

Geology

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Degrees offered: Bachelor of Science (BS), Bachelor of Arts (BA), and Master of Science (MS) in Geology; BS in Composite Teaching in Earth Science

Undergraduate emphases: *BS in Geology*—Hydrogeology-Engineering Geology and Geoarchaeology

Graduate Specializations: *MS in Geology*—Geomorphology, Hydrogeology, Igneous Petrology, Paleocology, Sedimentary Geology, Structural Geology, and Tectonics

Undergraduate Programs

Objectives

Geology is the study of the planet Earth, the materials of which it is made, the processes that act on these materials, the products formed, and the history of the planet and its life forms since its origin. Geology considers the physical forces that act within and on the Earth, the chemistry of its constituent materials, and the biology of its past inhabitants as revealed by fossil evidence. Geologists integrate biology, chemistry, engineering, mathematics, and physics in the study of our natural surroundings. The knowledge thus obtained is used by geologists to explore for energy, mineral, and water resources; to identify geologically stable sites for major structures; and to provide foreknowledge of some of the dangers associated with the mobile forces of a dynamic Earth. Geologists provide fundamental information required by modern society to plan for cultural and industrial development, reduce geological hazards, identify potential resources, and assist in the design of waste-disposal facilities.

The Department of Geology prepares students for professional careers in the geosciences and provides the background required for advanced studies. The department offers three options of study to meet the growing demand for geoscientists with training in general geology (BS in geology without an emphasis), hydrogeology-engineering geology emphasis, or geoarchaeology emphasis. All options provide exposure to the sciences and an appreciation of our physical surroundings. The BS program in Geology meets the curriculum standards established by the American Institute of Professional Geologists.

The department also offers the Composite Teaching Major in Earth Science to prepare teachers of earth science at the secondary

school level. Requirements for this major meet or exceed the standards of the National Science Teachers Association. Those students who major in earth science should be aware that state licensure is required of secondary education teachers. The Composite Teaching Major in Earth Science fulfills the requirements that provide eligibility for licensure. Licensure requirements vary from state to state, and students should investigate the requirements for the states in which they intend to seek employment. Advising for the Secondary Teacher Education Program (STEP) and State of Utah secondary education licensure is provided by the USU Department of Secondary Education.

The Department of Geology is housed within the Geology Building, which is located at the northeast corner of the Old Main Quad. The Geology Building provides spacious, well-equipped teaching labs, classrooms, and facilities, including a display and study area for students, computer access, document room, map room, preparation facilities, and research labs.

General College of Science Requirements

All general College of Science requirements are embedded within the various major requirements listed below. No extra coursework is required to fulfill the general college requirements.

Requirements

Departmental Admission Requirements. New freshmen admitted to USU in good standing qualify for admission to this major. Transfer students from other institutions need a 2.2 GPA, and students transferring from other USU majors need a 2.0 GPA for admission to this major in good standing. Students seeking admission to the Composite Teaching Major in Earth Science should be aware that a 2.75 minimum GPA is required for admission to the Secondary Teacher Education Program (STEP) in the Department of Secondary Education. Students in the Hydrogeology-Engineering Geology emphasis must meet all College of Engineering GPA standards appropriate for the courses to be taken having either the ENGR or CEE prefix.

Field Trips and Labs. Most Geology courses have required laboratories and/or field trips. Those enrolled are expected to dress properly for the conditions and observe safety precautions issued by the instructors. Most courses require modest lab fees.

Bachelor of Arts Degree. For a BA in Geology, the foreign-language requirement must be satisfied in addition to the Bachelor of Science in Geology requirements.

Bachelor of Science Degree in Geology. Three options of study are available for a BS in Geology: General Geology (BS in Geology without an emphasis), Hydrogeology-Engineering Geology Emphasis, and Geoarchaeology Emphasis. For a **BS in Geology (General Geology option)**, the following courses are required: GEOL 1150, 3200, 3500, 3520, 3550, 3600, 3700, 4500, 4700, 5200; CHEM 1210, 1220, 1230, 1240; PHYX 2210, 2220; MATH 1210; STAT 3000 or MATH 1220; CS 1050 or CS 1700 or CEE 5190 or AWER 4930; 12-20 credits of Geology electives; and up to 8 electives in approved, science-related areas. For a list of approved courses, students should see the current major requirement sheet or consult their geology advisor.

