

# GEOLOGICAL SCIENCES

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Dept. Code: GSC

## Geological Sciences

Geological Sciences is concerned with Planet Earth, its origin, evolution, structure, internal and surface processes, mineral resources, environmental preservation, global dynamics, paleoclimate reconstruction, and life history. Geologists use their knowledge of chemistry, biology, physics and mathematics to solve Earth problems.

Geological Sciences undergraduates are prepared for careers in industry as well as graduate study in geosciences, the environmental sciences, and marine sciences. Career paths include research and teaching, as well as employment in the petroleum and mineral industries and in industries and government organizations concerned with energy resources, geodynamics, the marine environment, conservation, and climate change.

## Major Options

There are three undergraduate degree options pertaining to the Geological Sciences: 1) the double major Bachelor of Science in Marine Science and Geological Sciences, 2) the Bachelor of Science in Geological Sciences, and 3) the Bachelor of Arts in Geological Sciences. Students often combine majors in the Geological Sciences with a second major or minor in diverse fields such as Anthropology, Mathematics, or Ecosystem Science and Policy. Interested students should read the information below and contact the Rosenstiel School Undergraduate office (Ungar 210A or 305-284-2180) for details.

- Bachelor of Science (B.S.) in Geological Science
- Bachelor of Science (B.S.M.A.S.) Marine Science/Geological Sciences
- Bachelor of Arts (B.A.) in Geological Sciences
- Five-year Master of Science Program (M.S.)

## 5 Year B.S./M.S. Program in Geological Sciences and Marine Geosciences

A 5-year B.S. /M.S. in Geological Sciences and Marine Geosciences allows qualified UM Undergraduate students to complete a master's degree in one year of study beyond the B.S. In doing so, students can save both time and money. By the beginning of their junior year students should have obtained a graduate faculty advisor, selected an approved topic for research, and begun work on their senior thesis as preparation for the M.S. In the senior year, students will increase their focus on graduate courses and work closely with their graduate faculty advisor. While courses cannot be double counted between the B.S. and M.S. degrees, some graduate courses can be taken as an undergraduate and transferred to the graduate program. During the final year, students complete the required M.S. course work while expanding their undergraduate research and completing the M.S. thesis.

For further information and application forms please visit this website (<https://admissions.miami.edu/undergraduate/academics/dual-degree-program/>).

### **GSC 101. Origin and Evolution of Planet Earth. 3 Credit Hours.**

The origin of the elements and the evolution of the universe. The formation and early evolution of the solar system. The differentiation of the earth into core, mantle, and crust. Origin of the oceans and atmosphere.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

### **GSC 102. Evolution of the Biosphere. 3 Credit Hours.**

The physical basis of life. The origin, early evolution, history of life on Earth. Emphasis on major crises and innovations, including the evolution of modern man.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

### **GSC 103. Evolution of the Modern Earth's Environment. 3 Credit Hours.**

The earth's crust: composition and morphology. Ocean and atmosphere: radiation balance and dynamics. Climatology and paleoclimatology. The ice ages and the evolution of the modern environment. The relationships between the geological environment and human activities.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

### **GSC 105. The Global Environment. 3 Credit Hours.**

Anthropogenic effects on the Earth's environment compared to analogous natural events.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**GSC 106. Geological Influences on Society. 3 Credit Hours.**

Impact of geological processes on daily human activities and decision-making. Geological hazards and human habitation. Economic geology and exploration of natural resources. Influences of geology on other disciplines.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**GSC 107. Natural Disasters: Hollywood vs. Reality. 3 Credit Hours.**

This course will explore the causes, effects and societal responses to disasters. We will look at a variety of natural hazards and related disasters including flooding, volcanoes, landslides, earthquakes, hurricanes, tsunami and drought. Using excerpted segments of "disaster films" in conjunction with scientific treatments

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**GSC 108. The Geologic Record. 3 Credit Hours.**

Analysis of the rock record to determine the geologic history using knowledge of rocks, minerals, fossils, and stratigraphy.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**GSC 109. Our Geoheritage: Geology of America's National Parks. 3 Credit Hours.**

