



University of South Carolina

College of Arts & Sciences

The School of the Earth,  
Ocean & Environment

# Geosciences

## Undergraduate Handbook

for majors in

## Geological Science and Geophysics

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## **THE CAROLINIAN CREED**

The community of scholars at the University  
of South Carolina is dedicated to personal  
and academic excellence.

Choosing to join the community obligates each member  
to a code of civilized behavior.

As a Carolinian...

I will practice  
Personal and academic integrity;

I will respect  
the dignity of all persons;

I will respect  
the rights and property of others;

I will discourage  
bigotry, while striving to learn from  
differences in people, ideas and opinions;

I will demonstrate  
concern for others, their feelings, and their need for  
conditions which support their work and development.

Allegiance to these ideals requires each Carolinian  
to refrain from and discourage behaviors which threaten  
the freedom and respect every individual deserves.

## **OVERVIEW OF THE SCHOOL OF THE EARTH, OCEAN AND ENVIRONMENT'S GEOSCIENCES' UNDERGRADUATE PROGRAMS**

### **Earth Science – It's not just a major, it's an adventure!**

Earth science is not only about dinosaurs and rocks. It's about the Earth's resources, energy, climate, oceans, natural disasters, and the environment. Earth sciences incorporate significant elements of all the other sciences and provide a unique perspective on applying these disciplines to critical aspects of our world today.

**There are many exciting career possibilities in the Earth sciences.** If you are interested in science, and in particular if you have done well in your physics, chemistry, or biology courses, or if you would like to try something new – consider applying your talents to the study of the Earth. The possibilities are endless...

### **Degrees Offered**

The School of the Earth, Ocean and Environment offers Bachelor of Science degrees in *Geological Sciences* (the study of the dynamics and physical history of the Earth, the rocks of which it is composed, and its physical, chemical, and biological changes) and *Geophysics* (the branch of geology that deals with the physics of the earth, including oceanography, seismology, volcanology, and geomagnetism). **We are one of only two institutions in the southeastern U.S. that offers a Geophysics undergraduate major degree.**

Both majors can be completed within four years. We have a large and diverse faculty with broad scientific expertise, so whether you want to focus on earthquakes, volcanoes, groundwater, climate change, or the coastal oceans, you will find someone in our department who shares your interests. If you are interested in fulfilling your **pre-med**, **pre-health**, or **pre-law** requirements and get a degree that can also offer you employment choices down the road, then consider Earth Sciences.

### **Employment Opportunities**

**It's never been a better time to be a Geologist!** With growing national and international attention upon energy, climate, and the environment, employment opportunities for undergraduate students with geology or geophysics degrees are excellent. Our graduates find jobs in companies of all sizes, where they commonly work on problems related to groundwater, natural resources, natural hazards, environmental, and engineering issues.

**There are many first-hand employment opportunities through summer internships** with: the S.C. Department of Natural Resources, the U.S. Geological Survey, the Incorporated Research Institutions for Seismology, environmental firms, and governmental agencies.

**Our students who continue their education also do very well.** We have had students in graduate programs in the Earth sciences at Stanford, Cornell, Yale, the University of Arizona, University of Texas and other major research universities. Students who complete masters and doctoral degrees find additional employment opportunities in research, teaching, the private sector, and in state and federal government.

### **Research**

Many of our students are involved in research, either through employment with one of our faculty members, or though the university's Magellan Scholars program. Occasionally, this leads to unique opportunities which are rarely afforded to students at the undergraduate level. **For example, in recent years, geological science and geophysics majors have participated in field**

**programs in Russia, Romania, China, Kyrgyzstan, Puerto Rico, and Antarctica.** These opportunities exist because we have a motivated faculty with active research programs who also have an interest in contributing to the quality of the experience of our undergraduate students.

## **Our Students**

Our students have been McNair, Carolina, Lieber, McKissick, Capstone, Magellan, and Goldwater Scholars. Each year, our undergraduate students win prestigious departmental awards including the LeConte Outstanding Senior, LeConte Outstanding Junior, and Stephen Taber Awards. Many of our students win national competitions that are made available annually, such as the Society of Exploration Geophysicists scholarship.

We have a, student-run Geology Club, which organizes local field trips, usually highlighted by hiking or rafting. **The Geology Club is also involved in our GEOL 318 course, which is built around a spring break field trip.** Recent destinations have included Death Valley, Hawaii, Spain, Costa Rica, and the Azores.

**In addition, we host two student chapters of large geosciences organizations** – the Society of Exploration Geophysicists and the American Association of Petroleum Geologists – which foster relationships with industry and provide guidance and support to our students.

## **Our School**

As a student in our school, you will enjoy the typically small class sizes (nearly always less than 25) and the tutelage of faculty members who have a genuine concern for your development and success. Our mission is to provide our undergraduate students with the highest quality education, including a rich academic experience, research opportunities and field related skills, employment prospects, a welcoming and friendly environment which includes a strong support group through in-house student organizations, and customized advisement to fit every student's needs and chances to grow as a scientist and responsible citizen.

## **Our Faculty**

The School of the Earth, Ocean and Environment at USC has a very dynamic and productive Geoscience faculty who are committed to providing excellence in teaching and research along with a vibrant and friendly academic environment. All of our professors have research labs in which graduate and undergraduate students work together on research projects sponsored by federal, state, or private agencies. Please see a list of the faculty at:

<http://artsandsciences.sc.edu/seoe/directories>.

We offer a broad range of specialties within the geosciences, and our students can become involved in many areas of research – some of which include:

### ***Global Climate Change***

Faculty in the climate change group are actively engaged in studying the Cenozoic to recent history of climate change preserved in both marine and continental records. Using a variety of analytical techniques, including micropaleontology, sediment geochemistry, trace metal geochemistry and stable isotope geochemistry, these faculty are both developing new climate proxies as well as using them to reconstruct past climate conditions that existed in diverse locations worldwide. This research explores the nature of climate change on a variety of time scales from decadal-scale variability to the link between tectonics and climate.

Ongoing projects include: Holocene climate variability preserved in the varved sediments of the Cariaco and Santa Barbara Basins, the role of the tropics in driving Pleistocene glacial-interglacial cycles, Holocene history of Lena River discharge to the Arctic, Pleistocene climate history preserved in Asian lakes and in the southeastern US, tectonically driven climate change in the western US, Eocene-Oligocene climate change in North America, and the influence of phytoplankton on ocean circulation and how it may affect interannual variability associated El Niño and global climate change.

### ***Environmental Geosciences***

Environmental geosciences span hydrology, geomorphology, sediment transport, and oceanography. Although individual research programs in this group address a very wide array of research problems, these programs generally relate to understanding how environmental systems change through time via fluid, solute, and sediment fluxes.

Research projects employ a range of techniques, from well installation and monitoring to satellite remote sensing, radioisotope geochemistry, GPS, GIS, environmental geophysics and numerical modeling. Time scales range from hours for coastal storm events to millions of years for deep sedimentary basin environments suitable for carbon sequestration.

Ongoing projects include: measurement of soil moisture through satellite remote sensing, investigation of solute transport in deep sedimentary basins, micro-topography and ecohydrology of coastal salt marshes, trace elements in Congaree National Park, nutrient cycling in the upper ocean, beach and inner shelf sediment dynamics, shelf benthic exchanges, numerical simulations of ocean wave propagation and coastal ocean circulation.

### ***Mountain Building***

Also called “Evolution of Orogenic Systems,” this research area applies modern methods in regional tectonics, seismology, lithospheric evolution, applied geophysics, marine geophysics, satellite geodesy, igneous and metamorphic petrology, structural geology, petroleum exploration, sediment analysis, and sequence stratigraphy to diverse environments around the globe.

Projects in this area center on the Carpathian orogen of Romania, the Tien Shan of Central Asia, the Himalaya, the South Indian lithosphere, the Sierra Nevada, the Aleutians, and the Scottish Highlands.

### ***Energy Related Research***

Several USC faculty members evaluate and reconstruct tectonic settings through the integration of geophysical, geochemical, stratigraphic, and geodynamic data. In addition to active- and passive-source seismic methods, faculty also uses geodesy, gravity and magnetics to constrain tectonic dynamics, as well as basin modeling and geochemical provenance analysis to evaluate tectonic models.

### ***Ocean Sciences***

More than a third of our faculty has research interests in ocean sciences, and many of this faculty participates in the University's interdisciplinary Marine Science Degree Program. The Ocean Sciences group uses modern methods and state-of-the-art equipment to study ocean biogeochemistry, nutrient cycling, coastal dynamics and salt marsh processes, wave-current interactions, sediment transport, shoreline evolution, marine sedimentation, sea floor geomorphic processes, and sea floor mapping.

Examples of ongoing studies include coastal ocean observing in the Southeastern Atlantic, coastal erosion in South Carolina, carbon export in cyclonic eddies off of Hawaii, time series measurements of sediment fluxes in Santa Barbara Basin and Cariaco Basin, volcanic processes on the East Pacific Rise, hydrothermal activity along the Galapagos spreading center, and river discharge into the Arctic Ocean.

## **DEGREES OFFERED**

The School of the Earth, Ocean and Environment (SEOE) offers Bachelor of Science degrees with general or intensive majors in Geological Sciences and a general major in Geophysics. We also offer two concentrations: one in Environmental Geosciences and one in Marine Geology. Minors in both Geological Sciences and Geophysics are also available.

### **BS in Geological Sciences**

Students who graduate with a B.S. in Geological Sciences should be able to ...

- demonstrate their knowledge of fundamental concepts and laboratory skills in the geosciences.
- demonstrate knowledge of geological field skills.
- demonstrate their preparation for careers or graduate studies in the geosciences.

#### **Curriculum (120 hours)**

##### **1. Carolina Core:**

##### **I. Effective, Engaged and Persuasive Communication (CMW) (6 hrs; grade of C or higher required)**

ENGL 101 Critical Reading and Composition; and

ENGL 102 Rhetoric and Composition

##### **II. Analytical Reasoning & Problem Solving (ARP) (12-14 hours)**

CALCULUS: MATH 122 Calculus for BA and Social Sciences OR MATH 141 Calculus I; and MATH 170 Finite Mathematics OR MATH 142 Calculus II (6-8 hrs);

STATISTICS: STAT 201 Elementary Statistics OR STAT 509 Statistics for Engineers OR STAT 515 Statistical Methods I (3 hrs)

COMPUTER SCIENCE: CSCE 102 General Applications Programming, or higher (3 hrs)

##### **III. Global Citizenship & Multicultural Understanding (GFL) (12-21 credits)**

FOREIGN LANGUAGE: Demonstration of proficiency in one foreign language equivalent to the minimal passing grade on the exit examination in the 122 course level (0-9 hours)

HISTORICAL THINKING: Two courses as specified by the Carolina Core (6 hours)

SOCIAL SCIENCE: Two courses as specified by the Carolina Core including courses from: anthropology, economics, criminal justice, environment (select courses), geography, political science, psychology, sociology, southern studies (select courses) and WGST 112 (6 hours)

##### **IV. Aesthetic and Interpretive Understanding (AIU) (6 credits)** Select one Fine Arts or Literature and one Fine Arts or Humanities. See

[http://www.sc.edu/generaleducation/coursesapproved.php?desig=0&col=0&core=L\\_1](http://www.sc.edu/generaleducation/coursesapproved.php?desig=0&col=0&core=L_1) for approved courses, including: ARTE 101, 260; ARTH 105, 106; ARTS 103, 104; CLAS 220; CPLT 270; DANC 101; ENGL 282-288; FILM 180, 240; FREN 290; GERM 290; MART 110, 210; MUSC 110, 113-115, 140; RUSS 280; SPAN 220; THEA 170, 181, 200. Additional courses will continue to be added to this list. **Note that one-credit theater production, music performance and dance performance courses do not count toward this requirement.**

