological sciences major or an emphasis, students must meet the following criteria:

- Complete preparation for the major;
- Complete a minimum of 60 transferable semester units;
- Have a minimum cumulative GPA of 2.0.

To complete the major, students must fulfill the degree requirements for the major described in the catalog in effect at the time they are accepted into the premajor at SDSU (assuming continuous enrollment).

Major Academic Plans (MAPs)

Visit http://www.sdsu.edu/mymap for the recommended courses needed to fulfill your major requirements. The MAPs Web site was created to help students navigate the course requirements for their majors and to identify which General Education course will also fulfill a major preparation course requirement.

Geological Sciences Major

With the B.S. Degree in Applied Arts and Sciences

(Major Code: 19141)

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on “Graduation Requirements.” All required upper division courses must be taken for letter grades only, not credit/no credit.

Courses to satisfy the requirement of 36 or more upper division units in the major may be selected from upper division geological sciences courses not explicitly excluded. Students may petition the department to include courses from other disciplines to complete the upper division major requirement.

A minor is not required with this major.

Emphasis in General Geology

(SIMS Code: 775324)

Preparation for the Major: Oceanography 100, or Geological Sciences 100 and 101, or Geological Sciences 101 and 104; Geological Sciences 200, 205, 221; Biology 100, 100L; Chemistry 200, 201; Mathematics 150, 151; Physics 195, 195L, 196, 196L. (45 units)

Recommended: Physics 197, 197L; Mathematics 252.

Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.

Major. A minimum of 38-40 upper division units in approved courses to include Geological Sciences 300, 306, 307, 324, 336, 498A, 498B, 508, 530, 537; plus six additional upper division units from geological sciences (upper division courses from outside department by approval).

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Emphasis in Engineering Geology
(SIMS Code: 775313)

Preparation for the Major. Oceanography 100, or Geological Sciences 100 and 101, or Geological Sciences 101 and 104; Geological Sciences 200, 205, 221; Biology 100; Chemistry 200, 201; Engineering Mechanics 200; Mathematics 150, 151, 252; Physics 195, 196, 197L, 197.; (52 units)

Recommended: Civil Engineering 218; Physics 195L, 196L, 197L.

Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.

Major. A minimum of 39 upper division units in approved courses to include Geological Sciences 300, 306, 307, 324, 336, 498A, 498B, 508 (4 units); Civil Engineering 301 or Mechanical Engineering 304, Civil Engineering 462, 463; two courses selected from Geological Sciences 514, 530, 550, 551, 560 or Civil Engineering 465; or other upper division courses approved by the department.

Emphasis in Geochemistry
(SIMS Code: 775335)

Preparation for the Major. Oceanography 100, or Geological Sciences 100 and 101, or Geological Sciences 101 and 104; Geological Sciences 200, 205, 221; Biology 100 or 101; Chemistry 200, 201, 232, 232L, 251; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L. (57 units)

Recommended: Physics 197, 197L.

Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.

Major. A minimum of 37 upper division units in approved courses to include Geological Sciences 300, 306, 324, 336, 498A, 498B, 530; Chemistry 410A-410B, 571; and six upper division units of approved courses in geological sciences at the 500-level or in chemistry at the 400-level or above.

Emphasis in Geophysics
(SIMS Code: 775346)

Preparation for the Major. Oceanography 100, or Geological Sciences 100 and 101, or Geological Sciences 101 and 104; Geological Sciences 200, 221; Biology 100 or 101; Chemistry 200, 201; Mathematics 150, 151, and 252; Physics 195, 195L, 196, 196L, 197L. Engineering 280 must be taken if students select Engineering 510 in the major. (48 units)

Recommended: Geological Sciences 205, Statistics 250.

Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.

Major. A minimum of 37-40 upper division units in approved courses to include Geological Sciences 300, 306, 307, 324, 336, 498A, 498B, 533, and 560; Mathematics 342A and 342B, or Engineering 510; two courses selected from Geological Sciences 336; Physics 350, Physics 400A (or Electrical Engineering 340); and three upper division units of approved courses in geological sciences at the 500-level.

Emphasis in Hydrogeology
(SIMS Code: 775357)

Preparation for the Major. Oceanography 100, or Geological Sciences 100 and 101, or Geological Sciences 101 and 104; Geological Sciences 200, 205, 221; Biology 100 or 101; Chemistry 200, 201; Mathematics 150, 151, 252; Physics 195, 196, 197. (49 units)

Recommended: Physics 195L, 196L, 197L.

Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.

