General Information

The School of Geosciences, part of the Mewbourne College of Earth and Energy, is located in the Sarkeys Energy Center on the main campus of the University of Oklahoma. Founded in 1900 by Charles Gould, the school has been a leader in the Geological Sciences for over a century, and continues to be a leader in education and research in petroleum-related fields. Today, the school continues to rank among top universities nationwide in placement of graduates in the energy industry. Over the last decade, the school has expanded into additional fields of geology and geophysics research. Presently, research programs in geochemistry and mineralogy, crustal-scale geophysics, diagenesis, paleoecology, and paleoclimate are highly regarded in their own right and increase the scope of educational opportunities for our graduates and undergraduates.

Geology is the study or science of the solid Earth and is one of several related subjects commonly grouped in the geosciences. Geologists are concerned primarily with rocks that make up the outer part of the Earth and the fluids and resources they contain, as well as various aspects of the Earth's deeper interior. An understanding of the Earth involves principles of physics, chemistry, and biology (but with the time domain emphasized, as in stratigraphy and paleontology). The study and mapping of surface forms is shared with geography. Hydrogeology is the study of subsurface fluids and their role in geologic processes, such as contaminant transport. An understanding of fluids is crucial in understanding ore formation and petroleum migration. Paleontology, the study of records left by animals and plants that lived in past ages, is part of geology and involves fundamental aspects of biological science.

Geophysics is the scientific study of the Earth using the methods of physics. The aim of geophysics is to determine the composition and state of the Earth's interior, and the manner in which internal processes produce the observed features of the Earth's surface, primarily through methods of remote sensing. Our geophysics teaching and research concentrates on gravity studies, exploration and development seismology for hydrocarbons, near-surface hydrologic problems, and imaging of shallow structures; geomagnetics and paleomagnetics; geomechanics; and terrestrial heat flow studies.

The mission of the School of Geosciences is to deliver the highest quality education obtainable in the discipline and to prepare its graduates for successful and rewarding careers in industry, education, and government service. While maintaining the breadth needed for a first-rate earth science program, the school will further enhance its leadership role as one of the premier universities for research and career placement in the petroleum industry.

Programs & Facilities

Programs for Academic Excellence

For the student, excellence can be achieved through immersion in the science itself.

- Students are encouraged to participate with their peers in professional societies through local chapters.
- Seminars and colloquia are regularly offered in the School featuring presentations of the latest advances in the geosciences by experts in the field.
- Students are actively encouraged to become involved in current faculty research projects, develop their own research projects, and present these results at regional and national meetings with school support.
- Opportunities for summer employment in professional and research settings are promoted.
- Strong connections are maintained with the Oklahoma Geological Survey, where many environmentally and economically important site-specific problems are being investigated.
- The school, together with the Oklahoma Geological Survey, maintains one of the best Geology and Geophysics libraries in the country.
- Interdisciplinary programs with other departments are encouraged.

Basin Analysis Laboratory

Petroleum system analysis requires the integration of geology, geophysics, petrophysics, geochemistry, and risk analysis. The generated basin models either incorporate data obtained directly from outcrops around the world or complement the Seismic Stratigraphy Laboratory by generating virtual wells from the interpretative output and taking them an additional step. For basin analyses using data from around the world, this lab incorporates our own computer programs along with the industry standard software of both Schlumberger's Petrel petrophysical software and Platte River's 1D, 2D, and 3D BasinMod, BasinView, and BasinFlow. The subsequent dynamic basin models of the petroleum system criticals (petroleum maturation, migration, and accumulation controlling parameters) with an emphasis upon crustal tectonic analyses are geoconstrained from geochemistry in order to yield risked predictive models of a basin's geodynamic evolution and accompanying hydrocarbon prospectivity.

Electron Microprobe Laboratory

The electron microprobe laboratory is built around a fully automated Cameca SX50 microanalyzer. The five wavelength-dispersive spectrometers, a PGT PRISM 2000 energy-dispersive detector, and a GATAN PanaCL/F spectrophotometer are fully integrated for all analytical and imaging functions (secondary electron, backscattered electron, and cathodoluminescence signals). The system provides quantitative elemental microanalysis of boron to uranium; digital acquisition of electron, x-ray intensity, and visible luminescence images; image analysis and other data processing routines. See the Electron Microprobe Laboratory website for a full description of the laboratory and its functions.

Experimental Petrology Laboratory

The experimental petrology laboratory has facilities for mineral synthesis, calibration of phase equilibrium reactions, and petrologic analogue or simulation experiments. In addition to sample preparation facilities, the experimental laboratory contains 18 externally heated cold-seal reaction
vessels for routine operation to 850° C, 200 MPa, and two vessels capable of operation to 700° C, 400 MPa.

**Fluid Inclusion Micro-Thermometry Laboratory**
This facility is used to assess the compositions and physical properties of fluid inclusions through microthermometric techniques. In addition to specialized sample preparation equipment, the laboratory includes a new Linkam TH600 programmable heating/freezing stage on a Zeiss Research Photomicroscope.

**Poromechanics Institute**
The school participates with the Mewbourne School of Petroleum and Geological Engineering and the Sarkeys Energy Center in maintaining laboratories dedicated to characterization of deformation and measurement of rock properties. Pressure vessels and load frames are available to study a variety of problems of interest to structural geology and reservoir characterization such as acoustic imaging of the fracturing process, fault sealing mechanisms, and borehole stability.

**Institute of Reservoir Characterization**
Roger Slatt, Director of the Institute of Reservoir Characterization (IRC), brings expertise drawn from a 14-year career in the oil and gas industry with Cities Service Co. and ARCO/ARCO International, and focused on various aspects of reservoir characterization globally. He has also been a professor at Memorial University of Newfoundland, Arizona State University, and Colorado School of Mines. At the latter institution, he was Chair of the Department of Geology and Geological Engineering, and Director of the Rocky Mountain Region Petroleum Technology Transfer Council (PTTC). At the University of Oklahoma, he holds the positions of Gungoll Family Chair Professor in Petroleum Geology and Geophysics as well as Director of the IRC. He has published approximately 150 papers in scientific journals, written textbooks on Reservoir Characterization (Elsevier), Petroleum Geology of Deepwater Depositional Systems (AAPG), Argillaceous Rock Atlas (Springer-Verlag) and has been editor/co-editor of additional books. He teaches principles of reservoir characterization, clastic sequence stratigraphy, turbidite petroleum geology, and shale geology to international audiences as well as to OU students. He has graduated approximately 60 graduate students since coming to OU in 2000 as Director of the School of Geology and Geophysics (2000-2005). He has received numerous awards, including Best Paper at an AAPG convention, two Best Poster's at SEPM/AAPG conventions, Distinguished Education (AAPG), Special Commendation Award (SEG), and has been a Distinguished Lecturer for both AAPG and SPE.

**Instrumental Neutron Activation Analysis Laboratory**
The INAA laboratory contains gamma-ray spectrometers for the determination of rare-earth elements and other trace element abundances in neutron activated geological materials.

**Petroleum Geochemistry/Environmental Forensics/ Organic Geochemistry/Stable Isotope Laboratories**
The organic above-mentioned laboratories have state of the art wet chemistry facilities and instrumentation for the isolation and analysis of organic compounds from a wide variety of geologic materials.

Dr. Engel has two HPLC systems and a HP GC/MSD instrument used for the analysis of amino acids and peptides. He has a conventional stable isotope laboratory equipped with vacuum lines and a Delta E isotope ratio mass spectrometer for high precision stable carbon isotope analyses of organic matter and carbonates and stable oxygen isotope analyses of carbonates and water.

Dr. Engel also has a state of the art Thermo Delta V Plus isotope ratio mass spectrometer that is equipped for continuous flow as well as with a dual inlet for conventional off-line analyses. For continuous flow, the instrument is interfaced to a Costech Elemental Analyzer for stable carbon, nitrogen and sulfur isotope analyses and a Thermo TC/EA system for stable hydrogen isotope analyses. The instrument is also interfaced to a Thermo gas bench system for automated analyses of carbonates (carbon, oxygen) and water samples (oxygen).