## **V. Scientific Literacy (SCI) (8 hours)**

(Laboratory Science) Courses (both with laboratory) selected from: astronomy, biology, chemistry, geological sciences, marine science, and physics. **The premajor requirements for the BS in Geological Sciences automatically fulfills this requirement.**

## **VI. Overlay**

Up to two overlay courses can also fulfill Carolina Core requirements as listed above, but one must stand alone. See

[http://www.sc.edu/generaleducation/coursesapproved.php?desig=0&col=0&core=I\\_1](http://www.sc.edu/generaleducation/coursesapproved.php?desig=0&col=0&core=I_1) for a list of these courses, including:

A. PERSUASIVE COMMUNICATION (CMS)

Select from: PHIL 325; SAEL 200; SPCH 140

B. INFORMATION LITERACY (INF)

Select from ENGL 102; LIBR 101; SLIS 202; STAT 112

C. VALUES, ETHICS & SOCIAL RESPONSIBILITY (VSR)

Select from BIOL 208; HIST 108; PHIL 103, 211, 320, 321, 322, 325; POLI 303; SAEL 200

## **2. Major Requirements:**

### **Major Prerequisites**

The following courses fulfill some of the Carolina Core requirements and must be completed for a general or intensive major in Geological Sciences:

- GEOL 101 Introduction to the Earth, 103 Environment of the Earth OR GEOL 201 Observing the Earth (grade of C or higher)
- 
- MATH 122 Calculus for BA and Social Sciences OR MATH 141 Calculus I
- MATH 170 Finite Mathematics OR MATH 142 Calculus II
- CHEM 111 General Chemistry I (with CHEM 111L lab)
- PHYS 201 General Physics I OR PHYS 211 Essentials of Physics I
- PHYS 201L General Physics I Lab OR PHYS 211L Essentials of Physics I Lab
- STAT 201, 509 or 515

Plus choose **two** of the following courses:

- CHEM 112 General Chemistry II (with CHEM 112L lab)
- PHYS 202 General Physics II (with PHYS 202L lab) or PHYS 212 Essentials of Physics II (with PHYS 212L lab)
- BIOL 101 Biological Principles I (with BIOL 101L lab)
- BIOL 102 Biological Principles II (with BIOL 102L lab)

### **General Major in Geological Sciences (26 Hours)**

All major courses must be passed with a grade of C or higher.

- GEOL 302 Rocks and Minerals
- GEOL 325 Stratigraphy and Sedimentary Basins
- GEOL 345 Igneous and Metamorphic Processes
- GEOL 355 Structural Geology

Plus select **two** of the following three courses:

- GEOL 305 Earth Systems through Time
- GEOL 315 Surface and Near Surface Processes
- GEOL 335 Processes of Global Environmental Change

Senior Capstone Experience (6 Hours)

- GEOL 500 Field Geology

### **General Major with Concentration in Environmental Geosciences (26 Hours)**

All major courses must be passed with a grade of C or higher.

- GEOL 302- Rocks and Minerals
- GEOL 315 - Surface and Near Surface Processes
- GEOL 325 - Stratigraphy and Sedimentary Basins
- GEOL 335 - Processes of Global Environmental Change
- GEOL 355 – Structural Geology and Tectonics

Plus select 1 of the following 3 courses:

- GEOL 305 - Earth Systems through Time
- GEOL 371 – A View of the River
- GEOL 548 – Environmental Geophysics

Senior Capstone Experience (6 Hours)

- GEOL 500 Field Geology

### **Intensive Major in Geological Sciences (43 Hours)**

All major courses must be passed with a grade of C or higher.

- GEOL 302- Rocks and Minerals
- GEOL 305 Earth Systems through Time
- GEOL 315 Surface and Near Surface Processes
- GEOL 325 Stratigraphy and Sedimentary Basins

- GEOL 335 Processes of Global Environmental Change
- GEOL 345 Igneous and Metamorphic Processes
- GEOL 355 Structural Geology and Tectonics

Senior Capstone Experience (6 Hours)

- GEOL 500 Field Geology

Plus 9 credits of GEOL courses numbered 399 or higher.

### **Intensive Major with Concentration in Marine Geology (43 Hours)**

Same course requirements as the intensive major plus 9 credits of GEOL courses selected from the following list (all courses must be passed with a grade of C or higher):

- GEOL 511 Advanced Paleontology
- GEOL 515 Marine Micropaleontology
- GEOL 516 Sedimentology
- GEOL 518 Surface to Subsurface Stratigraphy
- GEOL 521 Introduction to Geochemistry
- GEOL 531 Plate Tectonics
- GEOL 545 Geological Oceanography
- GEOL 546 Marine Geophysics
- GEOL 553 Marine Sediments
- GEOL 557 Coastal Processes
- GEOL 581 Estuarine Oceanography
- GEOL 582 Marine Hydrodynamics
- GEOL 583 Geology and Geochemistry of Salt Marshes
- GEOL 498 Undergraduate Research (limit 3 credits on approved research topics)
- GEOL 499 Undergraduate Research (limit 3 credits on approved research topics)

Note: The Cognate for the Intensive Major with Concentration in Marine Geology must include 3 credits of MATH 241 (or higher) or STAT 509, 510, 511, 512, 515, 516.

### **3. Cognates**

The cognate is intended to support the course work in the major. Cognate courses may all be in one outside department or in several departments, depending on the individual interests and requirements of the student as judged by the student's academic advisor. A cognate differs from a minor in that the courses must be above sophomore level and may be distributed over more than one subject area. Grades of **D** are acceptable for completion of the cognate requirement; however *courses applied toward Carolina Core requirements cannot be counted toward the cognate.*

Courses offered by departments in the College of Arts and Sciences that are acceptable for cognate credit for the Bachelor of Science (Curricula Section II) are listed in the on-line Undergraduate Academic Bulletin

(<http://bulletin.sc.edu/content.php?catoid=36&navoid=3733>); for cognate course offerings in other departments or colleges, consult the appropriate sections of that bulletin. In general, 399 courses are not used for fulfilling the cognate requirement. While they may appear on the College's list of cognate courses, GEOL courses may not be used toward the cognate for degrees in Geological Sciences.

It should be emphasized that the cognate is not a second set of elective courses to be chosen at random by the student. The cognate must be approved by the advisor as being related to the major field of study.

### **Degree with Distinction in Geological Sciences**

The designation "Distinction in Geological Sciences" is available to Geological Sciences majors who wish to participate in significant research activities in their major field under the supervision of a faculty mentor.

#### **Requirements:**

- A minimum GPA of 3.5 in the major and 3.3 overall
- Written sponsorship agreement from the faculty mentor on file in the SEOE Undergraduate Student Services office (*PSC 108*).
- 3 courses in addition to the general major requirements, including:
  - GEOL 498 or 499 - Undergraduate Research (3), preparing for the Senior Thesis;
  - GEOL 699 - Senior Thesis (3-6);
  - A minimum of one GEOL 500 level course appropriate to the research.
- A public presentation of the Senior Thesis research accompanied by a written document approved by the faculty mentor and a second reader that follows the Senior Thesis guidelines for the degree.
- Submission of text of Senior Thesis on CD Rom in pdf format or in electronic format requested by the SEOE Student Services office.

Students who successfully fulfill all of these requirements will be awarded their degree with "Distinction in Geological Sciences" upon graduation.

**NOTE:** South Carolina Honors College students taking this route would graduate with both Honors in SCHC and "Distinction in Geological Sciences".

- Submission of text of Senior Thesis in pdf format on CD Rom or in electronic format requested by SEOE Undergraduate Student Services Office (*PSC 108*).

## **BS in Geophysics**

Students who graduate with a B.S. in Geophysics should be able to ...

- demonstrate their knowledge of fundamental concepts and laboratory skills in the geosciences.
- demonstrate knowledge of geological field skills.
- demonstrate their preparation for careers or graduate studies in geophysics.

### **Curriculum (128 hours)**

#### **1. Carolina Core:**

##### **I. Effective, Engaged and Persuasive Communication (CMW) (6 hrs; grade of C or higher required)**

ENGL 101 Critical Reading and Composition; and  
ENGL 102 Rhetoric and Composition

##### **II. Analytical Reasoning & Problem Solving (ARP) (14 hours)**

CALCULUS: MATH 141 Calculus I AND MATH 142 Calculus II (8 hrs);

STATISTICS: STAT 509 Statistics for Engineers OR STAT 515 Statistical Methods I (3 hrs)

COMPUTER SCIENCE: CSCE 206 Scientific Applications Programming OR CSCE 207 Unix System Admin (3 hrs)

##### **III. Global Citizenship & Multicultural Understanding (GFL) (12-21 credits)**

FOREIGN LANGUAGE: Demonstration of proficiency in one foreign language equivalent to the minimal passing grade on the exit examination in the 122 course level (0-9 hours)

HISTORICAL THINKING: Two courses as specified by the Carolina Core (6 hours)

SOCIAL SCIENCE: Two courses as specified by the Carolina Core including courses in: anthropology, economics, criminal justice, environment (select courses), geography, political science, psychology, sociology, southern studies (select courses) and WGST 112 (6 hours)

##### **IV. Aesthetic and Interpretive Understanding (AIU) (6 credits)** Select one Fine Arts or Literature and one Fine Arts or Humanities. See

[http://www.sc.edu/generaleducation/coursesapproved.php?desig=0&col=0&core=L\\_1](http://www.sc.edu/generaleducation/coursesapproved.php?desig=0&col=0&core=L_1) for approved courses, including: ARTE 101, 260; ARTH 105, 106; ARTS 103, 104; CLAS 220; CPLT 270; DANC 101; ENGL 282-288; FILM 180, 240; FREN 290; GERM 290; MART 110, 210; MUSC 110, 113-115, 140; RUSS 280; SPAN 220; THEA 170, 181, 200. Additional courses will continue to be added to this list. **Note that one-credit theater production, music performance and dance performance courses do not count toward this requirement.**

##### **V. Scientific Literacy (SCI) (8 hours)**

(Laboratory Science) Courses (both with laboratory) selected from: astronomy, biology, chemistry, geological sciences, marine science, and physics. **The premajor requirements for the BS in Geophysics automatically fulfills this requirement.**

## **VI. Overlay**

Up to two overlay courses can also fulfill Carolina Core requirements as listed above, but one must stand alone. See

[http://www.sc.edu/generaleducation/coursesapproved.php?desig=0&col=0&core=I\\_1](http://www.sc.edu/generaleducation/coursesapproved.php?desig=0&col=0&core=I_1) for a list of these courses, including:

- A. PERSUASIVE COMMUNICATION (CMS)  
Select from: PHIL 325; SAEL 200; SPCH 140
- B. INFORMATION LITERACY (INF)  
Select from ENGL 102; LIBR 101; SLIS 202; STAT 112
- C. VALUES, ETHICS & SOCIAL RESPONSIBILITY (VSR)  
Select from BIOL 208; HIST 108; PHIL 103, 211, 320, 321, 322, 325; POLI 303;  
SAEL 200

## **2. Major Requirements**

### **Major Prerequisites**

The following courses fulfill some of the Carolina Core requirements and must be completed for a major in Geophysics (see changes below effective Fall 2017)\*:

- GEOL 101 Introduction to the Earth, 103 Environment of the Earth or GEOL 201 Observing the Earth (grade of C or higher)
- CHEM 111 and 111L General Chemistry I with lab and CHEM 112 and 112L General Chemistry II with lab
  - PHYS 211 Essentials of Physics I and PHYS 211L Essentials of Physics I Lab
  - PHYS 212 Essentials of Physics II and PHYS 212L Essentials of Physics II Lab
  - MATH 141 Calculus I and MATH 142 Calculus II
  - MATH 241 Vector Calculus
  - MATH 242 Elementary Differential Equations
  - MATH 527 Numerical Analysis
  - MATH 526 Numerical Linear Algebra or MATH 544 Linear Algebra
  - CSCE 206 Scientific Applications Programming or CSCE 207 UNIX System Administration
  - STAT 509 Statistics for Engineers or STAT 515 Statistical Methods I

### **Major Courses (34 Hours)**

- GEOL 302 Rocks and Minerals (4)
- GEOL 315 Surface and Near Surface Processes (4)
- GEOL 325 Stratigraphy and Sedimentary Basin (4)
- GEOL 345 Igneous and Metamorphic Process
- GEOL 531 Plate Tectonics (3)
- GEOL 554 Applied Seismology (3)
- GEOL 555 Elementary Seismology (3)
- GEOL 556 Seismic Reflection Interpretation (3)
- GEOL 575 Introduction to Groundwater Modeling (3)

- GEOL 582 Marine Hydrodynamics (3)

Senior Capstone Experience (4 Hours)

- GEOL 548 Environmental Geophysics (4)

Note: An approved field course may be substituted for the Capstone Experience.