Major. A minimum of 36 upper division units in approved courses to include Geological Sciences 300, 306, 324, 336, 498A, 498B, 530, 550, 551, either 514 or 560; and six upper division units of departmentally approved courses.

Emphasis in Marine Geology
(SIMS Code: 775368)

Preparation for the Major. Oceanography 100, or Geological Sciences 100 and 101, or Geological Sciences 101 and 104; Geological Sciences 200, 205, 221; Biology 100 or 101; Chemistry 200, 201; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L, 197, 197L. (52 units)

Recommended: Geological Sciences 537. A foreign language.

Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.

Major. A minimum of 36 upper division units in approved courses to include Geological Sciences 300, 306, 307, 324, 336, 498A, 498B, 530, and two of the following courses: Geological Sciences 508, 537, Biology 517; plus four upper division units of departmentally approved courses. Recommended: Chemistry 410A-410B for students anticipating postgraduate studies.

Emphasis in Paleontology
(SIMS Code: 775390)

Preparation for the Major. Oceanography 100, or Geological Sciences 100 and 101, or Geological Sciences 101 and 104; Geological Sciences 200, 205, 221; Biology 203, 203L, 204, 204L; Chemistry 200, 201; Mathematics 150, 151; Physics 195, 195L, 196, 196L. (49 units)

Recommended: Geological Sciences 307.

Graduation Writing Assessment Requirement. Passing the Writing Placement Assessment with a score of 10 or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See “Graduation Requirements” section for a complete listing of requirements.

Major. A minimum of 36 upper division units in approved courses to include Geological Sciences 300, 306, 324, 336, 498A, 498B, 508, 537; Biology 352, 354; and five upper division units of departmentally approved courses.

Geological Sciences Minor
(SIMS Code: 775301)

The minor in geological sciences consists of a minimum of 17 units in geological sciences, nine of which must be in upper division courses. Courses include Oceanography 100 or Geological Sciences 100 or 104; and 101, 105; and nine units selected from Geological Sciences 301, 302, 303, 304, 305; Oceanography 320.
Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general education requirements, if applicable. A minimum of six upper division units must be completed in residence at San Diego State University.

**Oceanography Minor**

For a listing of requirements refer to the section of this catalog on Oceanography.

**Courses (GEOL)**

Refer to Courses and Curricula and University Policies sections of this catalog for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.

### LOWER DIVISION COURSES

**GEOL 100. Planet Earth (3) [GE]**

Earth’s global systems. Plate tectonics, earthquakes, and volcanoes; evolution of our planet and life through geologic time; economic resources including fossil fuels and precious minerals; agents of erosion that shape the land.

**GEOL 101. Dynamics of the Earth Laboratory (1) [GE]**

Three hours of laboratory.

- Prerequisite: Credit or concurrent registration in Geological Sciences 100 or 104.
- Hands-on experience with land forms, rocks, minerals, topographic maps, and aerial photographs. Includes demonstrations and field trips. Designed to accompany and augment Geological Sciences 100 or 104.

**GEOL 104. Earth Science (3) [GE]**

Earth’s four principal reservoirs and their interconnectedness: solid earth, ocean, atmosphere, and biosphere. How humanity affects and is affected by these reservoirs. Most appropriate for liberal studies majors.

**GEOL 200. Geologic Inquiry and Problem Solving (3)**

Two lectures and three hours of laboratory.

- Scientific thought process using real problems addressed by student research in field and laboratory. Includes written report and oral presentation.

**GEOL 205. Historical Geology (4)**

Three lectures and three hours of laboratory. Arrangement for field study during the semester.

- Prerequisites: Oceanography 100 or Geological Sciences 100 and 101 or Geological Sciences 101 and 104.
- Evolutionary history of earth as traced through rock and fossil records. Stratigraphic and depositional concepts.

**GEOL 221. Mineralogy (4)**

Two lectures and six hours of laboratory.

- Prerequisites: Credit or concurrent registration in Geological Sciences 200. Oceanography 100 or Geological Sciences 100 and 101 or Geological Sciences 101 and 104; high school chemistry and trigonometry, or credit or concurrent registration in college chemistry and trigonometry.
- Practice in determination of common minerals; their geologic environment, utilization, and economic significance. Introduction to optical techniques in mineral identification.

**GEOL 296. Experimental Topics (1-4)**

Selected topics. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor’s degree.

### UPPER DIVISION COURSES (Intended for Undergraduates)

**GEOL 300. Geological Data Analysis (3)**

Two lectures and three hours of laboratory.

- Prerequisite: Credit or concurrent registration in Mathematics 150.