Dr. Philp has a number of gas chromatographs with a variety of detectors for characterizing a wide variety of samples containing hydrocarbons, S and N containing compounds, as well as chlorinated compounds in environmental samples. In addition, he has two Agilent GCMS systems for analyzing organic compounds in many different types of samples and one of these instruments is also used for determination of chlorine isotope composition volatile chlorinated organic compounds. His laboratory also has an additional 3 gas chromatograph–isotope ratio mass spectrometer systems that are used to determine carbon and hydrogen isotope ratios of individual compounds in a wide range of samples related to both petroleum related samples and environmental forensic problems.

**Paleomagnetics Laboratory**
The paleomagnetic laboratory is located in a magnetically shielded room and contains a 2G cryogenic magnetometer with DC squids, an automated sample handler and alternating field demagnetizer, a thermal demagnetizer, two magnetic susceptibility systems, and an impulse magnetizer. Most of the studies performed in the lab focus on understanding remagnetization mechanisms, paleomagnetic dating of diagenetic events, and paleoclimate studies.

**Paleontology Laboratories, Sam Noble Oklahoma Museum of Natural History**
Paleontological research is concentrated at the Sam Noble Museum, which includes fully equipped labs for invertebrate paleontology, vertebrate paleontology and paleobotany. Large collection areas house more than half-a-million specimens. In addition to various specimen preparation equipment, there are facilities for scanning electron microscopy and digital macrophotography. Exhibits in the Ancient Life Gallery are fully integrated into undergraduate classes (GEOL 1024; GEOL 3513), and allow detailed study of fossils ranging from trilobites to dinosaurs.

**Sedimentology/Stratigraphy Laboratory**
The Sedimentology/Stratigraphy Laboratory at OU contains all the necessary equipment and facilities to conduct basic and advanced sedimentological and sedimentary geochemical studies. This equipment includes acid-resistant fume hoods, water purification, centrifuge, freeze dryer, furnace, vacuum filtration system, and rock crusher. More specialized equipment includes a Beckman-Coulter laser particle-size analyzer, a Bartington portable magnetic susceptibility meter, and several research grade petrographic and stereo microscopes, one of which is equipped with an automated point-count system and with digital image acquisition and analysis systems.

**Gas Hydrates Laboratory**
The Gas Hydrates Laboratory houses high pressure equipment necessary for forming CO2 and CH4 gas hydrates in situ, including two Parr reactors. Analytical equipment includes pressure transducers and
thermocouples for measuring the thermodynamics and kinetics of hydrate formation and dissociation, as well as polarized light microscopy for analyzing gas hydrate phases in fluid inclusion samples.

**Physical Geochemistry Laboratory**

The Physical Geochemistry Laboratory is dedicated to the study of the thermodynamics and kinetics of natural materials relevant to sediments, soils, and solutions on Earth and planetary bodies. Equipment includes Atomic Absorption Spectrometer (Perkin-Elmer 2380), analytical balances, furnaces, gas adsorption analysis for surface area and pore size distribution (Quantachrome Nova 2000), geochemical thermodynamic and reaction path modeling software (Geochemist’s Workbench), geochemical reactors of various types, ultracentrifugation, ultrapure water system (Barnstead Nanopure Diamond), UV-visible scanning absorption spectroscopy (Thermo Scientific Genesys 6).

**Structural Geology Labs**

The physical modeling laboratory is equipped with controlled hydraulic and electric displacement equipment. These are employed to exert a variety of displacement boundary conditions on models made of sand, clay or plaster. Most of the experiments done in this laboratory are directed toward studies of upper crustal deformation, primarily faulting and fracturing.

**Seismic Stratigraphy Laboratory**

This facility is a premier geophysical exploration and development research laboratory focused upon integrated seismic modeling, processing, and interpretation of seismic data worldwide. Such integration forms a prerequisite foundation for accurate seismic stratigraphic interpretation and of subsequent petroleum system analysis in the Basin Analysis Laboratory. Two-dimensional and three-dimensional seismic data include more than 100,000 km of industry-acquired marine and land seismic field, stacked, and migrated land and marine records from North America, South America, the Middle East, and Southeast Asia.

Two- and three-dimensional AVO modeling and inversion is conducted using our own algorithms as well as Hampson-Russell software. Seismic processing is conducted using Schlumberger’s Omega, the preeminent industry standard for commercial processing of 2D and 3D reflection seismic data, and subsequent interpretation incorporates Schlumberger’s Petrel software.

**Crustal Imaging Facility**

This facility provides a state-of-the-art geophysical computer environment for the integration of 2D and 3D modeling, data processing, interpretation, mapping and visualization of seismic reflection and georadar data, as well as petrophysical analysis and reservoir modeling as related to the data interpretation. The facility provides 22 workstation class PCs with dual monitors in a laboratory class room environment as well as a variety of Linux-based multicore servers for research and development. Industry level software for the PC lab includes Schumberger’s Petrel software for seismic data interpretation and reservoir modeling, the Hampson-Russell suite for geophysical analysis and Tesserai seismic modeling software. The Linux-based servers host Landmark’s ProMAX/SeisSpace software for 2D and 3D seismic data processing. The CIF is managed by a full-time system administrator.

**Devon Powder X-Ray Diffraction and Clay Mineralogy Laboratory**

The Devon lab includes equipment for the preparation and analysis of rock and mineral samples by powder X-ray diffraction, including clay mineral separations. A Rigaku Ultima-IV X-ray diffractometer features cross-beam optics, allowing rapid switching between Bragg-Brentano and parallel-beam optical configurations. Scintillation and Si-strip detectors are mounted with a Y-arm system that facilitates either extremely rapid or extremely precise data collection. The Ultima IV can also be configured for grazing incidence measurements of thin films on diffracting surfaces. Additionally, the lab is equipped for preparation of bulk rock samples, with tools such as a McCrone Micronizing mill, and for the treatment of rock samples for clay analysis, requiring a sequence of extraction steps involving a number of chemical and physical treatments. To accomplish the clay separations, the lab contains a centrifuge, a dialysis bath, desiccators, a drying oven, a furnace, a heating water bath, and a microbalance. For data analysis, updated software tools such as MDI Jade, MDI ClaySim, and Rigaku PDXL are interfaced with databases from the International Centre for Diffraction Data.

**The Youngblood Energy Library**

A gift to the University of Oklahoma in memory of a leading Oklahoma City oilman has created a spacious geology library ringing a two-story atrium in the heart of the Sarkeys Energy Center. This attractive new library space is named in honor of Laurence S. Youngblood.

The library collection began in the late 1800’s with the personal library of Charles N. Gould (one of the earliest university faculty members, the first geologist on the OU faculty, and the first director of the Oklahoma Geological Survey). Its growth was accelerated with the depositor status Gould established with the U.S. Geological Survey that continues today. During the 1950s and 1960s, numerous complete retrospective runs of foreign serials were acquired through the Farmington Plan (a federal program to acquire literature in specific fields for libraries of identified excellence). Via the Oklahoma Geological Survey’s domestic and international exchanges, publications are acquired in several languages from nations around the world.

The current collection contains over 170,000 map sheets and approximately 99,000 catalogued volumes on the subjects of geochemistry, geology, geomorphology, geophysics, hydrology, mineralogy, paleontology, petrology stratigraphy, structure and tectonics. The interdisciplinary nature of the Earth sciences is supported by chemistry, math, physics and engineering branch libraries. Bizzell Memorial Library contains the biological sciences and the internationally recognized History of Science Collection.

**Field Courses**

To geologists and geophysicists, Planet Earth is a natural laboratory. Thus, it is important that students devote a portion of their academic careers to exploring and studying aspects of the Earth away from the OU campus. Field trips in geology are offered in the central and western U.S. as well as a senior-level geology field camp in Colorado, and faculty members involve students in their active field research programs around the world.

**Research Opportunities**

Faculty-supervised research is an important component of the School of Geosciences graduate program. Most graduate students are supported.
financially through research assistantships funded by federal and private industry grants and contracts. Other graduate students are financially supported through teaching assistantships awarded by their academic unit. In either case, faculty-supervised student research leads to master's theses and doctoral dissertations as part of the overall graduate degree requirements. This research is often published in scientific journals which may be useful in assisting graduates to obtain employment. Talented undergraduate students are encouraged to work with faculty on research projects. These student research projects can be an important component of the Honors Program and/or a source of part-time income and scholarship support. Such research participation provides the student with important experience in his or her discipline in addition to meeting normal academic requirements.

