GEOLOGY

COLLEGE OF SCIENCE

Graduate Faculty:

Anderson, Ken B., Associate Professor, Ph.D., University of Melbourne, Australia, 1989; 2004. Organic geochemistry.
Conder, James, Assistant Professor, Ph.D., Brown University, 2001; 2008.
Creeking, John C., Professor, Emeritus, Ph.D., Pennsylvania State University, 1973; 1977.
Dutcher, Russell R., Professor, Emeritus, Ph.D., Pennsylvania State University, 1960; 1970.
Esling, Steven P., Associate Professor and Chair, Ph.D., University of Iowa, 1984; 1982. Hydrogeology, quaternary stratigraphy, geomathematics.
Ferre, Eric C., Associate Professor, Ph.D., University of Toulouse, France, 1989; 2003. Structural geology, rock magnetism, tectonics.
Fifarek, Richard H., Associate Professor, Ph.D., Oregon State University, 1985; 1985. Economic geology, stable isotope geochemistry; fluid inclusion studies.
Frank, Charles O., Assistant Professor, Emeritus, Ph.D., Syracuse University, 1973; 1970.
Harris, Stanley E., Jr., Professor, Emeritus, Ph.D., University of Iowa, 1947; 1949.
Ishman, Scott E., Associate Professor, Ph.D., The Ohio State University, 1990; 1999. Paleocology, Cenozoic paleobiology, foraminifera.

Marzolf, John E., Associate Professor, Ph.D., The University of California, Los Angeles, 1970; 1982. Clastic sedimentology, clastic petrology, sequence stratigraphy.
Pinter, Nicholas, Professor, Ph.D., The University of California, Santa Barbara, 1992; 1996. Geomorphology, environmental geology, earthquake hazard.
Rimmer, Sue, Professor, Ph.D., Pennsylvania State University, 1985; 2009.
Sexton, John L., Professor, Ph.D., Indiana University, 1974; 1985. Geophysics, seismic reflection and refraction.
Staub, James R., Professor, Emeritus, Ph.D., University of South Carolina, 1985.
Utgaard, John E., Professor, Emeritus, Ph.D., Indiana University, 1963; 1965.

The Department of Geology offers programs leading to the Master of Science degree (thesis required), a Master of Arts degree in Earth Sciences (thesis not required), and a Graduate Certificate in Earth Sciences. Students wishing to pursue a Doctor of Philosophy degree in the geological sciences may do so under the auspices of the interdisciplinary doctoral program in Environmental Resources and Policy (ER&P). The ER&P program was introduced in 2000 and supercedes the doctoral offerings in Geology and Geography. For details, refer to the Environmental Resources and Policy entry in this catalog.

This program requires a nonrefundable $50.00 application fee that must be submitted with the application for Admissions to Graduate Study in Geology. Applicants may pay this fee by credit card if applying electronically. Applicants submitting a paper application must pay by personal check, cashier’s check, or money order made out to SIU, and payable to a U.S. Bank.

Graduate Programs

The objectives of the graduate degree programs are to develop the student’s competence in the basic fields of earth science and to provide for specialization dependent on student and faculty interest. Facilities and staff are available for studies involving environmental geology, geomorphology, hydrogeology, paleontology, micropaleontology, paleoecology, coal petrology, coal geology, Pleistocene geology, environmental geochemistry, molecular organic geochemistry, solid earth geophysics, environmental geophysics, applied geophysics, geographic information systems, remote sensing, surface and subsurface mapping, structural geology, stratigraphy, sedimentation, sedimentary petrology, sedimentary environments, ore deposits, petrology, mineralogy, crystallography, energy resources, and petroleum geology. Many of the faculty are actively conducting research in which statistical and computer techniques are applied to problem solving in the earth sciences. Interdisciplinary research with other departments is encouraged.