### **3. Cognate (12-13 Hours)**

The cognate is intended to support the course work in the major. Cognate courses may all be in one outside department or in several departments, depending on the individual interests and requirements of the student as judged by the student's academic advisor. A cognate differs from a minor in that the courses must be above sophomore level and may be distributed over more than one subject area. Grades of **D** are acceptable for completion of the cognate requirement; however *courses applied toward Carolina Core requirements cannot be counted toward the cognate*.

It should be emphasized that the cognate is not a second set of elective courses to be chosen at random by the student. The cognate must be approved by the advisor as being related to the major field of study.

For the Geophysics degree, the required math and statistics courses satisfy the College of Arts and Science's cognate requirement:

#### **Before August 2017**

- MATH 241 Vector Calculus (*3 credits*)
- MATH 242 Elementary Differential Equations (*3 credits*)
- MATH 527 Numerical Analysis (*3 credits*)
- MATH 526 Numerical Linear Algebra or MATH 544 Linear Algebra (*4 or 3 credits*)

#### **\*After August 2017**

- Math 241 Vector Calculus (*3 credits*)
- Math 242 Elementary Differential Equations (*3 credits*)
- Math 344 and 344L (*3 credits*) and (*1 credit for lab*)
- Select one of Math 520-522, 524-527, 550 or 552 (*4 or 3 credits*)

### **Degree with Distinction in Geophysics**

The designation "Distinction in Geophysics" is available to Geophysics majors who wish to participate in significant research activities in their major field under the supervision of a faculty mentor.

### **Requirements:**

- A minimum GPA of 3.5 in the major and 3.3 overall
- Written sponsorship agreement from the faculty mentor on file in the SEOE Undergraduate Student Services Office (*PSC 108*).
- 2 courses in addition to the general major requirements:
  - GEOL 498 or 499 - Undergraduate Research (3), preparing for the Senior Thesis;
  - GEOL 699 - Senior Thesis (3-6);
- A public presentation of the Senior Thesis research accompanied by a written document approved by the faculty mentor and a second reader that follows the guidelines of the degree.
- Submission of approved text of Senior Thesis in PDF format on CD Rom or in electronic format requested by SEOE Undergraduate Student Services Office (*PSC 108*).

Students who successfully fulfill all of these requirements will be awarded their degree with “Distinction in Geophysics” upon graduation.

**NOTE:** South Carolina Honors College students taking this route would graduate with both Honors in SCHC and “Distinction in Geological Sciences”.

# Geological Sciences Degree Requirements: Carolina Core

(Credits)



## CMW Written Communication (Grade of C or higher required)

- ENGL-101 (3)
- ENGL-102 (3)



## ARP Analytical Reasoning & Problem Solving

- MATH 122 Business Calculus or MATH 141 Calculus I (3 or 4)
- MATH 170 Finite Mathematics or MATH 142 Calculus II (3 or 4)
- STAT 201, 509 or 515 (3)
- CSCE 102 (or higher) (3)



## SCI Scientific Literacy

- PHYS 201/201L: General Physics I or 211/211L: Essentials of Physics I (3/1)
- CHEM 111/L: General Chemistry I (prereq: MATH 115) (3/1)

Select 2 of the following:

- PHYS 202/202L: General Physics II or 212/212L: Essentials of Physics II (3/1)
- CHEM 112/L: General Chemistry II (3/1)
- BIOL 101 and BIOL 101L (3/1)
- BIOL 102 and BIOL 102L (3/1)

## Global Citizenship & Multicultural Understanding



### **GFL Communicating Effectively In More Than One Language**

Foreign Language thru 122 level (0-9 credits)

(may include language 109, 110 (or 121) and 122



## GHS Historical Thinking

- One Carolina Core GHS* (3)  
approved course primarily focused on U. S. History: HIST 111, 112, 214, or another GHS- approved course determined by the College of Arts and Sciences to fit this geographic category, only under rare circumstances

- One Carolina Core GHS* (3)  
approved course primarily focused on non- U. S. History: HIST 101, 102, 104, 105, 106, 108, 109, GERM 280, FAMS 300, or another GHS- approved course determined by the College of Arts and Sciences to fit this geographic category, only under rare circumstances



## GSS Social Sciences

Select 2 courses (6 credits); at least one must be from:

AFAM 201; ANTH 101, 102, 204, 210, 211; COLA 298; CRJU 101; GEOG 103, 121, 210, 221, 223-226, 228; LASP 331; LING 101; POLI 101, 201; PSYC 101; SOCY 101; WGST 112, 113, 210

(3, 3)



## AIU Aesthetic & Interpretive Understanding

Select 2 courses (6 credits) from Fine Arts, Literature, or Humanities; at least one must be:



### Overlay

- A. CMS Persuasive Communication  
PHIL 325; SAEL 200; SPCH 140, 230, 260
- B. INF Information Literacy  
ENGL 102 (recommended); or LIBR 101, SLIS 202, STAT 112
- C. VSR Values, Ethics & Social Responsibility  
BIOL 208; CPLT 150; CSCE 390; HIST 108; LING 240; PHIL 103, 211, 320-322, 325; POLI 201, 302-304; RELG 205; SAEL 200; WGST 112

## **Geological Sciences Degree Requirements: Major Requirements**

(Credits)

### Geology Courses (Pass with C or higher)

- GEOL 101, 103 or 201 (4)
- GEOL 302: Rocks and Minerals (4)
- GEOL 325: Stratigraphy & Sedimentary Basins (prereq GEOL 302) (4)
- GEOL 345: Internal Earth (prereq GEOL 302, MATH 122 or 141) (4)
- GEOL 355: Mountain Building (prereq GEOL 302, PHYS 201 or 211) (4)

Select 2 of the following:

- GEOL 305: Earth Systems Through Time (4)
- GEOL 315: Surface & Near-Surface Processes (prereq PHYS 201 or 211) (4)
- GEOL 335: Processes of Global Environmental Change (4)

### Integrative Major Course

- GEOL 500 Field Camp, Colorado, May-June (prereq GEOL 325, GEOL 355) (6)

### Cognate

12 credits of non-GEOL courses at the 200-300 level; see Academic Bulletin for cognate courses

<input type="checkbox"/>	_____

**120 Credits needed for graduation (includes electives; does not include PEDU, Band and other one-credit performance courses)**

# **Geological Sciences (with Concentration in Environmental Geoscience)**

(Credits)



## **CMW Written Communication (Grade of C or higher required)**

- ENGL-101 (3)
- ENGL-102 (3)



## **ARP Analytical Reasoning & Problem Solving**

- MATH 122 Business Calculus or MATH 141 Calculus I (3 or 4)
- MATH 170 Finite Mathematics or MATH 142 Calculus II (3 or 4)
- STAT 201, 509 or 515 (3)
- CSCE 102 (or higher) (3)



## **SCI Scientific Literacy**

- PHYS 201/201L: General Physics I or 211/211L: Essentials of Physics I (3/1)
- CHEM 111/L: General Chemistry I (prereq: MATH 115) (3/1)

Select 2 of the following:

- PHYS 202/202L: General Physics II or 212/212L: Essentials of Physics II (3/1)
- CHEM 112/L: General Chemistry II (3/1)
- BIOL 101 and BIOL 101L (3/1)
- BIOL 102 and BIOL 102L (3/1)

## **Global Citizenship & Multicultural Understanding**



### **GFL Communicating Effectively In More Than One Language**

Foreign Language thru 122 level (0-9 credits)

(may include language 109, 110 (or 121) and 122



## **GHS Historical Thinking**

- One Carolina Core GHS* (3)

approved course primarily focused on U. S. History: HIST 111, 112, 214, or another GHS- approved course determined by the College of Arts and Sciences to fit this geographic category, only under rare circumstances

- One Carolina Core GHS* (3)

approved course primarily focused on non- U. S. History: HIST 101, 102, 104, 105, 106, 108, 109, GERM 280, FAMS 300, or another GHS- approved course determined by the College of Arts and Sciences to fit this geographic category, only under rare circumstances



## **GSS Social Sciences**

Select 2 courses (6 credits); at least one must be from:

AFAM 201; ANTH 101, 102, 204, 210, 211; COLA 298; CRJU 101; GEOG 103, 121, 210, 221, 223-226, 228; LASP 331; LING 101; POLI 101, 201; PSYC 101; SOCY 101; WGST 112, 113, 210 (3, 3)



## **AIU Aesthetic & Interpretive Understanding**

Select 2 courses (6 credits) from Fine Arts, Literature, or Humanities; at least one must be:



## Overlay

- A. CMS Persuasive Communication  
PHIL 325; SAEL 200; SPCH 140, 230, 260
- B. INF Information Literacy  
ENGL 102 (recommended); or LIBR 101, SLIS 202, STAT 112
- C. VSR Values, Ethics & Social Responsibility  
BIOL 208; CPLT 150; CSCE 390; HIST 108; LING 240; PHIL 103, 211, 320-322, 325; POLI 201, 302-304; RELG 205; SAEL 200; WGST 112

## **Geological Sciences Degree Requirements: Major Requirements**

(Credits)

### Geology Courses (Pass with C or higher)

- GEOL 101, 103 or 201 (4)
  - GEOL 302: Rocks and Minerals (4)
  - GEOL 315: Surface & Near-Surface Processes (prereq PHYS 201 or 211) (4)
  - GEOL 325: Stratigraphy & Sedimentary Basins (prereq GEOL 302) (4)
  - GEOL 335: Processes of Global Environmental Change (4)
  - GEOL 355: Mountain Building (prereq GEOL 302, PHYS 201 or 211) (4)
- Select 1 of the following:
- GEOL 305: Earth Systems Through Time (4)
  - GEOL 371: A View of the River (3)
  - GEOL 548: Environmental Geophysics (prereq MATH 141 and PHYS 201 or 211) (3)

### Integrative Major Course

- GEOL 500 Field Camp, Colorado, May-June (prereq GEOL 325, GEOL 355) (6)