For a **BS in Geology (Hydrogeology-Engineering Geology Emphasis)**, the following courses are required: GEOL 1150, 3200, 3500, 3550, 3600, 3700, 4700, 5200, 5510, 5600; CHEM 1210, 1220, 1230, 1240; PHYX 2210, 2220; MATH 1210, 1220, 2250; ENGR 2000, 2040; CEE 3500; CEE 3430 or 4300; SOIL 3000 or 5130.

For a **BS in Geology (Geoarchaeology Emphasis)**, the following courses are required: GEOL 1150, 3200, 3500, 3550, 3600, 3700, 4700, 5430; CHEM 1210, 1220, 1230, 1240 or CHEM 1110, 1120, 1130; BIOL 3010; MATH 1210; STAT 3000; ANTH 1030, 4350, 4360, 5300, 5310; SOIL 3000 or 5130; and any two courses chosen from: BIOL 2220, 3030, 3040, 3220, AWER 4930, 5930.

Bachelor of Science Degree in Composite Teaching—Earth Science. For the BS in Composite Teaching—Earth Science, the following courses are required: GEOL 1150, 2500, 3200, 3500, 3550, 3600, 3700, 4700; CHEM 1210, 1220, 1230, 1240; PHYX 2210, 2220; MATH 1210; STAT 3000; CS 1050 or 1700; PHYX 3010; ENVS 5110 or FRWS 2200; BMET 2000; AWER 3000 or GEOL 3300; SCI 4300; INST 5200; SCED 3100, 3210, 3300, 3400, 4200, 4210, 4300, 4400, 5300, 5500, 5600; SPED 4000; USU 1360.

Geology Minor. A minimum of 18 credits is required for an approved minor in Geology. Required courses are GEOL 1100 or 1150; and GEOL 3200. Elective geology courses must be numbered 3500 or higher.

Senior Thesis. Geology majors in good academic standing may elect to complete a senior thesis. This is an endeavor which normally spans a year in its preparation and presentation. Senior thesis credits may be applied toward the elective requirements in the General Geology option. For further information, students should contact their geology advisor or the geology department head.

Geology Honors. Geology majors with a minimum GPA of 3.30 may elect to complete the requirements for the Geology Honors degree option. This is a departmental recognition which is separate from the University Honors program. For further information, students should contact their geology advisor or the geology department head.

Graduate Programs

Admission Requirements

See general admission requirements on pages 90-91. In addition, applicants must have acceptable GRE scores. Minimum scores of 40th percentile on the Verbal section and 40th percentile on the Quantitative section and a combined minimum of 1,000 are required. A member of the Geology faculty must agree to serve as the major professor for the applicant prior to acceptance.

Applications will be considered throughout the year, but program entry in fall semester is preferred. Students who wish to be considered for assistantships or other financial aid must have complete applications on file no later than February 15 for entry into the program the following fall semester.

Prerequisites for Matriculation

Completion of a BS or BA in geology, biology, physics, chemistry, or engineering is required for matriculated status. Suggested prerequisite courses include: CHEM 1210, 1220, 1230, 1240; PHYX 2210, 2220; MATH 1210; STAT 3000; and CS 1050 or CS 1700 or CEE 5190 or AWER 4930. Deficiencies in geology are determined based on current USU undergraduate degree requirements for either the Geology or Hydrogeology-Engineering Geology option, as appropriate. The following geology courses or their equivalents are expected: GEOL 1150, 3200, 3500, 3550, 3600, 3700, 4700, and 5200. It is expected that any deficiencies will be made up before the end of the first year of study.

Degree Program

Master of Science Degree. The department offers advanced study and research opportunities leading to the MS degree in Geology. Although many research specialties require advanced courses selected primarily from Geology offerings, additional courses may be selected from other departments on campus, such as Civil and Environmental Engineering; Plants, Soils, and Biometeorology; Biology; Mathematics and Statistics; Aquatic, Watershed, and Earth Resources; Environment and Society; and Forest, Range, and Wildlife Sciences.

Specializations

Fields of specialization for graduate research include the following: hydrogeology, igneous petrology, paleoecology (including invertebrate paleontology), sedimentary geology (including petrology, basin analysis, sedimentation, stratigraphy, and petroleum geology), process geomorphology, Quaternary geology, structural geology, and regional tectonics.