SIUC Geology faculty and graduate students conduct internationally-recognized research all over the globe. In North America, there are current and recent research efforts in locations ranging from Alaska to Florida, from Nova Scotia to the Sonoran Desert. Farther afield, SIUC Geology researchers are active in Antarctica, Asia, South America and Europe. The Southern Illinois region itself offers a wide
variety of geological conditions ideal for individual study and research.

Students must be admitted unconditionally to the Graduate School before they can be officially admitted to the graduate program in geology. Admission to the graduate program in geology is based on an evaluation of the preparation, ability, and promise of the applicant. Prerequisites for admission include: 1) receipt of GRE test scores sent directly to the Department of Geology; 2) completion of department application forms which are available on request from the department; and 3) receipt of at least 3 letters of recommendation from professors, academic advisers, former employers, or others familiar with the applicant’s academic performance, research, or other relevant work. The Department of Geology normally admits graduate students for entrance in the fall semester; however, applicants will be considered for spring admission. The students will be expected to have satisfactorily completed at the undergraduate level the equivalent course work in the basic sciences required for a Bachelor of Science degree in geology at SIUC.

A student admitted with course deficiencies may be required to complete or audit some undergraduate courses. First year teaching assistants are required to enroll in and complete GEOL 500. Other specific requirements will be determined by the student’s advisory committee and the department chair. Students are evaluated on an individual basis, their programs are determined by their career goals and the results of informal interviews with individual faculty members.

Requirements for the Master of Science Degree (Thesis Option)

- A total of 30 hours of graduate work completed with a grade point average of 3.0 or better constitutes the minimum credit requirement for the master’s degree.
- Courses taken are determined by the student and an advisory committee. The student will not be allowed to apply more than 8 hours of independent study or research courses toward the master’s degree (exclusive of thesis credits).
- A student majoring in geology may select a minor field. The minimum course work should then include 20 hours of geology and 10 hours in the minor field.
- A thesis subject must be approved by the chair of the advisory committee at least 20 weeks before the date of graduation.
- A final oral examination, primarily concerned with defense of the thesis is administered as the last step before graduation. The student may be asked any questions the committee feels are relevant.
- In order to pass the final oral examination, students must receive a favorable majority vote from their thesis committee meeting in formal session. Should the student fail the final oral examination, the student, upon concurrence of a majority of the committee, may arrange a time for a re-examination not less than 30 nor more than 120 days after the first examination. Students who fail the final oral on their second attempt will be ineligible for the master’s degree from the Department of Geology.
- Two copies of the approved thesis must be presented to the Graduate School at least three weeks prior to graduation, and a third copy must be presented to the Department of Geology.

Requirements for the Master of Arts Degree in Earth Sciences

The Master of Arts Degree in Earth Sciences is open to post baccalaureate students with degrees in earth science, geology, or related fields. Two fields of concentration are available: Geospatial Analysis and Environmental Geology. It is intended to expand the knowledge, skills, and specialized training in geological topics. The required course work is thirty (30) graduate credit hours in geology. The courses taken will be determined by interests of the individual student, but must be approved by the student’s three-person departmental advisory committee. At least three (3) credits of GEOL 591 Individual Research in Geology must be taken.

Recommended Courses for the Geospatial Analysis Concentration:

GEOL 420 (3) Petroleum Geology
GEOL 428 (3) Paleocology and Environments of Deposition
GEOL 434 (3) Engineering and Environmental Geophysics
GEOL 435 (3) Solid-Earth Geophysics
GEOL 466 (3) Tectonics
GEOL 474 (3) Geomorphology
GEOL 476 (3) Quaternary Geology
GEOL 478 (3) Advanced Environmental Geology
GEOL 481 (3) Sedimentary Basin Analysis
GEOL 484 (3) Geologic Remote Sensing
GEOL 526 (3) Advanced Topics in Applied Paleocology
GEOL 535 (3) Advanced Topics in Geophysics
GEOL 536 (3) Earthquake Seismology
GEOL 538 (3) Gravity and Magnetism
GEOL 576 (3) Coastal Geomorphology and Sedimentology
GEOL 577 (3) Advanced topics in Surficial Geology
GEOL 578 (3) Fluvial Geomorphology
GEOL 579 (3) Soil Geomorphology
GEOL 591 (3) Individual Research in Geology
GEOG 418 (3) Introduction to Geographic Information Systems
GEOG 420 (3) Advanced Geographic Information Systems