Career Opportunities
According to the National Science Foundation, there are approximately 125,000 geologists and geophysicists at work in the United States today. Most are employed by private industry as petroleum geologists and geophysicists whose work is vital to oil and gas companies. Other geologists and geophysicists work for mining companies to locate ore deposits and estimate reserves. Geologists are also employed in other commercial fields such as cement and ceramic industries; sand and gravel firms; railroads; engineering companies; environmental agencies and in the banking industry. The largest single employer of geoscientists in the U.S. is the federal government. Most work for the United States Geological Survey, but others work for the U.S. Department of Energy national laboratories, Soil Conservation Service, Bureau of Land Management, Environmental Protection Agency, National Aeronautics and Space Administration, National Park Service, Bureau of Mines, Forest Service, or the U.S. Army Corps of Engineers. Many geoscientists work for the 50 state geological surveys. Colleges and universities employ about 8,000 geoscientists in teaching and research positions. Many geoscientists are self-employed. Some are independent oil operators; others work as consultants. Most consultants have acquired prior experience in industry, teaching or research. Opportunities also now exist in public school teaching.

The curricula for the Bachelor of Science in Geology and the Bachelor of Science in Geophysics are designed to provide the necessary preparation for professional work or graduate study. Options are available in petroleum geology, environmental geology, paleontology, and in exploration geophysics.

The Master's Degree in Geology or Geophysics is designed to provide a professional level degree for industry employment. Traditionally, this degree level has been favored by major petroleum companies.

The Ph.D. in Geology is a research-oriented degree which provides students the opportunity to seek employment in a variety of areas including academia, industry and government.

Undergraduate Employment Opportunities
Geology and geophysics students are eligible to participate in research projects and part-time employment opportunities with faculty members. Other opportunities for research and employment exist at the Oklahoma Geological Survey and the Youngblood Energy Library.

Financial Support — Graduate Studies
Several types of financial aid are available to students on a competitive basis. Prospective graduate students are considered automatically for financial aid at the time of application. The school offers annually approximately 20 teaching assistantships with stipends which include a partial waiver of tuition. International students are required to pass an English language proficiency exam (administered by the English Assessment Program) before they can hold a teaching assistantship. Additionally, the school awards several research assistantships and fellowships using funds from industrial and other private sources. Funds for graduate support are also available from the Oklahoma Geological Survey, and the Institutes of the Sarkeys Energy Center. Grant-supported research assistantships are available through faculty conducted federal, foundation- or industry-sponsored research. These assistantships carry a stipend comparable to teaching assistantships. Ph.D. students are encouraged to write research proposals with their graduate advisors for financial support and to apply for National Science Foundation Graduate Fellowships.

Undergraduate Study
GEOLOGY Bachelor of Science Programs
These curricula are designed to provide the necessary background for professional work or graduate studies in geology and allied sciences.

• Environmental Geology, Bachelor of Science
• Geology, Bachelor of Science
• Paleontology, Bachelor of Science
• Petroleum Geology, Bachelor of Science

GEOPHYSICS, Bachelor of Science
The Geophysics, Bachelor of Science curriculum constitutes a preparation for professional work and also provides the necessary background for graduate work in geophysics and geology.

Minor
The Geology Minor provides complimentary knowledge for students enrolled in all majors at the University of Oklahoma. The minor should give students a broad overview of Geology and the variety of subset topics within the field.

Graduate Study
The School of Geosciences offers the Master of Science and Doctor of Philosophy degrees. Some important aspects of these degree programs are described below.

Master of Science
The Geology, Master of Science and the Geophysics, Master of Science degree programs are intended primarily for those students who plan careers in the petroleum or minerals industries or with state and federal government agencies. The goal of the M.S. degree program is to prepare students by providing a broad background in the Earth sciences and related science and engineering fields through coursework; and encouraging critical thinking and analysis in the solution of geological and geophysical problems through independent thesis research.

Doctor of Philosophy
The Ph.D. degree programs in geology and geophysics are intended primarily for those students who plan research careers in the earth sciences in universities, industry or government agencies. The goals of the Ph.D. degree program are to prepare the student for a career in research by providing coursework in an area of specialization in geology or geophysics, provide a strong background in allied fields such as mathematics, physical science, biological science, and engineering to give the student the necessary tools to conduct original and significant
geological research; and encourage critical thinking and analysis of geological problems through the design of original research projects.

The Ph.D. degree normally requires a minimum of three years beyond the M.S. degree. The Graduate College at the University of Oklahoma requires 90 post-baccalaureate semester hours of coursework. Generally, the first year of residence is devoted primarily to coursework in preparation for the general examination; the remaining two years are devoted to both coursework and research. There are no specified course requirements for the Ph.D. degree in Geology. Rather, a coursework program is designed for each student in consultation with a doctoral committee composed of at least five graduate faculty members, including at least one from outside the major department within the University and one member outside the University. The Ph.D. in Geophysics has specific core requirements which will be determined by the faculty advisor. The purpose of the coursework is to prepare the student for the general examination, which tests the mastery of the field of specialization and related fields as well as the capacity for synthesis, sound generalization, and critical thinking. The examination consists of a written section in the major field of study, written sections in related fields, and oral defense of an original research proposal. Frequently, the original research proposal is the student’s dissertation topic.

The dissertation is the culmination of an original research project in the student’s field of specialization and should make a significant contribution to scientific understanding in the field. Normally, the student works closely with the faculty advisor in the design and execution of the research project. The student and the advisor may submit proposals to foundations or industry for financial support to carry out the research, and they report the results of the research at regional, national and international meetings and in papers published by national and international journals.

A graduate degree candidate in geology and geophysics must present the results of their dissertation research at a Graduate Colloquium of the School of Geosciences before they may schedule the final oral examination.

Courses

GEOL 1003 Volcanoes and Earthquakes 3 Credit Hours
Prerequisite: high school chemistry and algebra. Worldwide distribution of volcanic and earthquake activity; types of volcanic eruptions and associated landforms and rocks; causes of and techniques for location of earthquakes; prediction of volcanic eruptions and earthquakes; social consequences of predictions and actual volcanic and earthquake activity. (F, Sp) [II-NL].

GEOL 1013 Global Environmental Change 3 Credit Hours
Relationship between humanity and the environment from an intellectual and historical perspective. Principle of progress and the Industrial Revolution, the Enlightenment and Francis Bacon, the noble savage, conservation and land ethics. Malthusians and Cornucopians, the Gaia Hypothesis, risk analysis, global warming, fossil fuels and alternative energy sources. (Sp)

GEOL 1024 The History of the Earth and Life 4 Credit Hours
The origin of the Earth and solar system. Rocks and minerals; geologic time; plate tectonics and continental drift. The ocean-atmosphere system; climate change over time; biological evolution. The fossil record of early life; the ‘Cambrian Explosion’ of life in the oceans; invertebrate animals and their geological history. Geological history of fishes; evolution of plants. Terrestrial vertebrates, including dinosaurs and mammals. Mass extinctions; human evolution; impact of human activities on the global environment and the biosphere. No student may earn credit for both GEOL 1024 and GEOL 1124. (Sp) [II-LAB].

GEOL 1033 Earth, Energy, Environment 3 Credit Hours
Exploring human utilization of Earth's geological energy resources; formation and composition, extraction and use, and environmental impacts. The primary focus will be geologically sourced fuels (oil, gas, shale gas / fracking/ earthquakes, tar sands), coal, nuclear, geothermal, etc.; discussion of renewables (solar, wind, etc.) will also be included. (Sp) [II-NL].

GEOL 1034 Native Science and Earth Systems of North America 4 Credit Hours
(Crosslisted with METR 1034) Examines Earth systems of North America using both indigenous and Western perspectives, and an Earth science approach. This team-taught course will utilize a combination of geology, geography, meteorology, and Native American sciences, as expressed through the use of art. (Sp) [II-LAB].