### Cognate

12 credits of non-GEOL courses at the 200-300 level; see Academic Bulletin for cognate courses

<input type="checkbox"/>	_____

**120 Credits needed for graduation (includes electives; does not include PEDU, Band and other one-credit performance courses)**

# Geophysics Degree Requirements: Carolina Core

(Credits)

<input type="checkbox"/>	<b><u>CMW Written Communication (Grade of C or higher required)</u></b>	
<input type="checkbox"/>	ENGL-101	(3)
<input type="checkbox"/>	ENGL-102	(3)
<input type="checkbox"/>	<b><u>ARP Analytical Reasoning &amp; Problem Solving</u></b> (also fulfills cognate)	
<input type="checkbox"/>	MATH 141: Calculus I	(4)
<input type="checkbox"/>	MATH 142: Calculus II	(4)
<input type="checkbox"/>	MATH 241: Vector Calculus	(3)
<input type="checkbox"/>	MATH 242: Elementary Differential Equations	(3)
<input type="checkbox"/>	MATH 527: Numerical Analysis (spring of even years)	(3)
<input type="checkbox"/>	MATH 526 Numerical Linear Algebra or MATH 544 Linear Algebra	(4 or 3)
<input type="checkbox"/>	STAT 509 or STAT 515	(3)
<input type="checkbox"/>	CSCE 206 Scientific Applications Programming or CSCE 207 UNIX System Admin	(3)
<input type="checkbox"/>	<b><u>SCI Scientific Literacy</u></b>	
<input type="checkbox"/>	PHYS 211/211L: Essentials of Physics I and lab	(3/1)
<input type="checkbox"/>	PHYS 212/212L: Essentials of Physics II and lab	(3/1)
<input type="checkbox"/>	CHEM 111/L: General Chemistry I and lab	(3/1)
<input type="checkbox"/>	CHEM 112/L: General Chemistry II and lab	(3/1)
<input type="checkbox"/>	<b><u>Global Citizenship &amp; Multicultural Understanding</u></b>	
<input type="checkbox"/>	<b>GFL Communicating Effectively In More Than One Language</b>	
	Foreign Language thru 122 level (0-9 credits)	
	(may include language 109, 110 (or 121) and 122	
<input type="checkbox"/>	<b>GHS Historical Thinking</b>	
<input type="checkbox"/>	<i>One Carolina Core GHS</i>	(3)
	approved course primarily focused on U. S. History: HIST 111, 112, 214, or another GHS- approved course determined by the College of Arts and Sciences to fit this geographic category, only under rare circumstances.	
<input type="checkbox"/>	<i>One Carolina Core GHS</i>	(3)
	approved course primarily focused on non- U. S. History: HIST 101, 102, 104, 105, 106, 108, 109, GERM 280, FAMS 300, or another GHS- approved course determined by the College of Arts and Sciences to fit this geographic category, only under rare circumstances.	
<input type="checkbox"/>	<b>GSS Social Sciences</b>	
	Select 2 courses (6 credits); at least one must be from:	
	AFAM 201; ANTH 101, 102, 204, 210, 211; COLA 298; CRJU 101; GEOG 103, 121, 210, 221, 223-226, 228; LASP 331; LING 101; POLI 101, 201; PSYC 101; SOCY 101; WGST 112, 113, 210	(3, 3)
<input type="checkbox"/>	<b><u>AIU Aesthetic &amp; Interpretive Understanding</u></b>	



## Overlay

- A. CMS Persuasive Communication  
PHIL 325; SAEL 200; SPCH 140
- B. INF Information Literacy  
ENGL 102 (recommended); or LIBR 101, SLIS 202, STAT 112
- C. VSR Values, Ethics & Social Responsibility  
BIOL 208; HIST 108; PHIL 103, 211, 320, 321, 322, 325; POLI 201, 303; SAEL 200

# **Geophysics Degree Requirements: Major Requirements**

(Credits)

### Geology Courses (Pass with C or higher)

- GEOL 101, 103 or 201 (4)
- GEOL 202: Rocks and Minerals (4)
- GEOL 345: Internal Earth (prereq GEOL 202, MATH 141) (4)
- GEOL 325: Stratigraphy and Sedimentary Basins (prereq GEOL 202) (4)
- GEOL 355: Mountain Building (prereq GEOL 202, PHYS 211) (4)
- GEOL 531: Plate Tectonics (3)
- GEOL 554: Applied Seismology (3)
- GEOL 555: Elementary Seismology (3)
- GEOL 556: Seismic Reflection Interpretation (3)
- GEOL 575: Numerical Modeling for Earth Science Applications (3)
- GEOL 582: Marine Hydrodynamics (3)

### Math Courses (Pass with C or higher)

- MATH 241: Vector Calculus (3)
- MATH 242: Elementary Differential Equations (3)
- MATH 527: Numerical Analysis (3)
- MATH 526 Numerical Linear Algebra or MATH 544 Linear Algebra (4 or 3)

### Senior Capstone Experience

- GEOL 548: Environmental Geophysics (3)  
(note: an approved field course may substitute)

**128 Credits needed for graduation (includes electives; does not include PEDU, Band and other one-credit performance courses)**

# 2017 Geophysics Degree Requirements: Carolina Core

(Credits)

<input type="checkbox"/>	<b><u>CMW Written Communication (Grade of C or higher required)</u></b>	
<input type="checkbox"/>	ENGL-101	(3)
<input type="checkbox"/>	ENGL-102	(3)
<input type="checkbox"/>	<b><u>ARP Analytical Reasoning &amp; Problem Solving</u></b> (also fulfills cognate)	
<input type="checkbox"/>	MATH 141: Calculus I	(4)
<input type="checkbox"/>	MATH 142: Calculus II	(4)
<input type="checkbox"/>	MATH 241: Vector Calculus	(3)
<input type="checkbox"/>	MATH 242: Elementary Differential Equations	(3)
<input type="checkbox"/>	MATH 344 and 344L: Applied Linear Algebra and lab	(3/1)
<input type="checkbox"/>	Choose one from: MATH 520-522, 524-527, 550 or 552	(4 or 3)
<input type="checkbox"/>	STAT 509 or STAT 515	(3)
<input type="checkbox"/>	CSCE 206 Scientific Applications Programming or CSCE 207 UNIX System Admin	(3)
<input type="checkbox"/>	<b><u>SCI Scientific Literacy</u></b>	
<input type="checkbox"/>	PHYS 211/211L: Essentials of Physics I and lab	(3/1)
<input type="checkbox"/>	PHYS 212/212L: Essentials of Physics II and lab	(3/1)
<input type="checkbox"/>	CHEM 111/L: General Chemistry I and lab	(3/1)
<input type="checkbox"/>	CHEM 112/L: General Chemistry II and lab	(3/1)
<input type="checkbox"/>	<b><u>Global Citizenship &amp; Multicultural Understanding</u></b>	
<input type="checkbox"/>	<b>GFL Communicating Effectively In More Than One Language</b>	
	Foreign Language thru 122 level (0-9 credits)	
	(may include language 109, 110 (or 121) and 122	
<input type="checkbox"/>	<b>GHS Historical Thinking</b>	
<input type="checkbox"/>	<i>One Carolina Core GHS</i>	(3)
	approved course primarily focused on U. S. History: HIST 111, 112, 214, or another GHS- approved course determined by the College of Arts and Sciences to fit this geographic category, only under rare circumstances.	
<input type="checkbox"/>	<i>One Carolina Core GHS</i>	(3)
	approved course primarily focused on non- U. S. History: HIST 101, 102, 104, 105, 106, 108, 109, GERM 280, FAMS 300, or another GHS- approved course determined by the College of Arts and Sciences to fit this geographic category, only under rare circumstances.	
<input type="checkbox"/>	<b>GSS Social Sciences</b>	
	Select 2 courses (6 credits); at least one must be from:	
	AFAM 201; ANTH 101, 102, 204, 210, 211; COLA 298; CRJU 101; GEOG 103, 121, 210, 221, 223-226, 228; LASP 331; LING 101; POLI 101, 201; PSYC 101; SOCY 101; WGST 112, 113, 210	(3, 3)
<input type="checkbox"/>	<b><u>AIU Aesthetic &amp; Interpretive Understanding</u></b>	

Select 2 courses (6 credits) from Fine Arts, Literature, or Humanities; at least one must be from:

ARTE 101, 260; ARTH 105, 106; ARTS 103, 104, 210; CLAS 220; CPLT 150, 270; DANC 101; ENGL 270, 282-288; FILM 110, 180, 240; FREN 290; GERM 270, 290; MART 110, 210; MUSC 110, 113-115, 140, 310; RELG 270; RUSS 280; SOST 101; SPAN 220; THEA 170, 181, 200

(3, 3)



### Overlay

- A. CMS Persuasive Communication  
PHIL 325; SAEL 200; SPCH 140, 230, 260
- B. INF Information Literacy  
ENGL 102 (recommended); or LIBR 101, SLIS 202, STAT 112
- C. VSR Values, Ethics & Social Responsibility  
BIOL 208; CPLT 150; CSCE 390; HIST 108; LING 240; PHIL 103, 211, 320-322, 325; POLI 201, 302-304; RELG 205; SAEL 200; WGST 112

## **Geophysics Degree Requirements: Major Requirements**

(Credits)

### Geology Courses (Pass with C or higher)

- GEOL 101, 103 or 201 (4)
- GEOL 302: Rocks and Minerals (4)
- GEOL 345: Internal Earth (prereq GEOL 302, MATH 141) (4)
- GEOL355: Mountain Building (prereq GEOL 302, PHYS 211) (4)
- GEOL 531: Plate Tectonics (3)
- GEOL 554: Applied Seismology (3)
- GEOL 555: Elementary Seismology (3)
- GEOL 556: Seismic Reflection Interpretation (3)
- GEOL 575: Numerical Modeling for Earth Science Applications (3)
- GEOL 582: Marine Hydrodynamics (3)

### Senior Capstone Experience

- GEOL 548: Environmental Geophysics (4)  
(note: an approved field course may substitute)

**128 Credits needed for graduation (includes electives; does not include PEDU, Band and other one-credit performance courses)**

## Example Curricula

### **†TYPICAL CURRICULUM FOR GEOLOGICAL SCIENCE MAJORS For Freshman and Sophomore Years only**

FRESHMAN YEAR	FALL	SPRING	SOPHOMORE YEAR	FALL	SPRING
GEOL 201, 305	4	4	GEOL 302	4	
CHEM 111, 112	4	4	GEOL 315 or 345		4
*MATH 141, 142	4	4	PHYS 201, 202 with labs	4	4
UNIV 101	3		Cognate course (GEOG 363)		3
ENGL 101		3	ENGL 102	3	
			HIST 101 to 112		3
Foreign Language 109		3	Foreign Language 110, 122		3
Total	15	18		Total	15
					17

† This is a sample curriculum only and will vary for Freshman and Sophomores depending on AP, IB, Dual credit, etc., and USC placement exams in Math and Foreign Language. During the Junior and Senior years, students with their advisors will tailor the curriculum to meet career goals and the curriculum will vary widely from student to student and the selected emphasis area. (See potential courses and areas of emphasis:  
[http://bulletin.sc.edu/preview\\_program.php?catoid=36&poid=4092&returnto=4235](http://bulletin.sc.edu/preview_program.php?catoid=36&poid=4092&returnto=4235) )

\*If necessary, take MATH 115 first. Note that MATH 122 and MATH 170 form an alternate sequence for majors less confident in mathematics (although MATH 141 and 142 are preferred).