Recommended Courses for the Environmental Geology Concentration

GEOL 417 (3) Isotope Geochemistry
GEOL 418 (3) Low Temperature Geochemistry
GEOL 421 (3) Organic Geochemistry
GEOL 420 (3) Petroleum Geology
GEOL 428 (3) Paleocology & Environments of Deposition
GEOL 434 (3) Engineering and Environmental Geophysics
GEOL 470 (3) Hydrogeology
GEOL 470 (3) Hydrogeology Laboratory
GEOL 474 (3) Geomorphology
GEOL 476 (3) Quaternary Geology
GEOL 478 (3) Advanced Environmental Geology
GEOL 481 (3) Sedimentary Basin Analysis
GEOL 484 (3) Geologic Remote Sensing
GEOL 517 (3) Advanced Topics in Geochemistry
GEOL 526 (3) Advanced Topics in Applied Paleocology
GEOL 527 (3) Micropaleontology
GEOL 576 (3) Coastal Geomorphology and Sedimentology
GEOL 577 (3) Advanced Topics in Surficial Geology
GEOL 578 (3) Fluvisal Geomorphology
GEOL 579 (3) Soil Geomorphology
GEOL 591 (3) Individual Research in Geology
GEOG 418 (3) Introduction to Geographic Information Systems
GEOG 420 (3) Advanced Geographic Information Systems

Graduate Certificate
The Certificate in Earth Science with an optional concentration in Geospatial Analysis or Environmental Geology is open to post baccalaureate students with degrees in earth science, geology, or related fields. It is intended to expand the knowledge, skills, and specialized training in geological topics. The course work will include eighteen (18) graduate credit hours in Geology. While there are no specific courses required, the courses taken will be determined by the student and the departmental Coordinating Committee. For the concentrations in Geospatial Analysis and Environmental Geology, please refer to the above recommended course lists for the Non-Thesis Master’s program.

Students must maintain a B average in graduate courses and must follow the rules of the Certificate Policy established by the Graduate School. Maximum time allowed to complete the requirements for the certificate is five years.

Courses (GEOL)
Courses with a laboratory may require purchase of a laboratory manual and a supply fee. All courses requiring field trips may have a field trip fee of $2 to $7.

405-2 Science Writing and Scientific Communication. Course will teach “survival skills” in scientific reading, writing, communicating, and publishing for new graduate students. Topics will include database search, analysis of journal articles, abstracts, figures and tables, PowerPoint presentations, proposals, posters, thesis writing, and preparation of journal submissions. Enrollment is open to graduate students in the sciences and is by permission of the instructor.

412-3 Advanced Petrology. In-depth study of the rock forming processes. The relations of rock forming processes to petrographic analysis will be emphasized. Laboratories will deal with hand-specimen and thin-section analysis from selected rock suites with genetic modeling of the resulting data. Prerequisite: 310, 315.

413-3 Quantitative Methods of Geology. An introduction to quantitative methods in a geological and earth sciences context. Topics introduced include sampling plans for geologic studies, non-parametric test of geological data, comparisons of geological samples, analysis of sequential geological data. Laboratories will deal with numerical examples.
from all areas of geology. Prerequisite: advanced standing and consent of instructor.

**414-3 Paleobotany.** (See Plant Biology 414.)

**415-3 Optical Mineralogy.** The optical properties of minerals and the use of the petrographic microscope for identification of crystals by the immersion method and by thin section. Lecture, laboratory. Prerequisite: 310, Physics 203b or 205b.