GEOL 1104 The Dynamic Earth (Geology for non-Science Majors) 4 Credit Hours
Introduction to the fundamentals of geology and their application to land-use, groundwater, mineral use and fossil fuel problems facing society. Several guest lecturers from industry and state and federal surveys will contribute to the content of the course. Laboratory fee. Three hours lecture, two hours lab. Laboratory. (F, Sp) [II-LAB].

GEOL 1114 Physical Geology for Science and Engineering Majors 4 Credit Hours
Prerequisite: equivalent knowledge of high school chemistry, algebra and trigonometry. Laboratory included. Plate tectonics, the makeup of continents and mountain building. Heat flow, magnetism, gravity, rock deformation, earthquakes and the earth’s interior. Surface processes including weathering, erosion, transport and deposition. Landforms, rivers, groundwater, glaciers, ocean processes, and volcanoes. Minerals and rocks. Application of geology to land-use, groundwater, mineral and fossil fuel exploration. Laboratory. (F, Sp) [II-LAB].

GEOL 1124 Earth History 4 Credit Hours
Prerequisite: none; 1114 helpful but not required. Laboratory included; field trip. Physical history of the earth from its origin as a planet through the Great Ice age. Origin and growth of continents and ocean basins. Systematic survey of the history of continents with emphasis on North America: growth and leveling of mountain chains, rift valleys, transgressions and regressions of seas; continental fragmentation, assembly and relative motions. Plate tectonics, particularly as it relates to continent history. Climate and evolutionary changes through geologic time. Principles and methods used to interpret earth history and date rocks. Geologic time. Laboratory includes historical studies of specific regions; study of maps and fossils. Laboratory (F, Sp)
GEOL 1203 The Age of Dinosaurs 3 Credit Hours
Crosslisted with BIOL 1203. Introduction to basic principles and theories in biology (evolution, systematics, vertebrate morphology and relationships) and geology (geologic time, earth history, plate tectonics, sedimentation and stratigraphy), focusing on the evolutionary history of Dinosaurs. May not be counted for major coursework in Biology or Geology. (F) [II-NL].

GEOL 2014 The Earth System 4 Credit Hours
An integrated overview of earth sciences emphasizing earth materials, the oceans and atmosphere, the solar system, and earth's evolution. The interrelationship among the different earth systems will be emphasized. Topics will be explored through a learning-cycle approach. The lab component includes both in-class experiments and one field-based research project. Laboratory (Sp) [II-LAB].

GEOL 2224 Introduction to Mineral Sciences 4 Credit Hours
Prerequisite: CHEM 1315, MATH 1914 or 2423 and any 1000-level GEOL course. Main topics include crystal chemistry, optical properties and identification of minerals utilizing the petrographic microscope, mineral stability, crystal symmetry, and an introduction to the rock-forming minerals and their environments of formation. Laboratory (F; Sp).

GEOL 2970 Special Topics 1-3 Credit Hours
1 to 3 hours. Prerequisite: May be repeated; Maximum credit nine hours. Special topics course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research, and field projects. (Irreg.)

GEOL 3003 Structural Geology and Stratigraphy for Petroleum Engineers 3 Credit Hours
Prerequisite: 1114, Physics 2524 or concurrent enrollment. Treatment of structural and stratigraphic geology with an emphasis on aspects of importance to petroleum engineering. Includes an investigation of mechanical principles relating to the earth's crust, descriptive study of nomenclature, causes of tectonic deformation, sedimentary processes and environments, and stratigraphic principles. Laboratory. (Sp).

GEOL 3013 The Geology of Oklahoma 3 Credit Hours
Prerequisite: junior standing or permission of instructor. Provides an overview of geology emphasizing earth materials, surface processes, natural hazards, and the earth's evolution using Oklahoma as our natural laboratory. The course emphasizes problem solving and includes impact of anthropogenic changes and resources extraction. Required field trip. Grading based on exams, research paper and in-class exercises. (F) [II-NL].

GEOL 3023 The Geology of Natural Resources in Sub-Saharan Africa 3 Credit Hours
Prerequisite: Junior standing and one Natural Science General Education course 1000-level or higher, or instructor permission. Content will include the carbon cycle, rock/tectonic cycle, and water/climate cycle. Students will explore, through data analysis, processes that lead to the formation, distribution and variation of fossil fuels, mineral deposits, and lake and grassland ecosystems. These concepts will be highlighted through Oil/Gas Development, Mineral Mining, Land-use and Climate Change. (Fall) (F) [II-NL].

GEOL 3033 Earth Resources and the Environment 3 Credit Hours
Prerequisites: junior standing or permission of instructor. A geological perspective on Earth's water, energy, soil, and mineral resources, including their past, present, and potential future impact on society. By examining intersections between Earth resources and society, we will investigate the nature of science, role of science and scientists in society, evaluate scientific versus non-scientific sources of information, and communicate appropriately using scientific sources of information. (Sp) [II-NL].

GEOL 3063 Exploring Planetary Worlds 3 Credit Hours
Prerequisite: Six credits of introductory (1000 or 2000-level) natural science coursework; permission of instructor or department. Topics will include solar system and planet formation, planetary materials, and geologic processes that likely formed planetary features we observe today. Students will design a rover, lander, orbiter, or fly-by mission to gather data and test key hypotheses on a selected Planetary Body. Students will present on mission concept, including an outreach plan, in a written proposal and group presentation. (F) [II-NL].

GEOL 3114 Structural Geology 4 Credit Hours
Prerequisite: 2224, Physics 2524 or concurrent enrollment. An introduction to the concepts of stress, strain, the mechanisms of rock deformation, the mechanics of folding and fracturing, and description of structural styles in various tectonic settings. Laboratory. (F).

GEOL 3123 Introductory Field Geology 3 Credit Hours
Prerequisite: 2224, 3114, and 3223 or 3233, or permission (completed laboratory). Techniques of geologic fieldwork including: measuring stratigraphic sections, airphoto analysis, mapping, total station, writing reports. Course includes 10-12 field days in Oklahoma (during weekends) and a weekly laboratory. Students will be charged transportation costs. (Sp).

GEOL 3154 Environmental Geology 4 Credit Hours
Prerequisite: GEOL 1104 or GEOL 1114 or permission. Focuses on the reciprocal interactions between human activities and geological processes, especially soil properties, resource utilization, and geological hazards. Laboratory provides an introduction to techniques and skills relevant to environmental geology. Laboratory; field trip. (Sp).

GEOL 3223 Igneous and Metamorphic Petrology 3 Credit Hours
Prerequisite: 2224 or permission. Laboratory included. Field trip; students will be charged transportation costs. Generation, emplacement and crystallization of magma; phase chemistry; principles of igneous rock classification; the relationship of magma types to geologic setting. Principles of metamorphic petrology; phase chemistry and metamorphic reactions; concepts of metamorphic grade, P-T regimes and relationships to geologic environments; concepts of protoliths and provenance. Laboratory study of the textures, structures and mineral assemblages of igneous and metamorphic rocks utilizing hand specimens and thin sections. Laboratory. (Sp).

GEOL 3233 Sedimentary Petrology and Sedimentology 3 Credit Hours
Prerequisite: 2224 or permission. Laboratory included. Field trip; students will be charged transportation costs. Origin, evolution and interpretation of sedimentary rocks with an emphasis on terrigenous systems; interpretation of mineralogy, textures and structures of terrigenous clastic and carbonate rocks in hand specimen and thin section. Laboratory. (Sp).
GEOL 3333  Geowriting  3 Credit Hours
Prerequisite: English 1113 and English 1213 or Expository Writing 1213. Provides student with the information and skills needed to effectively communicate as professional geoscientists. Students will actively engage in writing and scientific communication exercises through in-class activities, weekly assignments, and semester-long projects. Substitutes for English 3153. (alt. F)

GEOL 3440  Mentored Research Experience  3 Credit Hours
0 to 3 hours. Prerequisites: ENGL 1113 or equivalent, and permission of instructor. May be repeated; maximum credit 12 hours. For the inquisitive student to apply the scholarly processes of the discipline to a research or creative project under the mentorship of a faculty member. Student and instructor should complete an Undergraduate Research & Creative Projects (URCP) Mentoring Agreement and file it with the URCP office. Not for honors credit. (F, Sp, Su)

GEOL 3513  Fundamentals of Invertebrate Paleontology  3 Credit Hours
Prerequisite: GEOL 1114 or GEOL 1024 or BIOL 1114 or permission of instructor. Fossil preservation and bias in the fossil record. Ontogeny and growth of invertebrates. Interpretation of the life habits of fossil organisms, with case histories from invertebrates and vertebrates. Speciation and macroevolution. Paleoecology of marine communities. Mass extinctions and mass extinctions in the fossil record. Biostatigraphic Laboratory covers classification, morphology and ecology of the major invertebrate fossil groups. Laboratory (F)

GEOL 3633  Introduction to Oceanography  3 Credit Hours
General survey of the scientific framework of the four specializations of the oceanographic study. Biological, chemical, geological/geophysical, and physical oceanography. Applications of ocean research to social and economic problems; interrelations between the ocean disciplines and other fields of study. (Sp) [II-NL].