## **MINOR IN GEOLOGICAL SCIENCES**

Designed for students interested in obtaining an in-depth background in the Earth's resources, energy, climate, oceans, natural disasters, and the environment. Geological sciences incorporate significant elements of all the other sciences and provide a unique perspective on applying these disciplines to critical aspects of our world today.

Core courses:

One of the following:

- |          |                                       |
|----------|---------------------------------------|
| GEOL 101 | Introduction to the Earth (4 credits) |
| GEOL 103 | Environment of the Earth (4 credits)  |
| GEOL 201 | Observing the Earth (4 credits)       |

And:

- |          |                                |
|----------|--------------------------------|
| GEOL 302 | Rocks and Minerals (4 credits) |
|----------|--------------------------------|

And:

One of the following:

- |               |                                      |
|---------------|--------------------------------------|
| PHYS 201/201L | General Physics I (4 credits)        |
| PHYS 211/211L | Essentials of Physics II (4 credits) |
| CHEM 111/111L | General Chemistry I (4 credits)      |

Plus three upper-level Geological Sciences courses, with at least two selected from the following:

- |          |  |
|----------|--|
| GEOL 305 | Earth Systems through Time (4 credits)               |
| GEOL 315 | Surface and Near Surface Processes (4 credits)       |
| GEOL 325 | Stratigraphy and Sedimentary Basins (4 credits)      |
| GEOL 335 | Processes of Global Environmental Change (4 credits) |
| GEOL 345 | Igneous and Metamorphic Processes (4 credits)        |
| GEOL 355 | Structural Geology and Tectonics (4 credits)         |

NOTE: GEOL 302 and MATH 122 or 141 are prerequisites for GEOL 345; PHYS 201 is required for GEOL 355 and 315.

## **MINOR IN GEOPHYSICS**

Designed for students interested in obtaining an in-depth background in geophysical techniques and how they apply to the study of the Earth. It targets students interested in expanding their quantitative skills to the understanding of the environment, land and ocean resources, natural hazards, and mountain building.

Core courses:

One of the following:

- |          |                                       |
|----------|---------------------------------------|
| GEOL 101 | Introduction to the Earth (4 credits) |
| GEOL 103 | Environment of the Earth (4 credits)  |
| GEOL 201 | Observing the Earth (4 credits)       |

And:

- |          |                                |
|----------|--------------------------------|
| GEOL 302 | Rocks and Minerals (4 credits) |
| MATH 141 | Calculus I (4 credits)         |

And:

One of the following:

- |               |                                      |
|---------------|--------------------------------------|
| PHYS 201/201L | General Physics I (4 credits)        |
| PHYS 211/211L | Essentials of Physics II (4 credits) |

Plus three upper-level Geological Sciences courses selected from the following:

- |          |   |
|----------|---|
| GEOL 345 | Igneous and Metamorphic Processes                 |
| GEOL 355 | Structural Geology and Tectonics                  |
| GEOL 531 | Plate Tectonics                                   |
| GEOL 548 | Environmental Geophysics                          |
| GEOL 554 | Applied Seismology                                |
| GEOL 555 | Elementary Seismology                             |
| GEOL 556 | Seismic Reflection Interpretation                 |
| GEOL 575 | Numerical Modeling for Earth Science Applications |
| GEOL 582 | Marine Hydrodynamics                              |

NOTE: GEOL 302 and MATH 122 or 141 are prerequisites for GEOL 345; PHYS 201 is required for GEOL 355.

## COURSES OFFERED IN THE GEOSCIENCES (GEOL)

- **GEOL 101 -- Introduction to the Earth.** (4) Origin and nature of the earth with emphasis on internal processes and phenomena such as earthquakes, volcanoes, and mountain building; surface processes, including landform evolution. Three lectures and three laboratory hours each week.
- **GEOL 102 -- Fossils and the Evolution of Life on Earth.** (4) Basic overview of fossils, including dinosaurs, and their importance for understanding earth history and the evolution of life. Three lectures and three laboratory hours each week.
- **GEOL 103 -- Environment of the Earth.** (4) Analysis of basic energy cycles of the earth. Interaction of human activity with earth processes to affect the environment. Three lectures and three laboratory hours each week. Field trips required.
- **GEOL 110 -- Cultural Geology.** (3) The growth of geological concepts, scientific and non- scientific. The impact of geological factors on human affairs. The role of time and evolution (biological and physical). Restricted to non-science majors.
- **201 -- Observing the Earth.** (4) An introduction to study of the earth through observation of ancient and modern earth systems in a field setting. Field trips required.
- **205 -- Earth Resources.** (3) Mineral, energy, and water resources with emphasis on geological processes governing their distribution. Intended for non-science majors. Three lecture hours each week with occasional field trips.
- **215 -- Coastal Environments of the Southeastern U.S. {=MSCI 215}** (3) Coastal zones of South Carolina and neighboring states, including geologic history, geomorphology, stratigraphy, hydrogeology, shoreline processes, environmental issues, and effects of man. Three lecture hours each week plus optional field trips. Not available for geology major credit.
- **215L -- Coastal Environments of the Southeastern U.S. (Laboratory).** {=MSCI 215L} (1) Exercises examining coastal ecology, geomorphology, hydrogeology, shoreline processes, environmental issues, and human impact. Two laboratory hours per week. Scheduled field trips required. Not available for marine science major credit.
- **220 -- Real Estate Geology.** (3) Application of geologic concepts to land development. Recognition of hazards related to the hydrologic cycle, land stability, soils, coastal environment, and earthquakes. Intended for nonscience majors. Three lecture hours and two laboratory hours each week.
- **230 -- Geology of the National Parks.** (3) An examination of the geologic setting and scientific significance of selected National Parks. Three lecture hours.
- **250 -- Continental Drift and Ice Ages.** (3) An introduction to geology and geophysics. The structure of the earth, core, mantle, and crust; problems of facies, plate motions, and their probable influence on climate and evolution. Future prospects.
- **302 -- Rocks and Minerals.** (4) (Prereq: GEOL 101 or 103 or 201) Introduction to rock-forming minerals and an overview of igneous, sedimentary, and metamorphic rocks. Includes laboratory. Field trips required.
- **305 -- Earth Systems through Time.** (4) Survey of earth history, the evolution of continents and oceans, the history of life, and geological dating methods. Includes laboratory and recitation. Required field trips. Taught alternate years.
- **315 -- Surface and Near Surface Processes.** (4) (Prereq: PHYS 201 or 211 or consent of instructor) Overview of groundwater, surface water hydrology, sediment transport, river systems, and coastal processes. Includes laboratory and recitation. Required field trips.

- **318 -- Field Studies in Geology. (1)** (Prereq: GEOL 101, 103, or 201 and consent of instructor) Directed field studies of extraordinary geological locations in North America. Requires a seven- to nine-day field trip during spring break.
- **325 -- Stratigraphy and Sedimentary Basins. (4)** (Prereq: GEOL 302) Overview of sedimentary basins, sediment transport, sedimentation, depositional environments, stratigraphy, seismic stratigraphy, eustacy, and sedimentary petrology. Includes laboratory and recitation. Required field trips. Taught alternate years.
- **335 -- Processes of Global Environmental Change. (4)** The science of global change, its relation to the hydrosphere, atmosphere, lithosphere, and biosphere. Global system science, biogeochemical cycles, paleoclimatology, glaciation, and eustacy. Includes laboratory and recitation. Taught alternate years.
- **345 – Igneous and Metamorphic Processes. (4)** (Prereq: GEOL 302; MATH 122 or 141 or consent of instructor) Origin and significance of igneous and metamorphic rocks, and relation to tectonic processes. Mineralogy, geochemistry, volcanism, plate tectonics, isostasy, heat flow. Includes laboratory and recitation. Required field trips.
- **355 – Structural Geology and Tectonics. (4)** (Prereq: GEOL3202; PHYS 201 or 211 or consent of instructor) Geologic structures and deformation of Earth materials. Stress and strain, deformation mechanisms, P-T-p paths, geologic maps, and structural regimes in plate tectonics. Includes laboratory and recitation. Required field trips. Taught alternate years.
- **371 -- A View of the River. (3)** (Prereq: GEOL 101 or 103 or 201) Introduction to terrestrial and tidal river morphology and processes, with case studies of South Carolina. Field trips required.
- **399 -- Independent Study. (1-6)** Contract approved by instructor, advisor, and department chair is required for undergraduate students.
- **498 -- Undergraduate Research. (3 each)** (Prereq: consent of instructor) Student research on problems of regional and fundamental significance, supervised by a faculty member of the student's choice. Emphasis is on the development of critical thinking and lucid scientific report writing.
- **499 -- Undergraduate Research. (3 each)** (Prereq: consent of instructor) Student research on problems of regional and fundamental significance, supervised by a faculty member of the student's choice. Emphasis is on the development of critical thinking and lucid scientific report writing.
- **500 -- Field Geology. (6)** (Prereq: GEOL 325 and 355 and or consent of instructor) Geological field techniques including the use of field instruments and the preparation of geologic maps. Written and oral reports required.
- **501 -- Principles of Geomorphology. {=MSCI 501} (3)** (Prereq: GEOL 101) The process of earth denudation with emphasis on chemistry of weathering, stream and erosion hydraulics, quantitative analysis of land form evolution.
- **502 -- Principles of Coastal Geomorphology. {=MSCI 502} (4)** (Prereq: MATH 122 or 141 [concurrent enrollment acceptable]) Geological and physical controls on the morphology, development, and stability of coastlines. Analysis of waves and erosional processes, and coastal zone morphodynamics. Several required field trips.
- **503 -- Regional Stratigraphy and Biostratigraphy of North America. (3)** (Prereq: senior standing) Sedimentologic, biostratigraphic, and tectonic history of North America, approached from paleogeographic considerations with emphasis on the Atlantic Coastal Plain and Continental Margin. Three hours lecture and three hours recitation per week. Required field trips.