**417-3 Isotope Geochemistry.** Isotope fractionation in natural systems containing D/H, carbon, oxygen, nitrogen, and sulfur. Application of stable isotope studies to environmental processes, paleoclimatology, and geothermometry. Stable and radioactive isotopes are tracers in hydrologic processes, ore deposits, sedimentology, and in crust—mantle differentiation processes. Prerequisite: 310, Chemistry 200, 201, 210, 211 or equivalent.

**418-3 Low Temperature Geochemistry.** The application of chemical principles to geologic processes that occur on and near the earth’s surface. Lecture, laboratory. Prerequisite: 310, Chemistry 200, 201, 210, 211 or equivalent.

**419-3 Ore Deposits.** Overview of the occurrence, geology and origin of metalliferous mineral deposits. Geologic principles and research techniques important to the understanding of mineral deposits. Introduction to exploration and mining methods. Lectures, laboratories, and field trips. Up to one or two day field trips may be required on weekends. Field trip fee = $30. Lab fee = $5. Prerequisite: 302, 315 or consent of instructor.

**420-3 Petroleum Geology.** The geological occurrences of petroleum including origin, migration and accumulation; a survey of exploration methods, and production problems and techniques. Laboratory study applies geological knowledge to the search for and production of petroleum and natural gas. Prerequisite: 221, 224.

**421-3 Organic Geochemistry.** The nature, origin and fate of natural and artificial organic materials in rocks and sediments. Topics include characterization of fossil fuels using biological marker compounds, petroleum source rock evaluation, and organic pollutants in the environment. Prerequisite: 325 or consent of instructor.

**425-3 Invertebrate Paleontology and Paleoecology.** Concepts of paleontology and paleoecology. Emphasis on functional morphology, lifestyles and habitats of fossil invertebrates and algae. The nature and evolution of marine and coastal paleocommunities. The effects of extinction events on paleocommunities and biodiversity. Laboratory. Up to 3 one- or two-day field trips may be required on weekends. Field trips required. Field trip fee = $95. Lab fee = $5. Prerequisite: 325 or a biology course.

**428-3 Paleocology and Environments of Deposition.** Characteristics, distribution, and classification of recent and ancient environments. Criteria for recognizing ancient environments. Sedimentological and paleoecological approaches. Recognition of ancient environments and environmental associations. Laboratory. Up to 3 one- or two-day field trips may be required on weekends. Field trip fee = $85. Prerequisite: 425, 325, or concurrent enrollment.

**434-3 Engineering and Environmental Geophysics.** Geophysical methods used in engineering and environmental site characterization and assessment and the physical detection of environmental hazards. Up to 3 one- or two-day field trips may be required on the weekends. Prerequisite: Physics 203a or 205a, 203b or 205b, Mathematics 150.

**435-3 Solid-Earth Geophysics.** Earth’s size, shape, mass, age, composition, and internal structure are reviewed in detail as understood from its volcanism, gravity and magnetic fields, seismicity and motion of continents and ocean basins; plate tectonics. Up to 3 one- or two-day field trips may be required on weekends. Prerequisite: 302, Mathematics 150 or consent of instructor.

**436-4 Elementary Exploration Geophysics.** Theory and practice of geophysics as applied to the exploration and development of natural resources. Laboratory involves use of geophysical instruments and interpretation of data. Up to 3 one- or two-day field trips may be required on the weekends. Prerequisite: 220 or 222; 223, Mathematics 150.

**437-3 Field Course in Geophysics.** Use of geophysical equipment for collection, analysis and interpretation of seismic, gravity, magnetic, electrical and other types of geophysical data. Field Trip required. Field trip fee = $115. Lab fee = $10. Prerequisite: 436 or consent.

**440-1 to 8 Advanced Topics in the Geological Sciences.** Individual study or research or advanced studies in various topics. Prerequisite: advanced standing and consent of instructor.