GEOL 3960  Honors Reading  1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. Consists of topics designated by the instructor in keeping with the student's major program. Covers topics not usually presented in the regular courses. (F, Sp, Su)

GEOL 3970  Honors Seminar  1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. Subjects covered vary. Deals with concepts not usually treated in regular courses. (Irreg.)

GEOL 3980  Honors Research  1-3 Credit Hours
1 to 3 hours. Prerequisite: Admission to Honors Program. May be repeated; maximum credit six hours. Will provide an opportunity for the gifted Honors candidate to work at a special project in the student's field. (F, Sp, Su)

GEOL 3990  Independent Study  1-3 Credit Hours
1 to 3 hours. Prerequisite: permission of instructor and junior standing. May be repeated once with change of content. Independent study may be arranged to study a subject not available through regular course offerings. (F, Sp, Su)

GEOL 4001  Colloquium Series  1 Credit Hour
Prerequisite: Departmental Permission. May be repeated for credit, maximum credit 9 hours. Departmental seminar series which will host a new guest lecturer, faculty member or student presenter each week. These lectures will provide greater exposure to scholarly work within the field of Geology and Geophysics, along with providing a platform for discussion and department interaction. All department scholarship students are required to enroll in this course each semester. (F, Sp)

GEOL 4113  Depositional Systems and Stratigraphy  3 Credit Hours
(Slashlisted with GEOL 5113) Prerequisite: Senior Standing, GEOL 3233, and GEOL 3114 or concurrent enrollment. Basic stratigraphic principles as well as reconstruction of ancient depositional systems. The controls (climatic, tectonic, eustatic) on deposition of stratigraphic sequences, stratigraphic completeness, biostatigraphy, magnetostratigraphy, and sequence stratigraphy. Field trip; students will be charged transportation costs. No student may earn credit for both 4113 and 5113. Laboratory. (F)

GEOL 4133  Petroleum Geology for Geoscientists  3 Credit Hours
Prerequisite: GEOL 3233 and GEOL 3114, majors only. Addresses the origin and distribution of conventional and unconventional petroleum resources, the petroleum system, source rocks, traps and seals, reservoir rock properties, and exploration and development methods. (F)

GEOL 4136  Field Geology  6 Credit Hours
Prerequisite: 3123; senior standing or permission. A six-week summer course held at the Oklahoma Geology Camp at Canon City, Colorado. Applications of field techniques, including use of aerial photographs, construction of geological maps and geophysical methods, to the recognition and interpretation of geologic phenomena. (Su) [V].

GEOL 4143  Petroleum Geology for Business Majors  3 Credit Hours
Prerequisite: 1104 or 1114. The integration of several fields of geology with geochemistry, geophysics, and engineering to provide an overview of the science and technology used in the exploration for and development of oil and natural gas fields. Briefly covers historical development of petroleum geology, environmental impact, and location of the world's major oil and gas reserves, and future potential for conventional and non-conventional hydrocarbon resources. (F)

GEOL 4204  Vertebrate Paleobiology  4 Credit Hours
(Slashlisted with 5204; Crosslisted with BIOL 4204) Prerequisite: BIOL 1114 and 1121, or 1124, or 1134, or permission of instructor. Systematics, relationships, zoogeography and evolutionary morphology of the major groups of vertebrates. Field trips. Laboratory. No student may earn credit for both 4204 and 5204. (Sp)

GEOL 4213  Earth System History  3 Credit Hours
Prerequisite: 4113 or concurrent enrollment; or permission of instructor. Provides an earth system perspective to earth history that emphasizes tectonic, climatic and biotic interactions throughout geologic time. No student may earn credit for both 4213 and 5213. (F)

GEOL 4223  Principles of Geochemistry (Slashlisted with GEOL 5223) 3 Credit Hours
Prerequisite: 2224, Chemistry 1315, and 1415. Experience with calculus recommended. Overview of major topics in geochemistry, emphasizing thermodynamics and kinetics within the context of natural systems. Additional topics will include nucleosynthesis and cosmochemistry, bulk Earth geochemistry, chemistry and bonding of natural materials, solutions and mineral solubility, redox processes, interfacial geochemistry, and isotope geochemistry. No student may earn credit for both 4223 and 5223. Laboratory (Alt. Sp)

GEOL G4233  Subsurface Methods  3 Credit Hours
Prerequisite: GEOL 4133 and majors only. Addresses the concepts and methods of subsurface petroleum analysis. The petroleum system is evaluated through geological, petrophysical, subsurface mapping, and 3-D reservoir modeling methods using drill cuttings, core, well logs, production data, and 3-D seismic data. (Sp)
GEOL 4373  History of Geology  3 Credit Hours
Prerequisite: junior standing. History of science and the scientific method with an emphasis on geology. Greek science, scholasticism, Copernican revolution Francis Bacon, principle of uniformity, evolution, continental drift, climate, progress. Discussion of writings by Plato, Geike, Kuhn, Popper, Chamberlin, Gilbert, Hubbert and others. No student may earn credit for both 4373 and 5373. (F) [IV-WC].

GEOL 4513  Evolutionary Paleobiology  3 Credit Hours
(Slashlisted with 5513) Prerequisite: 3513. Evolutionary patterns in the fossil record. Time resolution and bias in fossil assemblages. Taxonomic diversity and community replacement over geologic time. Mass extinctions and evolutionary radiations. Heterochrony and evolution. Application of methods in biosystematics to fossils, including computer-based techniques. No student may earn credit for both 4513 and 5513. (Alt. Sp)

GEOL 4533  Earth's Past Climate  3 Credit Hours
(Slashlisted with GEOL 5533; Crosslisted with METR 4533) Prerequisite: senior or graduate standing, or permission of instructor. Explores earth's climate system, controls on climate change, and evolution of climate history through geologic time as deciphered from climate proxies. No student may earn credit for both 4533 and 5533. (F)

GEOL 4633  Hydrogeology  3 Credit Hours
Prerequisite: MATH 2924 or MATH 2443, PHYS 2524, senior standing in geology, or permission of instructor. Darcy's law, Hubbert's fluid potential, equations of groundwater flow. Physical properties of geologic materials and fluids. Free convection, compaction- and gravity-driven flow. Role of fluids in geologic phenomena, including mineralization, metamorphism, hydrocarbon migration, sedimentary diagenesis, faulting and earthquakes, paleomagnetism. Application of geophysical and geophysical techniques to fluid flow problems. (F)

GEOL 4923  Pegmatites  3 Credit Hours
(Slashlisted with GEOL 5923) Prerequisite: GEOL 3223, CHEM 1415, and permission of instructor. Granitic pegmatites are the most complex rocks on earth. Class instructs students in the use of scientific methods, including historical background, working hypotheses, analytical methods, experimental test, and theory as they are utilized in solving the origins of pegmatites. No student may earn credit for both 4923 and 5923. (Sp)

GEOL 4960  Directed Readings  1-4 Credit Hours
1 to 4 hours. Prerequisite: good standing in University; permission of instructor and dean. May be repeated; maximum credit four hours. Designed for upper-division students who need opportunity to study a specific problem in greater depth than formal course content permits. (Irreg.)

