MARINE GEOLOGY AND GEOPHYSICS

- Dept. Code: MGG

Degree Programs

The undergraduate student wishing to prepare for graduate work in marine geology and geophysics must be well trained in the basic sciences. According to the special interests of the individual, the undergraduate major and minor should be in geology, physics, chemistry, and/or mathematics.

The Division of Marine Geology and Geophysics offers M.S. and Ph.D. programs in the following broad areas:

• Environmental Geology and Geochemistry
• Sedimentary Systems and Marine Geology
• Paleoclimatology and Global Change
• Igneous Petrology and Geochemistry
• Geophysics
• Geodesy

Within each discipline, students have considerable flexibility in choice of courses, and “cross-track” courses are possible for students with special interests. Interactions with other divisions are particularly encouraged.

Courses

MGG 601. Oceanography I (Geological). 2 Credit Hours.
The first section of the core course curriculum designed as an integrated and multidisciplinary view of ocean processes, covering the major disciplines of marine science and their applications to the study of the marine environment. To be taken in sequence with Oceanography II - Physical (MPO 502), Oceanography III - Chemical (MAC 501), and Oceanography IV - Biological (MBF 502). This course is for non-MGG majors only.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MGG 611. Earth Surface Systems. 3 Credit Hours.
An introduction to the elements of the earth surface environment and their interactions with an emphasis on the application to understanding the geologic record. Course includes discussions of the processes and agents that influence and shape the character of the earth’s surface, the attributes of the resultant sedimentary features, and the use of these features to unravel geologic and geomorphic history. Focus is placed on systems dynamics and interactions among sedimentologic, geomorphic, biotic, and hydrologic processes.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MGG 613. Introductory Geochemistry. 3 Credit Hours.
Fundamentals of atomic structure and quantum mechanics applied to Chemistry. Topics include origin and distribution of the elements, chemical bonding and substitution, basic thermodynamics of solids, liquids, and gases. Applications of these concepts to such geochemical processes as magmatic differentiation, rock-water interactions, low temperature aqueous geochemistry, and the geochemical cycling of the elements is also included.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MGG 614. Geophysics. 3 Credit Hours.
Course topics include seismology, gravity, heat flow, thermal history, geomagnetism, plate tectonics, and their importance in understanding the Earth’s crust, mantle, and core.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MGG 625. Applied Environmental Geophysics. 3 Credit Hours.
Application of subsurface geophysical tools to environmental problems. Course includes the theory and application of shallow refraction and reflection seismology, conducting field experiments and processing both marine and land seismic data, other marine survey techniques such as side-scan sonar surveying, potential field techniques (gravity, magnetics, EM), ground penetrating radar, and borehole geophysics.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 650. Mathematical Methods for Geoscientists. 3 Credit Hours.
Background mathematics needed to solve problems in the geosciences. Applications in tectonics, geodynamics, structural geology, seismology, and hydrology. Topics include linear inverse problems, least squares, linear algebra, matrix theory, vectors, dimensional analysis, probability and scientific inference, continuum mechanics, transform and numerical methods to solve differential, and partial differential equations.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 641. Field Evaluation of Fossil Platforms, Margins, and Basins. 2 Credit Hours.
Field investigation of classic rock sequences formed within ancient platform, margin, and basin environments. The use of ancient exposures as a guide to the interpretation of modern marine environments.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 640. Mathematical Methods for Geoscientists. 3 Credit Hours.
Background mathematics needed to solve problems in the geosciences. Applications in tectonics, geodynamics, structural geology, seismology, and hydrology. Topics include linear inverse problems, least squares, linear algebra, matrix theory, vectors, dimensional analysis, probability and scientific inference, continuum mechanics, transform and numerical methods to solve differential, and partial differential equations.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.
MGG 670. Continental Tectonics. 3 Credit Hours.
Reviews major research techniques used in the study of the structure
and evolution of continental crust and topical discoveries, with an
emphasis on the Neogene to Recent time. The course begins with brief
introductions to the fields of structural geology, seismology, and geodesy
as they relate to continental tectonics. New research in areas such
as the rheology of the lithosphere, plate motion models, deformation
of continental crust in plate boundary zones, oblique subduction, and
earthquake hazard assessment are also discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MGG 679. Plate Tectonics. 3 Credit Hours.
The theory of plate tectonics, sea floor spreading, and continental drift.
Mathematical description of plate motions, finite and instantaneous
rotation poles, consequences of plate tectonics, mountain building,
riifting, erosion, and recycling of continental materials are also discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