**445-3 Museum Studies in Geology.** History, nature and purpose of geology in museums, relationships of geology to other museum disciplines, application of geologic methods to museum functions, preparation and preservation of specimens; nature, acquisition and utilization of geologic collections in museums, role of research in museums.

**450-2 Introduction to Field Geology.** Introduction to field techniques, principles of geologic mapping and map interpretation. Field trip fee = $5.00. Prerequisite: 302, 315 or concurrent enrollment.

**451-1 to 12 Field Experience in Geology.** Preparation for and participation in academically rigorous field trips guided by faculty members. Trips will be to areas of geological interest and will occur during official breaks within or between semesters. Expenses will vary in proportion to the distance traveled and duration of trip and will be determined before each trip. A student may only take a specific trip once for credit. Prerequisite: consent of instructor.

**454-6 Field Geology.** Advanced field mapping in the Rocky Mountains, including problems in stratigraphy, structure, petrology, paleontology, geomorphology, and economic geology. Lab fee $250. Prerequisite: 302, 315, 325; 450 recommended.

**460-3 Geological Data Processing.** Computer applications to geological problems including the processing and
programming of data and the interpretation and evaluation of results. Lecture, laboratory. Prerequisite: Engineering 222 or Computer Science 202.

462-3 Fundamentals of Structural Geology II. Intermediate topics in structural geology including strain theory, field strain analysis, geometry of complex mesoscopic structures and introduction to dislocations, deformation history and microfabric analysis. Hypotheses and orogenesis are discussed and evaluated. Lecture and assigned problems only. Prerequisite: 302 or equivalent.

466-3 Tectonics. Fundamentals of geodynamics applied to plate tectonics: mantle composition and rheology, deformation of the lithosphere, structural characteristics of plate margins, stability of triple junctions, diachronous tectonics, and orogenesis will be examined in detail. One 3-day field trip is required. Field trip fee= $70. Prerequisite: 302, Mathematics 150 or consent of instructor.

470-3 Hydrogeology. Study of the distribution, origin and movement of groundwater and the properties of geologic materials that control groundwater flow and contaminant transport. Geology majors must also take 471 concurrently. Prerequisite: 220 or 222; 223, 221, 224; or consent of instructor. Field trips required. Field trip fee= $8. Prerequisite: 220 or 222; 223; Mathematics 150, or consent of instructor.

471-1 Hydrogeology Laboratory. Problem sets, laboratory experiments, and field exercises in hydrogeology. Geology majors must take this course concurrently with 470. Field trips required. Field trip fee= $8. Prerequisite: 220 or 222; 223; Mathematics 150, or consent of instructor.

474-3 Geomorphology. Study of the distribution, origin and movement of groundwater and the properties of geologic materials that control groundwater flow and contaminant transport. Geology majors must also take 471 concurrently. Prerequisite: 220 or 222; 223; Mathematics 150, or consent of instructor. Field trips required. Field trip fee= $35. Prerequisite: 220 or 222; 223.

476-3 Quaternary Geology. Methods used to identify, map, date and correlate Quaternary deposits and interpret Quaternary history. Covers glacial, fluvial, coastal, lacustrine and eolian chronologies, oxygen-isotope records from ocean sediments and continental ice cores, volcanic activity and Quaternary climate change. Field trips required. Prerequisite: 220 or 222; 223, 221, 224; or consent of instructor; 474 recommended.

478-3 Advanced Environmental Geology. Application of principles of geomorphology and Quaternary geology to environmental problems and geologic hazards. Lectures and case studies emphasize neotectonics, volcanic hazards, landslides and other mass movements, floods, river channel changes and coastal erosion. Field trips required. Field trip fee= $35. Prerequisite: 474; 476 recommended.