GEOL 4970  Seminar  3 Credit Hours
1 to 3 hours. Prerequisite: permission. May be repeated; maximum credit nine hours. (F, Sp)

GEOL 4983  Senior Thesis in Geology  3 Credit Hours
Prerequisite: senior standing with a major in geology and permission. May not be repeated. Individual research of a geological topic selected by the student in consultation with the instructor. The project may involve fieldwork, theoretical analysis, computer modeling, and/or data analysis and interpretation, culminating in a written thesis. (F, Sp, Su)

GEOL 4990  Independent Study  1-3 Credit Hours
1 to 3 hours. Prerequisite: three courses in general area to be studied; permission of instructor and department. May be repeated; maximum credit nine hours. Contracted independent study for topics not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. (F, Sp, Su)

GEOL 5003  Diagenesis  3 Credit Hours
Prerequisite: 26 hours of geology or geophysics or permission. Origin and interpretation of diagenetic features of sedimentary rocks, including porosity, permeability, fluid flow, compaction and cementation. Geochemical approaches are stressed. Laboratory. (Irreg.)

GEOL 5010  Paleomagnetism/Diagenesis Seminar  1-2 Credit Hours
Prerequisite: Senior or graduate standing; GPHY 5364 suggested. Seminar includes presentations by the professor on research topics as well as presentations by students on papers they read. In addition, each student will also make at least one presentation on their research. Also, students will work through a self-instruction lab with the microscopes. Focuses on recognizing diagenetic features that are important for paleomagnetism. May be taken for a total of six credit hours. (F, Sp)

GEOL 5020  Sedimentology and Stratigraphy Seminar  1-3 Credit Hours
Prerequisite: graduate standing. May be repeated with change of content; maximum credit twelve hours. Directed seminar on selected aspects of sedimentology and stratigraphy. (F, Sp)

GEOL 5113  Depositional Systems and Stratigraphy  3 Credit Hours
(Slashlisted with GEOL 4113) Prerequisite: Graduate Standing, GEOL 3233, and GEOL 3114 or equivalent. Basic stratigraphic principles as well as reconstruction of ancient depositional systems. The controls (climatic, tectonic, eustatic) on deposition of stratigraphic sequences, stratigraphic completeness, biostratigraphy, magnetostratigraphy, and sequence stratigraphy. Field trip; students will be charged transportation costs. No student may earn credit for both 4113 and 5113. Laboratory. (F)

GEOL 5173  Clastic Facies  3 Credit Hours
Prerequisite: 3233 or 4113 or equivalent. Bedforms, sedimentary structures, flow regime, intrinsic versus extrinsic controls on sedimentation, ancient depositional environments and depositional models (alluvial fan, fluvial, deltaic, lacustrine, eolian, shelf, etc.). (F)

GEOL 5204  Vertebrate Paleobiology  4 Credit Hours
(Slashlisted with 4204; Crosslisted with BIOL 5204) Prerequisite: graduate standing and permission of instructor. Systematics, relationships, zoogeography, and evolutionary morphology of the major groups of vertebrates. Field trips. Laboratory. No student may earn credit for both 4204 and 5204. (Sp)

GEOL 5213  Earth System History  3 Credit Hours
Prerequisite: graduate standing or permission of instructor. Provides an earth system perspective to earth history that emphasizes tectonic, climatic and biotic interactions throughout geologic time. No student may earn credit for both 4213 and 5213. (F)

GEOL 5223  Principles of Geochemistry (Slashlisted with 4223)  3 Credit Hours
Prerequisite: graduate standing or permission of instructor. Overview of major topics in geochemistry, emphasizing thermodynamics and kinetics within the context of natural systems. Additional topics will include nucleosynthesis and cosmochemistry, bulk Earth geochemistry, chemistry and bonding of natural materials, solutions and mineral solubility, redox processes, interfacial geochemistry, and isotope geochemistry. No student may earn credit for both 4223 and 5223. Laboratory (Alt. Sp)

GEOL 5343  Stable Isotope Geochemistry  3 Credit Hours
Prerequisite: Chemistry 1315, 1415; senior or graduate standing. Focuses on the stable isotopes of light elements (C, H, O, N, S) in the various processes that have resulted in their redistribution over geologic time. (Alt. F)
GEOL 5353  Carbonates and Sequence Stratigraphy  3 Credit Hours
Prerequisite: Senior undergraduate or graduate standing and permission of instructor. Sedimentology, sequence stratigraphy, paleo-climate, and reservoir attributes of Paleozoic carbonate (and associated eolian, fluvial and deep-water siliciclastics) of the classic Permian basin region. A highlight is a major field trip to world-class exposures in the Sacraments (NM) and Guadalupe (TX) mountains. (Irreg.)

GEOL 5363  Carbonate Geology  3 Credit Hours
Prerequisite: 26 hours of geology and geophysics, or permission. Students will be charged field trip costs. Petrology and petrography of modern and ancient chemical rocks, the reconstruction of their physical/chemical depositional and diagenetic environments in time and space; applied interpretation of cores, petrophysical logs, and seismic; five-day field trip to the Florida Keys. (Irreg.)

GEOL 5413  Paleobotany  3 Credit Hours
Prerequisite: permission of instructor. Introduction to the fossil record of terrestrial plants from algae to flowering plants. Lectures will address anatomy, morphology, taphonomy and paleoecology, including climate and plant-animal interactions. Laboratories will put lecture topics into practice using fossil plants from the Oklahoma Museum of Natural History collection and from fieldwork. Field trips. No student may earn credit for both 4413 and 5413. Laboratory. (Sp, even-numbered years)

GEOL 5513  Evolutionary Paleobiology  3 Credit Hours
(Slashlisted with GEOL 4513) Prerequisite: 3513. Evolutionary patterns in the fossil record. Time resolution and bias in fossil assemblages. Taxonomic diversity and community replacement over geologic time. Mass extinctions and evolutionary radiations. Heterochrony and evolution. Application of methods in biosystematics to fossils, including computer-based techniques. No student may earn credit for both 4513 and 5513. (Alt. Sp)

GEOL 5533  Earth’s Past Climate  3 Credit Hours
(Slashlisted with GEOL 4533; Crosslisted with METR 5533) Prerequisite: senior or graduate standing, or permission of instructor. Explores earth’s climate system, controls on climate change, and evolution of climate history through geologic time as deciphered from climate proxies. No student may earn credit for both 4533 and 5533. (F)

GEOL 5543  Minerals and the Environment  3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. Explores the bonding and reactivity of common environmental minerals, as well as laboratory methods in environmental mineral analysis, including diffraction, microscopy, and spectroscopy. (F)

GEOL 5633  Field Methods in Hydrogeology  3 Credit Hours
Prerequisite: GEOL 4633 and senior standing or graduate standing in Geology, Civil Engineering, Geography & Environmental Sustainability, or Environmental Science, or permission of instructor. This course provides students with a hands-on introduction to commonly used field methods in hydrogeology. Some aspects of surface hydrology will also be covered. Field-focused exercises in well installation, slug testing, aquifer testing, water sampling (of organic and inorganic constituents), in-situ measurement of water quality parameters, surface water discharge measurement techniques, and geophysical methods are covered. (F)

GEOL 5733  Sedimentation and Tectonics  3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. Provides a basic understanding of the coupling between tectonics and sedimentation, including how the composition, geometry, and stacking of sedimentary deposits are influenced by spatial and temporal changes in tectonics. Course content is delivered through a series of basic lectures outlining fundamental concepts, followed by discussion-based analyses of primary literature that highlights fundamental couplings between sedimentation and tectonics. (F)

GEOL 5813  Basin Analysis for Oil and Gas  3 Credit Hours
Prerequisite: permission. Development of exploration guidelines to oil and gas (origin, migration, accumulation) based on regional tectonic styles and related time and place associations of structure, sedimentation, heat history and fluid pressures. Laboratory. (F)

GEOL 5853  Groundwater and Seepage  3 Credit Hours
(Crosslisted with CEES 5853) Prerequisite: graduate standing in civil engineering, environmental science or geology or permission. An applied course dealing with properties of aquifers, modeling of groundwater flow, groundwater hydrology and its interrelation with surface water, well hydraulics, pumping tests and safe yield of aquifers. (F)

GEOL 5923  Pegmatites  3 Credit Hours
(Slashlisted with GEOL 4923) Prerequisite: GEOL 3223, CHEM 1415, and permission of instructor. Granitic pegmatites are the most complex rocks on earth. Class instructs students in the use of scientific methods, including historical background, working hypotheses, analytical methods, experimental test, and theory as they are utilized in solving the origins of pegmatites. No student may earn credit for both 4923 and 5923. (Sp)

GEOL 5960  Directed Readings  1-3 Credit Hours
1 to 3 hours. Prerequisite: graduate standing and permission of department. May be repeated; maximum credit twelve hours. Directed readings and/or literature reviews under the direction of a faculty member. (F, Sp, Su)

GEOL 5970  Special Topics/Seminar  3 Credit Hours
1 to 3 hours. Prerequisite: Graduate standing or permission of instructor. May be repeated; maximum credit nine hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research and field projects. (Irreg.)