- **508 -- Palynology. (3)** (Prereq: consent of instructor) Fundamentals of pollen analysis including morphology of modern and fossil forms, use of pollen and spores for correlation, dating, establishing phylogenetic trends, and reconstruction of ancient environments. Two lectures plus one two-hour lab per week.
- **510 -- Organic Sedimentation and Coal Genesis. (3)** Theories of origin of coal deposits and coal-forming ingredients. Basic concepts of coal composition and classification. Practical applications of coal petrographic techniques. Two lectures plus one two-hour lab. Two optional field trips.
- **511 -- Advanced Paleontology. {=MSCI 511} (3)** (Prereq: GEOL 305) Systematic, ecologic, biogeographic, and evolutionary aspects of paleontology; lectures, practical exercises, field trips.
- **515 -- Marine Micropaleontology. {=MSCI 515} (4)** (Prereq: consent of instructor) Marine microfossils; distribution, ecology, paleoecology, and biostratigraphy; use of microfossils in marine sediments to study oceanographic history. Three lectures and two laboratory hours per week.
- **516 -- Sedimentology. (4)** (Prereq: GEOL 325, 522 or the consent of instructor) Modern concepts of sediment composition, sedimentary facies, depositional environments, and stratigraphy. Includes laboratory.
- **518 -- Surface to Subsurface Stratigraphy. (3)** (Prereq: consent of instructor) Surface to subsurface stratigraphic interpretation and techniques; litho- and biostratigraphy; geophysical log interpretation and subsurface presentation.
- **520 -- Isotope Geology and Geochronology. (3)** Dating techniques for Pleistocene deposits, sediments, archaeological materials, igneous and metamorphic rocks.
- **521 -- Introduction to Geochemistry. {=MSCI 521} (3)** Investigation of low temperature chemical reactions controlling the geochemistry of the earth's surface. Emphasis on CO<sub>2</sub>, carbonates, oxidation-reduction, thermodynamics, isotopes, biogeochemistry.
- **524 -- Environmental Radioisotope Geochemistry. {=MSCI 524} (3)** (Prereq: CHEM 111, CHEM 112, MATH 141) Introduction to radioactivity and the use of radionuclides to study environmental processes, including age-dating and biogeochemical cycling in aquatic systems. Two lectures per week.
- **526 -- Igneous Petrology. (4)** (Prereq: GEOL 302) Petrography and petrogenesis of igneous rocks; evolution of contrasting petrotectonic terranes. Three lectures and three laboratory hours per week.
- **527 -- Metamorphic Petrology. (4)** (Prereq: GEOL 302) Petrography and petrogenesis of metamorphic rocks in orogenic belts. Three lectures and three laboratory hours per week.
- **531 -- Plate Tectonics. (3)** (Prereq: GEOL 101 or 103 or 201) Geological and geophysical evidence for plate tectonics, detailed development of the plate tectonics model, and present areas of research, including measurements of plate motion using satellite geodesy. Three lecture-discussion hours per week.
- **537 -- Field Methods in Geophysics. (3)** (Prereq: GEOL 536) Application of two or more geophysical field methods to a current geological problem. Independent study contract required.
- **540 -- Earth Science for Teachers I. {=EDSE 548} (3)** Survey of topics related to the origin, internal structure, and internal processes of the earth, including plate tectonics, earthquakes, volcanoes, and mountain building. Required field trips, two lectures, and three lab hours per week. Cannot be used in M.S. or Ph.D. programs in geology.
- **541 -- Earth Science for Teachers II. {=EDSE 549} (3)** (Prereq: EDSE 548/GEOL 540) Surface processes acting on the earth; introduction to weather and climate, weathering,

erosion, and sedimentary processes; landform evolution; ocean currents and tides, near-shore geologic processes. Required field trips, two lecture and three lab hours per week. Cannot be used in M.S. or Ph.D. programs in geology.

- **545 -- Geological Oceanography. {=MSCI 545} (3)** (Prereq: consent of instructor required for undergraduates only) A comprehensive study of the origin and development of the major structural features of the ocean basins and the continental margins. Discussion of the techniques used in obtaining geologic data and the interpretation of sedimentary processes, vulcanism, and the stratigraphy of the ocean basins.
- **546 -- Marine Geophysics. (3)** Introduction to the nature and structure of the ocean floor as revealed by geophysical techniques. Two hours lecture and three hours laboratory.
- **548 -- Environmental Geophysics. (4)** (Prereq: MATH 141 and PHYS 201 or 211) Practical geophysical techniques for exploring the shallow subsurface. Seismic, resistivity, well log, gravity, magnetic methods. Field exercises to collect and analyze data.
- **550 -- Sedimentary Simulations and Sequence Stratigraphy. {=MSCI 550} (4)** (Prereq: GEOL 325 or consent of the instructor) Problems of sequence stratigraphy resolved with graphic computer simulations. Sedimentary fill of basins by carbonates and/or clastics tracked as a function of rate of sediment accumulation, tectonic behavior, and sea level. Includes laboratory.
- **553 -- Marine Sediments. {=MSCI 553} (3)** (Prereq: GEOL 516 or consent of instructor) Marine sedimentary environments; physical/biological factors which control the formation and distribution of modern marine sediments.
- **554 -- Applied Seismology. (3)** (Prereq: MATH 141; PHYS 201 or 211; or consent of instructor) Theory of seismic wave propagation. Seismic reflection data acquisition, processing, and interpretation.
- **555 -- Elementary Seismology. (3)** (Prereq: MATH 241 or consent of instructor) Basic elements of seismology. Mathematical development of seismic wave equations; measurement, description, and interpretation of seismic data.
- **556 -- Seismic Reflection Interpretation. (3)** The interpretation of geologic structure using seismic sections. Recognition of apparent structure caused by velocity anomalies, multiples, and complex reflector geometry. Application to hydrocarbon exploration.
- **557 -- Coastal Processes. {=MSCI 557} (3)** Physical and geological processes controlling the formation and evolution of beach, barrier, and nearshore environments, including discussion of coastal management issues. Field trip(s) to coastal environments.
- **560 -- Earth Resource Management. (3)** An approach to problems of resource management by lecture and seminar using case studies in mineral, energy, hydrogeological, and environmental science.
- **561 -- Environmental Field Geology. (6)** An introduction to field methods in sedimentology, structural geology, hydrogeology and geophysics with special reference to geological hazards and environmental problems.
- **567 -- Long Term Environmental Change. {=GEOG 567} (3)** (Prereq: A 200-level course in physical geography or geology or equivalent) Climatic changes of the past and their impact on the physical landscape, with an emphasis on the Quaternary period.
- **568 -- Introduction to Micrometeorology. {=MSCI 568} (3)** (Prereq: PHYS 201 and MATH 141, or consent of instructor) Small-scale processes in the atmospheric boundary layers, including energy budget, radiation, soil heat transfer, humidity, viscous flows, turbulence, momentum and heat exchanges, evaporation, and marine atmospheric boundary layer.

- **570 -- Environmental Hydrogeology.** (3) (Prereq: GEOL 101 and CHEM 111 or their equivalents) Environmental considerations of the hydrologic cycle, occurrence and movement of ground water, aquifer analysis, and water well emplacement and construction. Water quality, pollution parameters, and the geochemistry of selected natural systems. The effects of environmental problems, waste disposal, and urban development upon the aqueous geochemical regime.
- **571 -- Soil Hydrology.** (4) (Prereq: PHYS 202 and MATH 142 or consent of instructor) Saturated and unsaturated water flow through soils, pore pressure development, runoff generation, and watershed response to rainfall. Three lecture and three laboratory hours per week.
- **575 -- Numerical Modeling for Earth Science Applications.** (3) (Prereq: MATH 142; MATH 241 is recommended) Mathematical and numerical models describing groundwater flow and contaminant transport; with application of numerical models.
- **579 -- Air-Sea Interaction.** {=MSCI 579} (3) This course provides knowledge of the physical mechanism responsible for interaction between the ocean and the atmosphere and of the influence of air-sea interaction on atmospheric and oceanic dynamics and thermodynamics on a wide variety of spatial/temporal scales.
- **580 -- Satellite Oceanography.** {=MSCI 580} (3) This course provides knowledge of various techniques used in satellite remote sensing of the oceans. Key skills will be developed in satellite data processing, image analysis, and hands-on research.
- **581 -- Estuarine Oceanography.** {=MSCI 581} (3) (Prereq: MSCI 312 or consent of instructor) Estuarine kinematics and dynamics; classification of estuaries; estuarine circulation and mixing. Scheduled field trips are required.
- **582 -- Marine Hydrodynamics.** {=MSCI 582} (3) (Prereq: differential equations, PHYS 201 or 211, or consent of instructor) Basic principles of fluid statics and dynamics. Conservation of mass, momentum, and energy; viscosity, vorticity, and boundary layers with examples from the marine environment. Applications to and analysis of ocean currents and waves. Scheduled field trips are required.
- **583 -- Geology and Geochemistry of Salt Marshes.** {=MSCI 583} (3) (Prereq: consent of instructor) Geological and geochemical processes in salt marshes. Methods of geological research in marshes, including instrumental techniques, sampling design, and data analysis. Two lectures per week plus four weekends of project-oriented fieldwork and/or equivalent lab work. Scheduled field trips are required.
- **600 -- Senior Seminar in Geology and Geophysics.** (2) (Prereq: senior standing) Advanced research topics in geology and geophysics; critical reading of literature, technical presentations, and written reports.
- **650 -- Electron Microscopy and Microanalysis.** (4) (Prereq: CHEM 111 or equivalent or consent of instructor) SEM, ESEM, TEM, and EMPA, WDS quantitative analysis, EDS semi-quantitative analysis, EBSD, methods of sample preparation, and applications in varieties of disciplines. Two lecture and three laboratory hours per week.
- **699 -- Senior Thesis.** (3-6) (Prereq: senior standing and contract approved by instructor, advisor, and department chair) Senior capstone experience, research on problem of fundamental significance, supervised by faculty member; must include field study component, written final project report, and oral presentation at departmental seminar. May be repeated for up to 6 credit hours total.

## **FIELD CAMP (GEOL 500)**

<http://geology.uga.edu/field-schools>

The Geological Sciences students at USC join efforts with the Geology students at the University of Georgia for their capstone experience. This arrangement allows us to increase the diversity of our faculty's expertise as well as to keep costs reasonable.

Field work is concentrated in the Cañon City, Colorado area, where the geology is dominated by Laramide uplift and subsequent erosion along the Rocky Mountain Front. This has produced a series of Precambrian-cored structures flanked by folded and faulted Paleozoic and Mesozoic sedimentary rocks. Cañon City lies within an embayment between two of these Laramide uplifts, the Front Range and the Wet Mountains, and these structures are spectacularly displayed within the area. Other features around Cañon City include isoclinally folded Precambrian metasediments and Precambrian to Tertiary intrusive and volcanic rocks, and mineralized zones.

In the Cañon City area, students measure, describe and correlate classic Paleozoic and Mesozoic sections. These observations are used to construct a geologic column of the region. Completion of this work establishes the basis for geologic mapping of structures involving the same stratigraphic units in the Cañon City area. Projects increase in complexity as the course progresses. The geology is mapped on aerial photographs or topographic base maps with the aid of Brunton compasses and handheld GPS units. In the evenings or during scheduled office time, students prepare final geologic maps and cross sections on digital topographic maps or aerial photographs, facilitated by GIS software.

In addition to stops on the way from Athens, Georgia to Cañon City, we conduct two major field trips. The first trip is to the Arches-Canyonlands and Book Cliffs areas in eastern Utah, during which we study depositional environments, sequence stratigraphy, and sedimentary basin analysis. The second trip is to the Jemez Mountains of New Mexico and San Juan Mountains of Colorado, where we study Tertiary volcanism, ore deposits, and environmental geochemistry. Additional short day trips include mining districts near Cañon City, Great Sand Dunes National Monument, and Capulin National Monument.

### **Course Format**

The field course is taught by three to four Geology faculty members and one to two teaching assistants. Typical enrollment is 12-20 students, which provides for an excellent student-to-teacher ratio.

While in Cañon City, Colorado, we stay at The Abbey School and each student has their own room. Breakfast and dinner are served at the Abbey School. Students pack their own bag lunch for the field.

The summer course typically runs from mid-May through the end of June. Students earn six credits for participation in this course (GEOL 500).

## **ADVISEMENT PROCESS AND ASSIGNING OF ADVISORS**

Each student is assigned a faculty advisor in the SEOE after their first year. All majors are required to meet with their advisors each semester during an officially scheduled advisement period to choose their courses for the following semester. Advisement by an assigned advisor is necessary to avoid delays in graduation, **even for students who receive supplementary advice from other sources** (such as athletes advised by athletic counselors, Honors College students advised by Honors College advisors or ROTC members advised by ROTC advisors).

Advisement appointments are individual, one-on-one sessions during which students may discuss not only their classes for the upcoming semester, but also research opportunities and internships, career goals, and other topics related to the student's education. In addition to the scheduled advisement period, faculty members are always willing to meet with students throughout the year as needed. Although students are assigned to a First Year Advisor initially, students are subsequently assigned a faculty member and may request a change in advisor at any time through the program's Student Services Office.