480-3 Geology of Coal. Geology as related to exploration, development and mining of coal; stratigraphy, sedimentation and structure of coal deposits; type of coal basins and their tectonic setting; concepts of cyclical deposition in coal basins; origin of splits and partings in coal seams; relationship of modern environments and ancient coal-forming environments; structural problems relevant to exploration and mining of coal; methods of resource evaluation. Three 1-hour lectures week; five half-day field trips. Prerequisite: 220 or 222; 223, 221, 224, 302, 325, or consent of instructor.

481-3 Sedimentary Basin Analysis. The use of stratigraphy, structure, sedimentology and geophysics to determine the paleogeographic evolution of sedimentary basins. Topics include the study of the relationships between host strata and both primary and post-depositional non-renewable resources, plate tectonics and basin evolution and subsurface geologic methods. Prerequisite: consent of instructor.

482-3 Coal Petrology. Structural features and microscopy of coal seams. Origin and alteration of coal constituents. Includes field trips, study of coal specimens and techniques. Prerequisite: 220 or 222; 223, 221, 224; or consent of instructor.

483-3 Forensic Geology. An introduction to the use of geological materials and techniques in criminal investigation. Details from actual criminal cases will be used as examples in all the topics covered which include rock and mineral types, geological and topographic maps, fossils, sand, soils, spores and pollen, geological building materials, art fraud and gemstones. Techniques covered will include optical microscopy, scanning electron microscopy, and x-ray diffraction.

484-3 Geologic Remote Sensing. Applications of remote sensing using aerial photographs, multi-spectral imagery, hyperspectral imagery, thermal infrared imagery, and radar imagery, in structural geology, stratigraphy, geomorphology, oil and mineral exploration, geologic hazard analysis, and planetary exploration. Prerequisite: 220 or consent of the instructor.

500-1 to 2 Teaching for Geology Graduate Students. To help teaching assistants develop skills in conducting laboratory work and leading discussions. One hour required for all teaching assistants in geology. Graded S/U only.

510-2 Advanced Sedimentology. Basic principles of field observation, field and laboratory sampling, and data analysis of clastic sedimentary rocks; introduction to laboratory techniques; introduction to statistical, physical and empirical models in sedimentary geology. Field trips required. Prerequisite: 325 or 474.

515-3 Instrumental Analysis in Geology. An introduction to modern methods of instrumental inorganic geochemical analysis that are particularly important in the geology sciences. This includes both operational theory and practical application of methods for the analysis of minerals, rocks and aqueous solutions. Lecture, laboratory. Prerequisite: 310, Chemistry 222 or equivalent, and consent of instructor; 418 recommended.

517-2 to 9 (2 to 6 per semester) Advanced Topics in Geochemistry. Specialized topics in geochemistry. Topics covered might include thermodynamic modeling of mineral-solution equilibria, the role of kinetics in mineral-solution reactions, experimental hydrothermal geochemistry or
other topics to be announced by the department. Maximum credit nine semester hours. Prerequisite: 418 or consent of instructor.

518-3 Clay Mineralogy. Study of the structure, chemistry, origin, and geologic importance of clay minerals. Industrial and other applications of clays. Lecture, laboratory. Prerequisite: 310 or consent.

520-2 to 9 (2 to 6 per semester) Advanced Topics in Igneous and Metamorphic Petrology. Petrologic principles and their relationships and other selected topics to be announced by the department. Prerequisite: consent of instructor.

522-3 Sedimentary Petrology—Siliciclastics. The petrography and petrology of siliciclastic rocks, emphasizing sandstone. Microscopic studies of composition and components of detrital clastic rocks, their origin, provenance, characteristics, diagenesis, cementation and lithification. Prerequisite: 325 or 415 or consent; 520 or 521 recommended.

523-3 Sedimentary Petrology—Carbonates. The origin, classification, diagenesis, and geochemistry of carbonate rocks, with emphasis on petrographic analysis. Study of recent carbonate depositional environments. Laboratory required. Prerequisite: 325, 418 recommended.