**GEOL 301. Geology of National Parks and Monuments (3) [GE]**

Prerequisite: Completion of the General Education requirement in Foundations of Learning II.A., Natural Sciences and Quantitative Reasoning. Recommended: Geological Sciences 100.

- Geology of a group of national parks and monuments, selected for their geological significance, scenic beauty, and visitor popularity. Not acceptable for a major in geological sciences.

**GEOL 302. Fossils: Life Through Time (3) [GE]**

Prerequisite: Completion of the General Education requirement in Foundations of Learning II.A., Natural Sciences and Quantitative Reasoning. Recommended: Geological Sciences 100.

- Geology of fossiliferous rock; techniques of fossil recovery and study during the semester.
- Graphical, computer, and analytical techniques for working with fossils and their geological significance, scenic beauty, and visitor popularity. Not acceptable for a major in geological sciences.

**GEOL 303. Natural Disasters (3) [GE]**

Prerequisite: Completion of the General Education requirement in Foundations of Learning II.A., Natural Sciences and Quantitative Reasoning. Recommended: Geological Sciences 100.

- Geologic processes that have dramatically affected the human race: earthquakes, volcanoes, landslides, and floods. Not acceptable for a major in geological sciences.

**GEOL 304. Planetary Geology (3) [GE]**

Prerequisite: Completion of the General Education requirement in Foundations of Learning II.A., Natural Sciences and Quantitative Reasoning. Recommended: Geological Sciences 100.

- Structure, evolution, and surface features of planets from a geologic point of view. Insights gained into origin and evolution of planetary bodies provide greater understanding of how planet earth operates and why it is unique. Not acceptable for a major in geological sciences.

**GEOL 305. Water and the Environment (3) [GE]**

Prerequisites: Completion of the General Education requirement in Foundations of Learning II.A., Natural Sciences and Quantitative Reasoning. Recommended: Geological Sciences 100 or Geography 101.

- Movement of fresh water on earth. Hydrologic cycling of water from precipitation, runoff, infiltration, stream and groundwater flow to the ocean. Problems caused by change in use of water resources, urbanization, and water pollution examined with case studies. Not acceptable for a major in geological sciences, emphasis in hydrogeology.

**GEOL 306. Structural Geology and Field Methods (5)**

Two lectures and three hours of laboratory and six weekends in the field.

- Prerequisites: Geological Sciences 300, 324; algebra, trigonometry and at least high school physics. Highly recommended: First semester college physics.
- Integrates structural and introductory field geology. Principles, causes, and mechanisms of rock deformation combined with field study. Graphical, computer, and analytical techniques for working with folds and faults are applied in the field. Field observations are presented in geologic maps, cross sections, and reports.

**GEOL 307. Geophysics and Field Methods (4)**

Two lectures and three hours of laboratory and a minimum of three weekends in field during semester.

- Prerequisites: Geological Sciences 306; Mathematics 150; Physics 180A or 195.
- Principles and field studies of gravity, magnetic, and seismic techniques applied to structure, dynamics, and shallow environment of the earth. Computer-aided data reduction and interpretation.

**GEOL 324. Petrology (4)**

Two lectures and six hours of laboratory.

- Prerequisite: Geological Sciences 221.
- Composition, classification, occurrence, and origin of igneous, sedimentary, and metamorphic rocks. Identification of rocks in hand specimen; petrographic analysis of rocks in thin section; modeling and interpretation of petrologic data.

**GEOL 336. Sedimentology and Lithostratigraphy (3)**

Two lectures and three hours of laboratory.

- Prerequisites: Geological Sciences 205 (not required but recommended for Emphases in Geochemistry and Geophysics) and 221.
- Sedimentologic description and interpretation of the textures and structures of sediments and sedimentary rocks. Stratigraphic analysis of stratal succession, age relationships, and correlation on local and global scales. (Formerly numbered Geological Sciences 536.)
GEOL 412. Processes and Inquiry in the Earth Sciences (4)
Three lectures and two hours of activity.
Prerequisites: Geological Sciences 303 or Biology 204; and completion of the General Education requirement in Foundations of Learning I.A., Natural Sciences and Quantitative Reasoning.
Investigation of processes of inquiry and rational thinking skills characteristic of the earth sciences.

GEOL 496. Selected Topics in Geology (1-4)
Prerequisite: Consent of instructor.
Selected topics in geology and related earth sciences. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor’s degree. Maximum credit six units.

GEOL 498A. Research Methods and Communication (1) Cr/NC
Prerequisite: Nine upper division units in geological sciences.
Development and testing of scientific hypotheses and their effective communication through oral, written, and visual modes. To be taken in fall semester of senior year prior to registration in Geological Sciences 498B, Senior Thesis.