MGG 680. Geological and Environmental Remote Sensing. 3 Credit Hours.
This one semester course will cover major remote sensing techniques
used in the geological and environmental sciences. The course will begin
with an introduction to the basic physics of remote sensing, followed by
a review of major remote sensing techniques used in aircraft and satellite
platforms, including IR and near IR, optical and microwave systems. We
will then discuss specific terrestrial and coastal applications using a
case history approach, including geologic, soil and biomass mapping,
environmental monitoring, and natural hazard assessment. The course
is aimed at graduate students and senior undergraduates with some
background in math and physics. Grades are based on problems sets (a
minimum of three), a mid-term test, and a report or lab exercise involving
image processing, due at the end of the semester.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MGG 681. Petroleum Geology. 4 Credit Hours.
Students will learn the basics of hydrocarbon generation, migration
and entrapment using a variety of tools and real subsurface datasets.
Participants should be comfortable with sedimentary geology,
stratigraphy, structural geology. Some basic geophysics is helpful but
not necessary. At the end of the course, students will be able to use
ARCGIS and other software tools to build risk maps of hydrocarbon
prospectively, assess exploration potential of an area and understand the
basics of reserve estimation, prospect level risk assessment and ways
to estimate yet-to-find volumes for a basin using a variety of statistical
as well as geological techniques. The course stresses an understanding
of practical applications of petroleum geochemistry, source rock and
fluids characterization, burial history and oil and gas show evaluation to
predict new accumulations and appraise discoveries. Basic principles
of rock property analysis, coupled with an understanding of subsurface
pressures, seals and ways to recognize hydrocarbons on electric logs are
also covered. Lastly, seismic stratigraphy and plate tectonics are
touched upon. A larges for number of subsurface datasets are used
and the opportunity exists to learn additional software packages for
those interested. Many subsurface problems will involve small teams of
students working together to make final presentations simulating real
work-place discussions and processes.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MGG 683. Scanning Electron Microscopy. 2 Credit Hours.
Theory and practical application of the SEM and the electron probe
to research problems. Lectures and laboratory with emphasis on
independent operation of the SEM, special preparation techniques, and
interpretation of results are included. Course is designed to provide
students with a broad and thorough background in scanning electron
microscopy.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MGG 684. Special Topics. 1-4 Credit Hours.
Lectures, research projects or directed readings in special topics related
to Marine Geology and Geophysics.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 685. Special Topics. 1-4 Credit Hours.
Lectures, research projects or directed readings in special topics related
to Marine Geology and Geophysics.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 686. Special Topics. 1-3 Credit Hours.
Lectures, research projects or directed readings in special topics related
to Marine Geology and Geophysics.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.
MGG 701. Seminar in Marine Geology and Geophysics. 1 Credit Hour.
Oral presentation and discussion of research and special topics by
students, faculty, and visiting scientists. Students receiving credit are
required to present a seminar.
Components: LEC.
Grading: GRD.
Typically Offered: Fall & Spring.

MGG 720. Satellite Radar Interferometry in the Earth Sciences. 3 Credit
Hours.
Spaceborne interferometric Synthetic Aperture Radar is an important
technique for various disciplines in the Earth Sciences, such as geodesy,
glaciology and hydrology. This course reviews the principles of radar,
synthetic aperture radar of interferometric and differential radar
interferometric techniques.
Components: LEC.
Grading: GRD.

MGG 722. Geophysical Onverse Theory. 3 Credit Hours.
This course covers the principles of geophysical inverse theory as applies
to problems in the Earth Sciences. Inverse theory is a set of mathematical
techniques used to obtain inferences about the Earth from physical
measurements. The focus of this class will be on formulating and solving
inverse problems, and understanding the non-uniqueness and resolution
associated with inversions. The emphasis will be on geodetic data
(obtained from GPS and InSAR measurements).
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MGG 750. Stable Isotopes in Biogeochemical Processes. 3 Credit Hours.
Theory of stable isotope fractionation, methods of measurement, and
application of results to geological, biological, and oceanographic
processes. Hands-on experience in the stable isotope laboratory is
provided utilizing a range of techniques. A project chosen either by the
student or instructor is required. All students who wish to use the stable
isotope facility should take this course. Lecture, 2 hours; laboratory, 3
hours. Prerequisite: Permission of instructor.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 751. Diagenesis of Carbonate Sediments. 3 Credit Hours.
The processes of basin formation and filling. The principles of seismic
facies analysis, seismic sequence stratigraphy, and their applications
in basin analysis, groundwater management, and exploration for
hydrocarbons are discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

MGG 766.Paleoclimatology. 3 Credit Hours.
Climatic variables and their effects on geological and biological
processes. The development of the paleoclimatic record, modeling of
present climate, and the extrapolation to past and future climates are
discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

MGG 767. Physical Volcanology. 3 Credit Hours.
Volcanology is the study of volcanoes of the Earth and planets. On
Earth, volcanoes occur on land and under the sea. Eruptions vary in
size, duration, and frequency, and in the composition of eruptive rocks
and volatiles. Proximity to centers of population makes some of them
extremely dangerous. This course covers the principles of physical
volcanology, including introductory petrology, mineralogy, geology,
magma physics, the fluid dynamics of magmas, and volcanic hazards.
Course logistics: Lectures supplemented by homework. Homework will be
designed to illustrate physical processes.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.
MGG 782. Advanced Studies. 1-4 Credit Hours.
Special study in areas of special interest to graduate students.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 783. Advanced Studies. 1-4 Credit Hours.
Special study in areas of special interest to graduate students.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 784. Advance Studies. 1-3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

MGG 785. Advance Studies. 1-3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

MGG 786. Advance Studies. 1-3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

MGG 787. Advance Studies. 1-3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

MGG 788. Advance Studies. 1-3 Credit Hours.
Components: LEC.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

MGG 800. Practical Training and Internship. 1-6 Credit Hours.
Supervised internship or off-campus employment for students pursuing the M.A., M.S., or Ph.D. degree. Consists of work related to research in progress.
Components: THI.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

MGG 805. Special Report. 1-6 Credit Hours.
Supervised project for students pursuing the Master of Arts degree in Marine Studies. Course consists of a research paper, researched, and written on a topic approved by the student’s advisory committee, and presented as a seminar to the student’s division. Six credits are required for graduation.
Components: THI.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

MGG 820. Research in Residence. 1 Credit Hour.
Used to establish research in residence for the thesis for the master’s degree after the student has enrolled for the permissible cumulative total in MGG 710 (usually six credits). Credit not granted. May be regarded as full time residence.
Components: THI.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

MGG 830. Doctoral Dissertation. 1-12 Credit Hours.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 12. Not more than 12 hours of MGG 730 may be taken in a regular semester, nor more than six in a summer session. Where a student has passed his/her (a) qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

MGG 850. Research in Residence. 1 Credit Hour.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.