524-2 to 9 (2 to 6 per semester) Advanced Topics in Sedimentary Geology. Advanced topics in sedimentary geology. Topics may include clastic depositional environments, carbonate depositional environments; diagenesis of sedimentary rocks, and other topics to be announced by the department. Up to 3 one- or two-day field trips may be required on the weekends. Prerequisite: 428 or 522 or 523 or consent of instructor.

525-2 to 6 (2 to 3 per semester) Advanced Topics in Invertebrate Paleontology. Lectures, readings, field and laboratory studies, including techniques and quantitative methods of study. Preparation for research in paleontology. Topics may include corals, bryozoans, brachiopods, mollusks, echinoderms, biostratigraphy, tempo and mode of invertebrate evolution and other topics to be announced by the department. Maximum credit six semester hours. Prerequisite: 425 or consent of instructor.

526-3 Advanced Topics in Applied Paleoecology. Lectures, field, and laboratory studies, including techniques and quantitative methods. Preparation for research in paleoecology. Emphasis on using fossil marine invertebrates and trace fossils to interpret ancient sedimentary environments. Prerequisite: 428 or consent.

527-3 MicroPaleontology. Structure, classification, paleoecology, stratigraphic distribution, and evolution of microfossils. Laboratory work in techniques of collection, preparation and study of microfossils. Identification and use of microfossils in solving stratigraphic and paleoenvironmental problems. Preparation for research in micropaleontology. Up to 3 one- or two-day field trips required on weekends. Field trips required. Field trip fee=$85. Prerequisite: 425 or consent of instructor.

535-1 to 9 (1 to 6 per semester) Advanced Topics in Geophysics. Specialized topics in geophysics. Examples include but are not limited to seismic stratigraphy, midcontinent seismicity, isostacy, data processing techniques. The topic to be covered is announced by the department. Maximum credit nine semester hours. Up to 3 one- or two-day field trips may be required on weekends. Prerequisite: 435 or 436, Mathematics 150 or consent of instructor.

536-3 Earthquake Seismology. Observational seismology. Topics include earthquake source mechanisms; propagation, reflection and refraction of elastic waves; ray theory; dispersion of surface waves; the effect of earth structure on the seismogram; and the seismograph. Research projects will be conducted using data from the SIU Geophysical Observatory. Up to 3 one- or two-day field trips may be required on weekends. Prerequisite: 435 or 436, Mathematics 150 or consent of instructor.

537-3 Applied Seismology. Study of the seismic reflection techniques, including theory and methods of collection and analysis of seismic reflection data, the seismic method, waveform analysis, and digital filtering with computer applications and seismic instrument characteristics. Up to 3 one- or two-day field trips may be required on weekends. Prerequisite: Mathematics 150 or consent.

538-6 (3,3) Gravity and Magnetism. (a) Gravity. Study of gravitational methods used in the solution of geological problems; topics include theory, field operations, data reduction, anomaly separation, two and three-dimensional analysis, and interpretation. Up to 5 one- or two-day field trips may be required on the weekends. (b) Magnetism. Study of magnetic methods used in the solution of geological problems; topics include theory, origin, time variations and induction, paleomagnetism, magnetic properties of earth materials. Field operations, anomaly separation, and interpretation. Up to 5 one- or two-day field trips may be required on the weekends. Prerequisite: 435 or 436, Mathematics 150 or consent of instructor.

550-4 Advanced Economic Geology. In-depth examination of the geologic characteristics, classification and origin of metallic mineral deposits. Aspects of mineral exploration and mining techniques are also discussed. Laboratory exercises emphasize hand specimen and petrographic study of ore and host rock suites. Up to 3 one- or two-day field trips may be required on the weekends.