Degree Requirements

Only the Plan A thesis option is allowed for the MS degree in Geology. The recommended distribution is 20 credits of coursework and 10 credits of thesis to obtain the required 30 credits for the MS degree. A minimum of five 6000-level geology courses (other than GEOL 6800) is recommended for the degree program. Only two grades of less than *B* (*C* to *B-*) will be accepted as part of the required degree program as listed on the "Program of Study for Master's Degree." A 3.0 grade point average must be obtained in required coursework as listed on the Program of Study. Thesis credits will be graded *P-F* only (i.e., no letter grade will be given). Geology graduate students using department or University facilities and/or under geology faculty supervision must register for a minimum of 3 credits every semester, up to and including the semester in which the thesis is cleared by the School of Graduate Studies. Registration may not be required during the summer.

Research

There are six broad areas of research emphasis within the department: (1) sedimentary geology, (2) structural geology (3) regional tectonics, (4) igneous petrology and geochemistry, (5) geomorphology, and (6) hydrogeology.

Research in **sedimentary geology** is diverse: sedimentation and development of coral reefs and associated carbonate environments during Pleistocene and Holocene times, changes in shallow-water carbonate environments through early Paleozoic time,

nonmarine siliciclastic depositional systems and petroleum reservoirs, geochemical provenance methods, and large-scale architecture of Mesozoic-Cenozoic intracontinental basins in Asia. Research activities are dominantly field-oriented, and often have a subsurface component. Studies are ongoing in the western United States, Mexico, the Caribbean, China, and west Africa.

Research in **structural geology** includes the examination of the mechanical and chemical evolution of fault zones, the development of fold-and-thrust structures in Idaho, Montana, Wyoming, and Utah, and the characterization of fluid-flow properties in fractured crystalline rocks.

Research in **regional and global tectonics** examines the structural and tectonic development of extensional structures in the Great Basin and Salton Trough; collisional and accretionary tectonics in the Western U.S., Pakistan, and the southern Appalachians; the relationship of ophiolites to active margin processes; and the application of basin analysis to the tectonics of basin formation and large scale crustal structures in China, Mongolia, Pakistan, and west Africa.

Research in **igneous petrology and geochemistry** focuses on the origin and evolution of basic to intermediate magmatic systems, and their relationship to global tectonic processes. Current projects include plume-related volcanism and its interaction with continental lithosphere in the Snake River Plain, Idaho; the origin and tectonic evolution of accreted arc terranes; the multi-stage origin of ophiolites; and the formation and evolution of lunar highlands crust.

Geomorphology research includes the study of climate and anthropogenic controls on landscape change and sedimentation; controls on alluvial stratigraphy; hillslope processes; numerical modeling of climate controls on basin stratigraphy; Quaternary landscape evolution of the Grand Canyon; and the integration and evolution of the Colorado River.

Research activity in **hydrogeology** includes wellhead protection in confined to semiconfined aquifers, the relationships between stream losses and water table depths, and the identification and geochemical characterization of groundwater recharge to surface streams.

Geology faculty members commonly interact with the faculty and staff of the Utah Water Research Laboratory; the College of Natural Resources; the Department of Plants, Soils, and Biometeorology; and the Department of Civil and Environmental Engineering.

Financial Assistance

Departmental financial support for incoming graduate students consists primarily of graduate teaching assistantships, which are awarded on a competitive basis. There is often other financial support available, such as research assistantships, resulting from grants or other external funding. Students requesting financial

support should apply directly to the department no later than February 15. Admission to the MS program does not guarantee financial assistance.

Additional Information

Additional information on the research activities of faculty and graduate students may be obtained directly from the Department of Geology's website at <http://www.usu.edu/geoldept>.

Geology Faculty

Professors

James P. Evans, structural geology, structural petrology

W. David Liddell, marine ecology, paleoecology, sedimentology

John W. Shervais, igneous petrology, geochemistry

Adjunct Professors

Lynn M. Dudley, soil chemistry

David G. Tarboton, water resources and hydrology

Professor Emeritus

Robert Q. Oaks, Jr., sedimentary petrology, stratigraphy

Associate Professors

Donald W. Fiesinger, igneous petrology, Dean of College of Science

Susanne U. Janecke, tectonics, structural geology

Peter T. Kolesar, carbonate petrology, geochemistry

Thomas E. Lachmar, hydrogeology

Adjunct Associate Professors

Janis L. Boettinger, soil mineralogy

John C. Schmidt, fluvial geomorphology

Assistant Professors

Joel L. Pederson, process geomorphology, Quaternary geology

Bradley D. Ritts, basin analysis

Research Assistant Professor

Carol M. Dehler, sedimentation, geochemical cycles

Adjunct Assistant Professor

David G. Chandler, surface hydrology

Course Descriptions

Geology (GEOL), pages 404-406