GEOL 498B. Senior Thesis (2)
Prerequisite: Consent of instructor.
Individual research project, written thesis, and oral presentation done under supervision of professor chosen by student.

GEOL 499. Special Study (1-4)
Prerequisites: Acceptable grade average in at least 12 upper division units within the major and consent of staff.
Individual study in field, library, laboratory, or museum work. Maximum credit four units.

UPPER DIVISION COURSES
(Also Acceptable for Advanced Degrees)

GEOL 505. Photogeology and Remote Sensing (3)
Two lectures and three hours of laboratory.
Prerequisite: Geological Sciences 200.
Geologic interpretation of aerial and satellite photographs, elementary stereoscopy and stereometry applied to structural and stratigraphic problems, and compilation of geologic maps from aerial and satellite photographs.

GEOL 508. Advanced Field Geology (4 or 6)
One lecture and three hours of laboratory plus 28 days in the field. For the option with six units: two additional weeks of field or laboratory work.
Prerequisite: Geological Sciences 306.
Investigation of individually assigned areas, preparation of geologic maps, field work, and gathering other types of data, e.g., petrologic, geophysical, or paleontologic, as appropriate. Students are responsible for cost of food and transportation. Students must demonstrate the physical ability to adequately and safely perform fieldwork under varying weather conditions; in steep, uneven or rocky terrain; for long periods of time.

GEOL 514. Process Geomorphology (3)
Two lectures and three hours of laboratory.
Prerequisite: Geological Sciences 306.
Processes shaping and affecting the earth’s surface, and application of resultant land forms in interpretation of geologic structure, stratigraphy, and neotectonics.

GEOL 520. Ore Deposits (3)
Prerequisite: Geological Sciences 306.
Geologic relations, origin, distribution, and economics of metallic and nonmetallic mineral deposits.

GEOL 521. Petroleum Geology (3)
Prerequisite: Geological Sciences 306.
History of petroleum exploration; statistics of energy use; principles of well logging; theories of petroleum generation, migration, and accumulation; exploration and production techniques; case studies of important oil fields.

GEOL 530. Geochemistry (3)
Two lectures and three hours of laboratory.
Prerequisites: Geological Sciences 324; Chemistry 201; Mathematics 150.
Fundamental principles of low- and high-temperature geochemistry. Origin of the elements; formation of the solar system; differentiation of the earth; weathering at the earth’s surface; chemistry of natural waters. Laboratory methods applied to geological problems.

GEOL 533. Geophysical Analysis (3)
Two lectures and three hours of laboratory.
Prerequisites: Geological Sciences 307, Mathematics 252, Physics 197. Recommended: Physics 196L, 199L, 197L.
Analog and digital data collection, processing, modeling and error estimation. Computer-aided examples and field tests from seismics, gravity, magnetics, and electromagnetics including magnetotellurics.

GEOL 537. Geobiology (3)
Two lectures and three hours of laboratory.
Prerequisite: Geological Sciences 306.
Interrelationships between geologic processes and works of humans. Topics include rock and soil mechanics, ground water flow, slope stability, seismicity, land subsidence, and evaluation of geologic materials with respect to dam sites, tunnel alignments, and building foundations.

GEOL 551. Hydrogeology (3)
Two lectures and three hours of laboratory.
Prerequisites: Geological Sciences 306 and Mathematics 150.
Theory of ground water flow. Exploration for and development of the ground water resource. Aquifer tests, water quality, and water resource management. Occurrence of water in alluvial, sedimentary, volcanic, plutonic, and metamorphic terrains.

GEOL 560. Earthquake Seismology (3)
Two lectures and three hours of laboratory.
Prerequisites: Mathematics 252, Physics 197. Recommended: Mathematics 342A.
Theory of seismic wave excitation, propagation, and recording. Methods of seismogram interpretation and analysis. Application to tectonics and earthquake hazard analysis.

GEOL 580. Seismic Interpretation and 3D Visualization (3)
Two lectures and three hours of laboratory.
Prerequisite: Geological Sciences 306.
Computer-based seismic interpretation, mapping, and modeling in both 2D and 3D. Overview of basic seismic processing. Emphasis on industrial applications, both petroleum and shallow geotechnical.

GEOL 596. Advanced Topics in Geology (1-4)
Prerequisite: Consent of instructor.
Advanced special topics in the geological sciences. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor’s degree. Maximum credit of six units of 596 applicable to a master’s degree with approval of the graduate adviser.

GRADUATE COURSES
Refer to the Graduate Bulletin.