555-1 to 6 (1 to 3 per semester) Advanced Topics in Economic Geology. Advanced study in a specific area of economic geology to be determined by course participants. Course content may focus on a specific type of mineral deposit or such topical areas as field characteristics, mineral exploration techniques, stable isotope geochemistry, fluid inclusion studies and hydrothermal processes. Maximum six credit hours. Field trips may be required on up to 3 weekends and possibly over Spring vacation. Prerequisite: 550.

565-3 Rock Deformation and Structural Systems. Advanced topics in structural geology with emphasis on theo-
retical and experimental study of rock deformation and analysis of complex structural systems. Lecture and assigned problems only. Prerequisite: 462.

566-3 Advanced Topics in Structural Geology. Lectures, readings, and discussion of advanced aspects of rock deformation: dislocation theory and its applications to flow processes of rocks; experimental rock deformation: incremental and finite strain theory and analysis; and recent developments in structural geology. Prerequisite: 565.

570-3 Advanced Hydrogeology. A combination of lectures, seminars, and independent studies of advanced topics in hydrogeology, particularly geochemistry and the response of aquifers to stresses such as tides, recharge and saline intrusion. Prerequisite: 470.

576-3 Coastal Geomorphology and Sedimentology. Detailed examination of coastal processes and clastic coastal depositional systems. Coastal storms, wave processes, tidal systems, sea level changes, coastal sediment transport, deltaic, barrier island-strandplain, estuarine depositional systems and coastal stratigraphic sequences. Field trip to Louisiana and Texas Gulf Coast required. Field trip fee: $35. Up to 3 one- or two-day field trips may be required on weekends. Prerequisite: 474 or consent of instructor.

577-2 to 9 (2 to 6 per semester) Advanced Topics in Surficial Geology. Studies of processes, landforms, and deposits in the surface or near surface geologic setting. Selected topics to be announced by the department. Maximum credit nine semester hours. Prerequisite: consent of instructor.

578-3 Fluvial Geomorphology. Detailed study of fluvial processes and landforms within the context of major concepts in geology and geomorphology. Topics include drainage basins, hydro-climatology and surface water hydrology, channel processes, fluvial depositional systems, paleohydrology and changes in fluvial systems through time. Field trips required. Field trip fee: $35. Prerequisite: 474 and consent instructor.

579-3 Soil Geomorphology. Study of geomorphologic applications of soils. Covers the effects of time, climate, parent material, topography, eolian additions on soil development, classification and chemistry; soil indices; pedogenic thresholds; paleosols; use of soils to evaluate landform age, landform stability, Quaternary stratigraphy, faulting and climate fluctuations. Field trips required. Prerequisite: 474 or consent of instructor.

582-1 to 6 (1 to 3 per semester) Advanced Coal Petrology. Microscopy, source materials, coalification, constitution, and classification of peats, lignites, bituminous coal, anthracite; applications to industrial problems. Prerequisite: 482.

585-3 Earth and Space Science for Teachers. Class designed to help teachers gain an understanding of some of the earth science concepts they need to teach today’s standards-based curricula. Develops an understanding of earth materials, how the earth works, earth resources, the causes of natural disasters, and the exploration of the bodies of our solar system. Prerequisites: A general physical science course or equivalent and consent of the department.

588-3 Global Energy Resources. Ready access to energy is essential to sustaining modern societies. This course will discuss the nature of the resources that have been, are, or potentially could be used to provide energy in the US and around the globe, including fossil fuels, nuclear energy resources, bioenergy resources and emerging energy resources such as geothermal, wind, tidal, and solar energy.

591-1 to 6 Individual Research in Geology. Investigations in geology other than those for theses or dissertations.

599-1 to 6 Thesis. Minimum of three hours to be counted toward a Master’s degree.

600-1 to 30 (1 to 16 per semester) Dissertation. Research for and writing of the doctoral dissertation. Prerequisite: consent of instructor.

601-1 per semester Continuing Enrollment. For those graduate students who have not finished their degree programs and who are in the process of working on their thesis, or research paper. The student must have completed the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded S/U or DEF only.