This course is designed to introduce the student to the geologic setting and geological processes that have contributed to the formation and evolution of America's national parks. The concept of a national park, an American concept, provides a sense of place, and as such contributes to our collective geoheritage. For international students, this course will introduce them to diverse environmental settings, physiography, and tectonic forces that have similarly affected all the landmasses of Earth. This course will focus on the fundamental geological processes that have collaborated to form the U.S. national parks.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**GSC 110. The Earth System. 4 Credit Hours.**

Interactions among the major components of the Earth System - the geosphere, the hydrosphere, the atmosphere, and the biosphere.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**GSC 111. Earth System History. 4 Credit Hours.**

Earth History, beginning with earliest origins and surveying major steps in the evolution of the geosphere, atmosphere, hydrosphere, and biosphere.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**GSC 222. Earth's Climate Past and Future. 3 Credit Hours.**

This course will provide undergraduate students majoring in geological sciences, as well as enthusiastic non-majors, with the foundation to better understand climate change on geological to human timescales. The natural processes that control the earth's climate will be discussed, with special attention to the climate of the Holocene, and the potential influence climate may have played on human civilizations. Finally, the expected climate shifts and feedbacks will be discussed based on the outcome of climate models for the next century.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**GSC 230. Reef Systems Through Time. 3 Credit Hours.**

Interacting geological, physical, chemical, biological, and climatic processes that define a reefal setting and system. Field trips included.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 231. Field Studies in Earth Systems. 2 Credit Hours.**

Field Study of Earth systems through geologic time. Hands-on investigation of the geologic record to reveal Earth's past environments, climates, and life.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 240. Introduction to Marine Geology. 3 Credit Hours.**

Learn about the origin, structure and evolution of the ocean basins and their margins, including interpretation of the paleo-archives hidden on the seafloor. The course material is necessarily broad, covering marine geography, plate tectonics, active and passive margins, coastal and ocean processes, sediment processes, continental margin and seafloor resources, and climate and ocean history and interactions. Our approach will be interdisciplinary, requiring integration of chemical, physical and biological systems, as well as geologic processes. A special emphasis will be placed on learning to read the sediment record as an archive of information on biologic and climate evolution.

Prerequisite: GSC 110 or GSC 111.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring Even Years.

**GSC 260. Earth Materials. 4 Credit Hours.**

Physical and optical properties of common rock-forming minerals and their occurrence in igneous, metamorphic, sedimentary rocks, and ore deposits. Lecture, 3 hours; laboratory, 4 hours.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**GSC 309. Microbes and the Environment. 3 Credit Hours.**

This course is designed to provide students in geology, biology and environmental science a fundamental understanding of the role microbes play in shaping the Earth and its environments as well as the basic principles and approaches to studying these interactions in both modern and ancient settings. The metabolic diversity displayed by microbial communities makes them an integral component of global elemental cycles. In this regard, microorganisms have shaped our planet over the past 4 billion years and continue to do so in a very prominent way. The goal of this course is to learn about microbial diversity and metabolism, and the ability of microbes to shape and influence the environment.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**GSC 360. Depositional and Diagenetic Systems. 4 Credit Hours.**

Sedimentary processes, sedimentology, and sedimentary diagenesis. Physical, biological and chemical sedimentation in Earth's surficial environments. Paleoenvironmental and diagenetic history reconstruction using petrologic, hand specimen, and field methods. Cyclicity in sedimentary systems. Lecture, 3 hours; field/ laboratory, 3 hours.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**GSC 371. Readings in Geological Sciences. 1-3 Credit Hours.**

Library research and discussion on selected topics under faculty supervision. No more than 6 credits in total from GSC 371, GSC 411, and GSC 412 can be counted towards any of the Rosenstiel School major or minor requirements with no more than 3 credits from each course.

Rosenstiel majors only.

**Components:** DIS.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**GSC 380. Paleontology and Stratigraphy. 4 Credit Hours.**

Biostratigraphy, paleoecology, taphonomy, micro- and macro-evolutionary processes, and physical and chemical methods used for stratigraphic correlation. Major groups of invertebrate phyla comprising the bulk of the fossil record. Lecture, 3 hours; laboratory, 2 hours.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 411. Research in Geological Sciences. 1-3 Credit Hours.**

Individual, independent research projects in Geological Sciences with faculty supervision. A formal written report is required after every semester. Each credit of research will correspond to a minimum of 3 hours of hands-on research experience per week. No more than 6 credits in total from ATM, GSC, MBE, or MSC 371, 411, and 412 can be counted towards the Rosenstiel School major or minor requirements with no more than 3 credits from each course.