## **SENIOR RECORDS CHECK**

All geological sciences and geophysics undergraduates are required to schedule an appointment for a Senior Records Check with the Associate Dean for Undergraduate Studies in the College of Arts and Sciences (110 Flinn Hall) the semester before they plan to graduate (typically after completing 90 credit hours.) The student's program of study is evaluated during this appointment to ensure that the degree requirements will be completed by the time the student plans to graduate. Program of Study Forms for Senior Records Check are available in the Student Services Office in PSC 108 and should be completed in conjunction with the student's faculty advisor before making an appointment with the Dean's office.

## **RESEARCH OPPORTUNITIES FOR UNDERGRADUATES**

Many of our students are involved in research, either through employment with one of our faculty members (such as Susan Lang, Andrew Leier and Lori Ziolkowski), or through the university's Magellan Scholars program. Occasionally, this leads to unique opportunities which are rarely afforded to students at the undergraduate level. **For example, in recent years, several USC undergrads have participated in field programs in Russia, Romania, China, Kyrgyzstan, Puerto Rico, and Antarctica.** These opportunities exist here because we have a motivated faculty with active research programs who also have an interest in contributing to the quality of the experience of our undergraduate students.

The best way to participate in research is to investigate faculty research areas, contact a faculty member whose research appeals to you, and ask if you can volunteer in their lab. Many volunteer positions evolve into formal research projects and paid jobs.

The School of the Earth, Ocean and Environment's Geosciences faculty have chosen to strengthen its Geological degrees by adopting three primary research areas: Evolution of Orogenic Systems, Environmental Geosciences, and Global Climate Change. Within these umbrella designations, our research and teaching encompasses the traditional subdisciplines found in most geoscience departments. These research areas are listed below and include the names of the faculty members associated with them. The department is replete with modern hardware and software to work in these disciplines.

### ***Basin Evolution, Sedimentary Petrology, Stratigraphy and Sequence Stratigraphy***

Studies of modern and ancient marine and terrestrial sediments to determine the processes that control the temporal and spatial distribution of different sediment types, their provenance, erosion, transport and deposition. These include studies of depositional setting, eustasy, tectonics, climate and biology. (Barbeau, Thunell, Torres, Wilson)

### ***Biogeochemistry***

Study of the processes and reactions that govern the composition of the environment both in the present day and throughout the geologic past. The interaction and co-evolution of the biosphere and geosphere. Elemental cycles of carbon, phosphorus, nitrogen, and sulfur. Structure and function of ecosystems. (Lang, Ziolkowski)

### ***Climate Change***

Paleoceanography and Paleoclimatology - Studies of ancient climate change using a variety of biotic and geochemical proxies preserved in marine, lacustrine and terrestrial records. (Ziolkowski, Thunell)

### ***Economic Geology and Fossil Fuels***

Research areas include conceptual and numerical schemes developed to improve exploration and exploitation of petroleum, coal, and metallic ores. Emphasis areas include the depositional environment and the preservation of the fossil fuels, and their detection and exploitation using data from recent settings, outcrops, wells, seismic, gravity and magnetics. Included in this research are methods for the protection and amelioration of the environment associated with exploration and exploitation. (Kellogg, J. Knapp)

### ***Geochemistry***

Research covers all aspects of geochemistry, including low temperature and environmental geochemistry, stable isotope and U-series isotope geochemistry, high temperature crust and mantle geochemistry, planetary geochemistry, and organic geochemistry. (Benitez-Nelson, Bizimis, Scher, Thunell, Wilson, Yogodzinski)

### ***Geomorphology, Surface Processes and Sedimentation***

Studies of sediments in marine and terrestrial settings to determine the processes that control the distribution of different sediment types, erosion, transport and deposition and relationship to landforms. (Lakshmi, Torres, Voulgaris, White, Yankovsky)

### ***Geophysics and Seismology***

USC has one of the most active seismological field programs in the country. Projects spanning the globe focus on: lithospheric process investigations using active and passive seismological studies; processes of intraplate and induced seismicity; seismological problems of South Carolina; and seismological issues in monitoring and verifying a Comprehensive Nuclear Test Ban Treaty. USC hosts the South Carolina Seismic Network and has an active program in monitoring the state and studying prehistoric seismicity and paleoliquefaction features in the southeast. (Kellogg, Kendall, C. Knapp, J. Knapp, Owens, White)

### ***Hard Rock Petrology***

We are active in the study of the origin and metamorphic and igneous rocks to determine their origin in active tectonic provinces. (Bizimis, Yogodzinski)

### ***Hydrogeology***

In this cross-disciplinary science we investigates the temporal and spatial variability of processes which control sediment and water fluxes in surface and near-surface systems in terrestrial and coastal settings. We combine field, laboratory and theoretical studies designed to quantitatively define transport laws and how land utilization and land management practice affect fluxes and how those affects propagate through natural systems. (Lakshmi, Torres, Voulgaris, Wilson, Yankovsky)

### ***Oceanography, Coastal and Estuarine Processes***

Study of the geology, physics, chemistry, and biology of the marine environment. Areas of current research include: geophysical fluid dynamics and fluxes, sediment dynamics, marine turbulence, physical properties of sea water, influx of terrestrial waters into the marine environment, ocean and coastal currents, estuarine dynamics, air-sea interaction, waves, and tides. (Benitez-Nelson, Bulusu, Scher, Thunell, Voulgaris, White, Wilson, Yankovsky)

### ***Satellite Oceanography***

Observations of the sea surface using satellites now provide researchers with information about the oceans' impact on our environment, climate change and weather forecasting. Satellite sensors observe the sea's surface, measuring many properties that include temperature, color and changes in height. These data reveal information about circulation, storms and the biology of the oceans (Bulusu)

### ***Paleontology and Paleoecology***

Research into the relationships of fossilized organisms to their environments, both as individuals and in the natural communities in which they occur. The study of fossils, which are the preserved remains of former life on earth, is used to reconstruct paleoenvironmental conditions and to examine evolutionary processes. (Scher, Thunell)

### ***Petroleum Geology***

Research into sedimentary, stratigraphic, structural and geochemical relationships with the occurrence of petroleum. These studies include those of seismic and sequence stratigraphy, biostratigraphic markers, organic productivity, source rocks, and acoustic, magnetic and gravitational geophysics. (Kellogg, C. Knapp, J. Knapp)

### ***Sedimentology & Stratigraphy***

Studies of modern and ancient marine and terrestrial sediments to determine the processes that control the temporal and spatial distribution of different sediment types, their provenance, erosion, transport and deposition. These include studies of depositional setting, eustasy, tectonics, climate and biology. (Leier)

### ***Tectonics and Structural Geology***

Our expertise in tectonic problems extends from using satellite geodesy for understanding large scale plate motions to extracting the tectonic implications of small-scale fold and fracture features. Seismic imaging to depths of 700km in active tectonic provinces and sedimentary basins adds a third dimension to these studies. (Barbeau, Kellogg, C. Knapp, J. Knapp, Owens, White)

## **AWARDS & SCHOLARSHIPS**

The Geosciences program offers a number of academically-based scholarships and awards to undergraduate majors in Geological Sciences and Geophysics. In addition, the Student Services office (PSC 108) maintains a list of outside scholarships and awards for students in the geosciences (email [mcclaryj@mailbox.sc.edu](mailto:mcclaryj@mailbox.sc.edu) to request an electronic copy).

Departmental awards include:

**Stephen Taber Undergraduate Scholarships** – Departmental scholarships available to both incoming and continuing majors in geological sciences and/or geophysics. Competitive awards are \$250 per semester based on GPA. Out-of-state students may be eligible for reduced tuition, substantially increasing the value of these awards. Applications are due April 1 for awards covering the following academic year, and are automatically renewed each year provided the recipient maintains a 3.0 cumulative GPA and does not switch out of the major.

**Joseph R. LeConte Outstanding Junior Award** - The Joseph R. LeConte Outstanding Junior Award is presented to a junior major with an outstanding academic record in the Department of Earth and Ocean Sciences.

**Joseph R. LeConte Outstanding Senior Award** - The Joseph R. LeConte Outstanding Senior Award is presented to a graduating major with an outstanding academic record in the Department of Earth and Ocean Sciences.

**Stephen Taber Award** - The Stephen Taber Award is given to recognize superior academic achievement in the geosciences.

**The Distinguished Academic Achievement Award** -This award is given on an occasional basis to students with senior standing in Geological Sciences or Geophysics degrees who have established a distinguished record of academic achievement.

**Dr. Mack Gipson Award** – This merit-based award is given in honor of a deceased member of the Earth and Ocean Sciences faculty who was African-American and strongly believed in encouraging young scientists from ethnic minorities.

## **SENIOR THESIS GUIDELINES**

Students who wish to finalize their Bachelor's degree in Geological Sciences or Geophysics with a Senior Thesis must follow the guidelines provided below. A passing grade in GEOL 699 will indicate successful completion of all Senior Thesis requirements. Your thesis becomes a permanent record of your independent research or creative effort. The best academic tradition and professional practice require the degree program to preserve and share your work with other scholars. To do that successfully, the program must maintain high standards concerning the form and appearance of your thesis, and must require that your work meet those standards.

A thesis must be based on original research that has been approved by the thesis advisor. The thesis must be presented in a public venue as described below. A written manuscript is required that is approved by the student's advisor and meets the formatting guidelines described below. The faculty recommend that theses be written following style guidelines for Geological Society of America publications (<http://www.geosociety.org/pubs/contrib.htm>).

**Style.** Students are responsible for providing manuscripts in which approved geological and other scientific terminology are used correctly and which have no grammar or spelling errors. Students must check their manuscripts for accuracy and consistency in use of capitalization, spelling, abbreviations, and dates. The project recommends that theses be written following general style and typography guidelines in the *Chicago Manual of Style*; geological usage and spelling should conform to the *Glossary of Geology*, fourth edition, American Geological Institute, Alexandria, Virginia, 1997.

**Abstract.** A brief and objective abstract of no more than 250 words should present in capsule form the paper's content and conclusions. A topic sentence should give the overall scope and should be followed by emphasis on new information. Omit references, figure or table callouts, and criticisms.

**Organization.** Precisely define the contribution at the outset and present it clearly in the fewest words possible (while avoiding jargon) so that the reader may get a maximum of facts and ideas in a minimum of time. State the purpose; give minimal background information, concisely present the data that led to the conclusions clearly differentiate fact and inference, and present justifiable conclusions and, perhaps, further implications of the conclusions. Provide complete descriptions of methods and laboratory techniques preferably as an Appendix. Do not describe standard methods in detail if references to the methods can be cited. Number figures and tables in the order that they appear in the text.

**Footnotes.** Avoid footnotes and parenthetical statements. Textual footnotes that are deemed necessary should be numbered consecutively with superscripts.

**Units of Measure.** Use the International System of units (metric) in captions, illustrations, and text; where English measurements are necessary, follow metric with English in parentheses.

**Captions.** Make captions precise and explain all symbols and abbreviations used. Captions should appear at the *bottom* of the figure, with the first line 2 spaces below the image. Captions should begin with the word 'Figure' followed by a number and a period.

**Tables** should replace text, not duplicate it. Tables should be numbered in the order discussed in the text. Titles should appear at the *top* of the table, with the bottom line of the title 2 spaces above the first line of the table. A table title may not consist of more than one sentence or phrase. Titles should begin with the word ‘Table’ followed by the number of the table, and a period.

**Appendices**. Title all appendices (for example, APPENDIX 1. SAMPLE DESCRIPTIONS). Place appendices at the end of the text before the References Cited.