GEOL 5980  Research for Master's Thesis  2-9 Credit Hours
Variable enrollment, two to nine hours; maximum credit applicable toward degree, four hours. (F, Sp, Su)

GEOL 5990  Special Studies  1-3 Credit Hours
1 to 3 hours. Prerequisite: permission. May be repeated; maximum credit nine hours. Advanced special studies in geological problems. May include directed reading in geology, fieldwork, laboratory research or preparation of reports. (F, Sp, Su)

GEOL 6103  Petroleum Geochemistry  3 Credit Hours
Prerequisite: graduate standing in geology or chemistry. An introduction to the basic concepts of petroleum geochemistry and their role in exploration. Includes the biomarker concept, pyrolysis techniques, isotopes in petroleum exploration, basin modeling and kinetic studies, organic petrography and detailed studies of a number of case histories. (Irreg.)

GEOL 6283  Seismic Reservoir Modeling  3 Credit Hours
(Crosslisted with P E 6283) Prerequisite: graduate standing or permission of instructor. This course is designed to explore the seismic response of rocks and how it is related to petrophysical parameters. This understanding is key to interpretation of seismic data in terms of subsurface rocks and fluids. (F)
GEOL 4653  **Topics in Petrology and Plate Tectonics**  3 Credit Hours
Prerequisite: graduate standing, GEOL 3114, GEOL 3223, and GEOL 3233. May be repeated with change of subject matter; maximum credit six hours. Geological processes at plate margins with emphasis on the relationship between structural and petrologic features; plate kinematics and petrotectonic associations; the origin of mountain belts, basins, and rock suites at convergent, divergent, and transform boundaries. (Irreg.)

GEOL 6633  **Aqueous Geochemical Modeling**  3 Credit Hours
Prerequisite: Graduate standing in geology, civil engineering, environmental science, or other program with permission of instructor, and GEOL 5223/4223. Provides an interactive platform to improve our understanding of complex biogeochemical reactions and processes in natural systems. Course will cover the mathematical and thermodynamic basis for widely used geochemical modeling programs including PHREEQC, Visual MINTEQ, and Geochemists Work Bench (GWB). Various types of modeling approaches will be explored using geochemical data representative of real work applications. (Sp)

GEOL 6950  **Research**  1-4 Credit Hours
1 to 4 hours. Prerequisite: graduate standing and permission of faculty supervisor. May be repeated with change of content; maximum credit twelve hours. Individual research in various areas of geology. (F, Sp, Su)

GEOL 6960  **Directed Readings**  1-6 Credit Hours
1 to 6 hours. Prerequisite: graduate standing and permission of faculty supervisor. May be repeated; maximum credit six hours. Supervised reading at an advanced graduate level. (F, Sp, Su)

GEOL 6970  **Seminar**  4 Credit Hours
1 to 4 hours. Prerequisite: graduate standing and permission of faculty supervisor. May be repeated with change of subject matter; maximum credit 20 hours. Directed seminar on selected aspects of geologic knowledge and inquiry. (F, Sp, Su)

GEOL 6980  **Research for Doctoral Dissertation**  2-16 Credit Hours
2 to 16 hours. (F, Sp, Su)

GEOL 6990  **Independent Study**  1-3 Credit Hours
1 to 3 hours. Prerequisite: Graduate standing and permission of instructor. May be repeated; maximum credit nine hours. Contracted independent study for a topic not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. (Irreg.)

GPHY 1103  **Adventures in Geophysics**  3 Credit Hours
The field of applied near-surface geophysics will be introduced within the broader scope of the geophysical sciences. Key geophysical techniques and tools will be covered through exploration of existing case studies involving fields such as archaeology, law enforcement and ground water resources. There will also be opportunities for 'hands on' experience with high-tech geophysical tools. (Sp) [II-NL].

GPHY 3423  **Introductory Petroleum Geology and Geophysics**  3 Credit Hours
Prerequisite: GEOL 1114, MATH 2924 or MATH 2423, PHYS 2514, and GEOL 3003. Fundamentals of the utilization of geological and geophysical data in the exploration for and development of petroleum reserves. Fundamental principles, geological and geophysical data acquisition, processing and interpretation. (F)

GPHY 3440  **Mentored Research Experience**  3 Credit Hours
0 to 3 hours. Prerequisites: ENGL 1113 or equivalent, and permission of instructor. May be repeated; maximum credit 12 hours. For the inquisitive student to apply the scholarly processes of the discipline to a research or creative project under the mentorship of a faculty member. Student and instructor should complete an Undergraduate Research & Creative Projects (URCP) Mentoring Agreement and file it with the URCP office. Not for honors credit. (F, Sp, Su)

GPHY 3960  **Honors Reading**  1-3 Credit Hours
1 to 3 hours. Prerequisite: Admission to Honors Program. May be repeated; maximum credit six hours. Consists of topics designated by the instructor in keeping with the student's major program. The topics will cover materials not usually presented in the regular courses. (F, Sp, Su)

GPHY 3970  **Honors Seminar**  1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. Subjects covered vary. Deals with concepts not usually treated in regular courses. (Irreg.)

GPHY 3980  **Honors Research**  1-3 Credit Hours
1 to 3 hours. Prerequisite: Admission to Honors Program. May be repeated; maximum credit six hours. Will provide an opportunity for the gifted Honors candidate to work at a special project in the student's field. (F, Sp, Su)

GPHY 3990  **Independent Study**  1-3 Credit Hours
1 to 3 hours. Prerequisite: permission of instructor and junior standing. May be repeated once with change of content. Independent study may be arranged to study a subject not available through regular course offerings. (F, Sp, Su)

GPHY 4133  **Colorado Field Geophysics**  3 Credit Hours
Prerequisite: 4113; Geology 3123; or permission of instructor. Students become familiar with field methods in geophysics and apply principles of geophysical methods to survey design, data acquisition, data processing, and interpretation. Students plan geophysical surveys, collect field geophysical data in small groups, interpret the acquired datasets in terms of earth structure, and learn about the tectonics and structure of the front range of the Rocky Mountains. Field course is taught at the OU field camp near Canon City, Colorado, and is predominantly field based. Three-week field experience required. (Su) [V].

GPHY 4413  **Global Geophysics**  3 Credit Hours
Prerequisites: GEOL 3114; MATH 2924 or 2423; PHYS 2524; or equivalent coursework or permission of instructor. Introduces students to geophysical methods, the structure and physical properties of earth's interior, active processes on earth, and the use of geophysical methods to study structure and processes. No student may earn credit for both 4413 and 5413. Laboratory (Alt. F)

GPHY 4874  **Seismic Exploration**  4 Credit Hours
Prerequisite: PHYS 2524; MATH 2934 or MATH 2443 or concurrent enrollment. Lectures and laboratory/problem sessions covering theory and applications of reflection and refraction seismic exploration methods. Emphasis is on the common-depth-point reflection method. (F)

GPHY 4953  **Senior Thesis in Geophysics**  3 Credit Hours
Prerequisite: senior standing with a major in geophysics and permission. May not be repeated. Individual research of a geophysical topic selected by the student in consultation with the instructor. The project may involve fieldwork, theoretical analysis, computer modeling, and/or data analysis and interpretation, culminating in a written thesis. (F, Sp, Su) [V].
GPHY 4960  Directed Readings  1-4 Credit Hours
1 to 4 hours. Prerequisite: good standing in University; permission of instructor and dean. May be repeated; maximum credit four hours. Designed for upper-division students who need opportunity to study a specific problem in greater depth than formal course content permits. (Irreg.)