Requisite: Junior or Senior Standing.

**Components:** THI.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**GSC 412. Undergraduate Thesis in Geological Sciences. 1 Credit Hour.**

Students will write a formal thesis summarizing the results of independent research carried out under faculty supervision. The thesis must be reviewed and approved by a committee. An approved public presentation of research findings (oral or poster presentation) is required at the end of the term. No more than 6 credits in total from ATM, GSC, MBE or MSC 371, 411, and 412 can be counted towards any of the Rosenstiel School major or minor requirements with no more than 3 credits from each course.

Pre-Requisite: ATM 411 or GSC 411 or MBE 411 or MSC 411, And Requisite: Senior Standing.

**Components:** THI.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**GSC 424. Origin and Geology of the Galapagos Islands. 3 Credit Hours.**

This course explores the origin and geology of volcanic oceanic islands, using the Galapagos Islands as a natural laboratory. Though all share a common origin in plate tectonic theory, each island presents a host of environments that originate in the processes of volcanic action, erosion and hydrology. Individual islands therefore develop distinctive ecosystems within which organisms interact and evolve. The emphasis of this course will be to lay out the underlying geological processes that have led to the formation of the islands and to their present state, and to explore through daily field excursions a wide suite of volcanic features displayed on Isabela Island.

Prerequisite: GSC 110.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**GSC 440. Petrology. 4 Credit Hours.**

Genesis and classification of igneous and metamorphic and sedimentary rocks, field relationships of rock assemblages and results of recent laboratory investigations. Identification of common rock types in hand specimens and by thin-section and X-ray diffraction techniques. Lecture, 3 hours; laboratory, 3 hours.

Prerequisite: GSC 260.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 462. Earth's Ancient Atmospheres, Climates, and Sea Levels. 3 Credit Hours.**

The Earth's atmospheres, climates, and sea level from the early Pre-Cambrian to present. Focus is placed on how the study of Earth's past is relevant to both modern and future climate change.

Prerequisite: GSC 110 and GSC 111.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 480. Structural Geology. 4 Credit Hours.**

Behavior of rock materials; analysis, description and classification of geologic folds, faults, joints; analysis of rock fabrics; tectonic and geologic history of continents and continental margins. Lecture, 2 hours; laboratory, 2 hours.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 482. Field Methods. 2 Credit Hours.**

Field and laboratory exercises in mapping; interpretation of aerial and satellite imagery, coring, rock description, and stratigraphic interpretation. Course meets most Saturdays.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 550. Hydrogeology. 3 Credit Hours.**

Explore the cycling of water in the Earth's hydrosphere with a focus on geological, physical and chemical aspects of surface and sub-surface reservoirs and processes. Topics include climate change and other challenges facing the hydrologist in ensuring adequate availability and quality of water through exploring and developing new resources and managing and protecting existing ones.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 561. Communicating Geoscience. 2 Credit Hours.**

Evaluate the scientific works of others, both oral and written, and work on developing the skills to clearly and concisely present your own work and ideas as a geoscientist. Discuss career opportunities and prepare to move forward toward a career in the Earth sciences.

**Components:** DIS.

**Grading:** GRD.

**Typically Offered:** Spring.

**GSC 580. Summer Field Geology. 4 Credit Hours.**

An intensive four-week summer field laboratory study of modern geological processes and ancient rock sequences. Mapping, description and interpretation of rock and structural sequences, paleoenvironmental reconstruction, interpretation of tectonic history. Reports required. Touring course. Travel fee required.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**GSC 581. Summer Field Environmental Geology. 2 Credit Hours.**

Field evaluation of environmental geology problems in marine, coastal, wetland and terrestrial environments. Effects of human alteration of landscape, natural hazards, pollution of ground water, surface water and soils. Role of climate change on surficial environments. Reports required. Touring course. Travel fee required. Co-requisite: GSC 580.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**GSC 582. Field Studies. 1-4 Credit Hours.**

Conducted field trips to selected geological sites in the United States and abroad. Report required.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.