**Mathematical Expressions.** Define your use of symbols in the text the first time each appears. Mathematical expressions and equations in text follow this format:

The relations of displacement, uplift, and rotation for this model are

$$\sin \phi = H/L_n \quad (1)$$

and

$$S = L_n - L_n \cos \phi = L_n(1 - \cos \phi), \quad (2)$$

where  $\phi$  is the angle of rotation,  $H$  is the amount of uplift,  $L_n$  is the limb length, and  $S$  is the amount of displacement

**References.** Manuscripts will contain proper citation of works by others, especially publications of the original hypotheses, ideas, and/or data upon which manuscript is based. All references mentioned in the text, figures, captions, tables, and appendixes must be listed in the References Cited section. Only references cited in the paper are to be listed. References in the text consist of the surname of the author(s) followed by the year of publication in parentheses. For references with two authors, list alphabetically by first author and then alphabetically by second author. For references with more than two authors, list alphabetically by first author and then chronologically, earliest year first. Do not abbreviate journal titles or book publishers in references. Include the city of publication for books. Please follow the following sample:

Author(s), Year of publication (in parentheses), Title of article, Name of journal, Volume number, and Page numbers.

**Figures.** It is recommended that figures be inserted in the text. Each Figure must be accompanied by a caption.

- **Lines and Labels in Graphs, Maps and Legends**
  - Use clean black lines, no finer than 1 point and no greater than 2 points.  

  - On maps, please include latitude ( $^{\circ}\text{N}$ ,  $^{\circ}\text{S}$ ) and longitude ( $^{\circ}\text{W}$ ,  $^{\circ}\text{E}$ ), a north arrow, and a scale in kilometers.
  - Graphs must have all axes and lines labeled.
  - General titles of illustrations should appear in the figure caption, not in the figure itself.
- **Lettering**
  - Use a clear, sans serif typeface (Helvetica or Arial).
  - All lettering should be between 7 point and 12 point type size.

- Avoid making the lettering too large for the figure. This can result in a "cartoonish" appearance.
- Place a white background behind lettering that crosses a dark or textured area in a figure.

**Formatting.** The following is the standard format for a Senior Thesis in the Geological Sciences or Geophysics degree program:

**Title Page** (signed)  
 Acknowledgements  
 Dedication (optional)  
 Introduction  
 Background (optional)  
 Methods (optional)  
 Results  
 Conclusions  
 References Cited  
 Appendices (optional)

- **Margins.** On all pages, margins should be one inch at the top, bottom, and right and one and a half inch on the left.
- **Page Numbering.** Use lowercase Roman numerals (e.g. i, ii, iii, iv...) to number your introductory pages (title page, acknowledgements, dedication, etc.) with the title page bearing no number but included in the sequence. Arabic numerals (e.g. 1, 2, 3...) are to be used to number the remaining pages of the text, including appendices, beginning with the first page of the first chapter. Placement of page numbers must be consistent (bottom-center) and always one-half inch from the edge of the page (i.e. in the "footer" of the page).
- **Typefaces and Color.** Use a black color for all text in the body of the thesis. Any of the following standard 12-point fonts are acceptable: Arial, Calibri, Courier New, Palatino, Tahoma, Times New Roman. Do not use running headers or footers, and please use boldface sparingly.

**Submission.** The student must submit the final text of the Senior Thesis to the SEOE Undergraduate Student Services office (PSC 108) on a CD-ROM or other electronic format as requested by the office. The disk version must correspond exactly to the paper copy and include a copy of the title sheet, signed by advisor [and second reader\*].

### The Senior Thesis Presentation.

Two weeks prior to the presentation, the student will submit one copy of a complete draft of the thesis, to the advisor [and to the second reader\*].

Senior thesis presentation is a public event. The presentation should be announced a week or more in advance through an email to students and faculty in the School of the Earth, Ocean and Environment, including the location and time/date of the event. The student may take the initiative to post signs advertising the Senior Thesis presentation. As a minimum, the advisor [and

Second reader\*] must attend the presentation.

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The length of a presentation usually ranges from about thirty minutes to an hour. The advisor [and second reader \*] determines the format, but the usual procedure is for the student to make a 30-40 minute presentation of the thesis research and then respond to questions. Suggestions for revisions may be made both during and after the presentation. The advisor may choose to delay assigning a grade until after the revisions have been made to the thesis. Arrangements are also made for delivery of the final thesis to the advisor [and second reader\*] to acquire their signatures on the title page.

\* Additional requirements for Graduation with Distinction in the Department of Earth and Ocean Sciences



## **GUIDELINES FOR APPLICATION AND ADMISSION TO THE ACCELERATED BACHELOR'S/GRADUATE DEGREE PLAN IN GEOLOGICAL SCIENCES**

The School of the Earth, Ocean and Environment offers exceptional undergraduate students the opportunity to spend an extra year at USC and earn a Master of Science in Geological Sciences degree in addition to the Bachelor of Science degree. Qualifying students take a combination of undergraduate and graduate courses in their fourth year and concentrate on graduate work in their fifth year. Students earn their Bachelor's degree in the fourth year and the opportunity to earn the Master's degree in the following, fifth year. The accelerated plan allows students to count 12 credit hours of graduate course work (500 level and above) towards *both* the undergraduate and graduate degree. As research experience is essential for a Master's Degree, candidates for this program must arrange to participate in a research project in a faculty member's laboratory prior to applying for the Accelerated Bachelor's/Graduate Degree Plan.

Students interested in the Accelerated Bachelor's/Graduate Degree Plan should make an appointment with the Director of Undergraduate Studies in the School of the Earth, Ocean and Environment as soon as possible (ideally, during sophomore year). The following factors will be considered for admission of students wishing to enter the Accelerated Bachelor's/Graduate Degree Plan:

- 1) Cumulative and undergraduate major GPA of 3.5 or better;
- 2) A faculty sponsor willing to serve as research advisor;
- 3) Proposed research plan and area of research;
- 4) Number of credit hours completed at the time of application (90 minimum);
- 5) Maturity of the student; and
- 6) Availability of research support.

Students should apply for this plan during the spring of their junior year, normally by February 1 or in the semester in which they reach 90 undergraduate credit hours. Recommendation by the program and approval by the Graduate School confers admission to the Accelerated Bachelor's/Graduate Degree Plan only (signifying a student's intent to pursue a graduate degree); students must also apply to the graduate program through the regular admission process\* and be accepted by the USC Graduate School to graduate study. Admission to the Accelerated Bachelor's/Graduate Degree Plan does not guarantee admission to the Master's program, nor does the SEOE guarantee Instructional Assistantships or other financial support to students admitted to the Accelerated Bachelor's/Graduate Degree Plan.

\***Note:** Apply to the graduate program via the USC Graduate School:  
<http://gradschool.sc.edu/gap/>. It is recommended the student file the complete application for admission to the M.S. in Geological Sciences program, including letters of recommendation and GRE scores, by February 1<sup>st</sup> of the student's senior year.

### **Application Process:**

To apply\*\* to the Accelerated Bachelor's/Graduate Degree Plan, submit the following documents as a packet, using the attached Accelerated Bachelor's/Graduate Degree Plan Checklist as a cover sheet, to the SEOE Student Services Office in PSC 108 by the recommended deadline of February 1 of the student's junior year.

1. Application for Admission to the Accelerated Bachelor's/Graduate Degree Plan (G-BGPA form) available on the Graduate School website:  
<http://www.gradschool.sc.edu/doclibrary/documents/G-BMPA.bachelors.masters.plan.admission.GS59.pdf>;
2. Current transcript (printed from VIP);
3. Resume;
4. Statement explaining why you want to enter the Accelerated Bachelor's/Graduate Degree Plan (~ 2 paragraphs);
5. Brief overview of your research plan (2 page maximum), including details of available research support, if any; and
6. Written letter of support from the student's faculty advisor.

Once admitted to the Accelerated Bachelor's/Graduate Degree Plan, students must complete the Course Work Authorization (G-BGCA) form available on the Graduate School website in order to register for courses under the Plan:

<http://www.gradschool.sc.edu/doclibrary/documents/G-BMCA.bachelors.master.plan.coursework.GS19a.pdf> .

**\*\* Note:** Undergraduate students participating in Senior Privilege or the Accelerated Bachelor's/Graduate Degree Plan may opt for only one program. If a student has been approved to participate in one of these programs, that student is prohibited from applying for, or taking courses under, the other.

### **Master's of Science in Geological Sciences Degree Requirements:**

#### **Course Requirement:**

To obtain the M.S. degree in Geological Sciences, students qualifying for the accelerated program are required to complete the 30 graduate credit hours required for the degree (see the *Graduate Studies Bulletin* for details), but are allowed to count 12 hours for both the undergraduate and Master's degrees. Once admitted to the Accelerated Bachelor's/Graduate Degree Plan, students are advised of what courses to take by the program's Graduate Director. Students in the Plan are typically advised to register for courses which satisfy the breadth requirement for the M.S. degree:

Solid Earth Breadth Requirement: *choose one from*

- GEOL 725 Internal Earth Processes
- GEOL 735 Regional Tectonics

Ocean and Hydrologic Sciences Breadth Requirement: *choose one from*

- GEOL 711 Paleoclimatology GEOL
- 781 Physical Oceanography GEOL
- 782 Chemical Oceanography GEOL
- 770 Groundwater Geology

Data Analysis Breadth Requirement: *choose one from*

- GEOL 755 Environmental Measurement and Analysis
- GEOL 758 Analysis of Geological Data
- GEOL 783 Oceanographic Time Series Analysis

In addition, as part of the 30 graduate credits required for the degree, Master of Science students are required to complete one additional course numbered 700 or above (other than 799 Thesis Preparation.) The remaining credits may be earned in courses numbered above 500, including 6 hours of 799; to have the coursework count toward the M.S. degree, students must achieve and maintain an overall GPA of 3.00 in all courses taken for graduate credit and complete each of the core courses with a minimum grade of B.

**Thesis Requirement:**

Master's students are required to complete a thesis in accordance with the guidelines established by the Graduate School and the College of Arts and Sciences, including the oral defense of the thesis in a public seminar. Defense of the thesis proposal will occur during the first semester of graduate study.

Name		SSN	
Anticipated B.S. Date		Anticipated M.S. Date	

**ACCELERATED BACHELOR'S/GRADUATE DEGREE PLAN  
APPLICATION PROCESS**

Application for Admission to a Combined Bachelor's/Graduate Degree Plan ( <a href="http://www.gradschool.sc.edu/doclibrary/documents/G-BMPA.bachelors.masters.plan.admission.GS59.pdf">http://www.gradschool.sc.edu/doclibrary/documents/G-BMPA.bachelors.masters.plan.admission.GS59.pdf</a> )	
Current transcript (print from VIP)	
Resume	
Statement of Purpose (explaining why student wants to enter program)	
Overview of research plan (2 pages maximum)	
Details of available research support (if any)	
Letter of support from faculty advisor	
To SEOE Student Services Office, PSC 108 (Undergraduate Director to review; Graduate Director to review/sign)	
To Dean of the Graduate School for approval	

**GRADUATE SCHOOL APPLICATION PROCESS**

Online application completed ( <a href="http://gradschool.sc.edu/gap/">http://gradschool.sc.edu/gap/</a> )	
Application fee paid to Graduate School	
Two (2) letters of recommendation	
Official transcript	
GRE test scores	
To Graduate Director for review/action sheet recommendation	
To Graduate School for acceptance or decline	