GPHY 4970  Seminar  3 Credit Hours
1 to 3 hours. Prerequisite: permission of instructor. May be repeated with change of content; maximum credit nine hours. (F, Sp)

GPHY 4990  Independent Study  1-3 Credit Hours
1 to 3 hours. Prerequisite: three courses in general area to be studied; permission of instructor and department. May be repeated; maximum credit nine hours. Contracted independent study for topics not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. (F, Sp, Su)

GPHY 5020  Computational Geophysics  1-3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. May be repeated with change in content; maximum credit 12 hours. Algorithm design. Implementation and application for numerically intensive geophysical problems. Focus will cycle semester to semester from Interactive algorithms (using Matlab and C# languages) to more computationally demanding seismic processing, imaging and inversion algorithms (using Fortran 90, C, and MPI). (F, Sp)

GPHY 5364  Paleomagnetism  4 Credit Hours
Prerequisite: permission. Concerns the magnetic properties of minerals and rocks and the physical and chemical processes which produce them. Laboratory techniques used in investigations are discussed. (F)

GPHY 5413  Global Geophysics  3 Credit Hours
Prerequisite: Graduate standing or permission of instructor. Introduces students to geophysical methods, the structure and physical properties of earth's interior, active processes on earth, and the use of geophysical methods to study structure and processes. Will be taught every other fall semester. Laboratory included. No student may earn credit for both 4413 and 5413. (Irreg.)

GPHY 5513  3-D Seismic Interpretation  3 Credit Hours
Prerequisite: graduate standing or permission of instructor. Principles of seismic stratigraphy, seismic geomorphology, structural geology, and rock physics to interpret seismic reflection data and associated attributes to delineate faults, fractures, folds, fluvial-deltaic complexes, turbidites, mass transport complexes, karst, and other structural and stratigraphic features of interest. Course is intended for graduate students in geophysics, geology, and petroleum engineering. Laboratory (F)

GPHY 5523  3-D Seismic Processing  3 Credit Hours
Prerequisite: GPHY 4874 or equivalent and MATH 3333. Theory and application of seismic signal analysis to modern 3-D surface seismic surveys including sorting, statics, deconvolution, coherent noise suppression, velocity analysis and migration. At the end of the course, the student will be able to apply appropriate modern work flows to 3-D land data surveys resulting in prestack time migrated images amenable to AVO, attribute, and velocity anisotropy analysis. (Sp)

GPHY 5533  Quantitative Seismic Interpretation  3 Credit Hours
Prerequisite: graduate standing, and GPHY 5513 or current research work in reservoir characterization or simulation. This course is the second part of a two-course sequence on seismic interpretation and will investigate the theoretical foundation and application of tools used in quantitative reservoir characterization. This course is intended for upper level graduate students in geophysics, geology, and petroleum engineering doing research in reservoir imaging, characterization, and simulation. (Sp-even yrs)

GPHY 5613  Introduction to Seismic Stratigraphy  3 Credit Hours
Prerequisite: Physics 2524, Mathematics 3333, or permission. Introduction to the stratigraphic interpretation of reflection seismic data, emphasizing 2-D exploration seismic reflection group analysis. Topics covered include the theory and practice of borehole constrained interpretation, analysis, and mapping of seismic sequences, fault mechanical stratigraphy, chronostratigraphy, seismic facies, relative changes in sea level, and integrated geohistory analysis with emphasis upon providing a foundation for petroleum system analysis. Seismic sections for the analyses are taken from varying tectonic and depositional settings worldwide. (Alt. F)

GPHY 5864  Gravimetric and Magnetic Exploration  4 Credit Hours
Prerequisite: Graduate standing, MATH 2924 or MATH 2433, PHYS 2524, or permission of instructor. Lectures and laboratory/problem sessions covering theory and applications of gravimetric and magnetic exploration. Includes potential theory, filtering, modeling and interpretation. Emphasis is on exploration for minerals, oil and gas. Concepts of geodesy and isostasy are briefly considered. Laboratory (Sp)

GPHY 5960  Directed Readings  1-3 Credit Hours
1 to 3 hours. Prerequisite: graduate standing and permission of department. May be repeated; maximum credit twelve hours. Directed readings and/or literature reviews under the direction of a faculty member. (F, Sp, Su)

GPHY 5970  Special Topics/Seminar  1-3 Credit Hours
1 to 3 hours. Prerequisite: Graduate standing or permission of instructor. May be repeated; maximum credit nine hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research and field projects. (Irreg.)

GPHY 5980  Research for Master's Thesis  2-9 Credit Hours
Variable enrollment, two to nine hours; maximum applicable toward degree, four hours. (F, Sp, Su)

GPHY 5990  Special Studies  1-3 Credit Hours
1 to 3 hours. Prerequisite: permission. May be repeated; maximum credit nine hours. Advanced special studies in geophysical problems. May include directed reading in geophysics, fieldwork, laboratory research or preparation of reports. (F, Sp, Su)

GPHY 6873  Seismic Imaging  3 Credit Hours
Prerequisite: Graduate standing. Seismic imaging is a fundamental tool to understand Earth's structure. This class will focus on various migrations used in exploration geophysics including ray-based and wavefield-based methods. Also, it will cover velocity analyses of the structure such as travel-time tomography and full-waveform inversion. (Sp)

GPHY 6950  Research  1-4 Credit Hours
1 to 4 hours. Prerequisite: graduate standing and permission of faculty supervisor. May be repeated with change of content; maximum credit 12 hours. Individual research in various areas of geophysics. (F, Sp, Su)
GPHY 6960  Directed Readings  1-6 Credit Hours
1 to 6 hours. Prerequisite: graduate standing and permission of faculty supervisor. May be repeated; maximum credit six hours. Supervised reading at an advanced graduate level. (F, Sp, Su)

GPHY 6970  Seminar  1-4 Credit Hours
1 to 4 hours. Prerequisite: graduate standing, permission. May be repeated with change of subject matter; maximum credit twenty hours. Directed seminar on selected aspects of geophysical knowledge and inquiry. (F, Sp, Su)

GPHY 6980  Research for Doctoral Dissertation  2-16 Credit Hours
2 to 16 hours. Prerequisite: permission of instructor. (F, Sp, Su)

GPHY 6990  Independent Study  1-3 Credit Hours
1 to 3 hours. Prerequisite: Graduate standing and permission of instructor. May be repeated; maximum credit nine hours. Contracted independent study for a topic not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. (Irreg.)

## Faculty

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First/Middle Name</th>
<th>Middle Name init.</th>
<th>OU Service start</th>
<th>Title(s), date(s) appointed</th>
<th>Degrees Earned, Schools, Dates Completed</th>
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<tbody>
<tr>
<td>Bedle</td>
<td>Heather</td>
<td></td>
<td>2018</td>
<td>ASSISTANT PROFESSOR OF GEOLOGY AND GEOPHYSICS, 2018</td>
<td>PhD, Northwestern Univ, 2008; MS, Northwestern Univ, 2005; BS, Wake Forest Univ, 1999</td>
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<tr>
<td>Behm</td>
<td>Michael</td>
<td></td>
<td>2017</td>
<td>ASSISTANT PROFESSOR OF GEOLOGY AND GEOPHYSICS, 2017</td>
<td>PhD, Vienna Univ of Technology, 2006; MS, Vienna Univ of Technology, 2002</td>
</tr>
<tr>
<td>Carpenter</td>
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<td>M</td>
<td>2017</td>
<td>ASSISTANT PROFESSOR OF GEOLOGY AND GEOPHYSICS, 2017</td>
<td>PhD, Penn State Univ, 2012; MS, Penn State Univ, 2007; BS, Mansfield Univ of Pennsylvania, 2005</td>
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<td>Chen</td>
<td>Xiaowei</td>
<td></td>
<td>2015</td>
<td>ASSISTANT PROFESSOR OF GEOLOGY AND GEOPHYSICS, 2015</td>
<td>PhD, Univ of California, San Diego, 2013; MS, Univ of California, San Diego, 2010; BS, Univ Sci &amp; Tech of China, 2007</td>
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<td>Dee</td>
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<td>T</td>
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<td>PhD, Colorado School of Mines; MS, Univ of Kansas; BS, Univ of Kansas</td>
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<td>Engel</td>
<td>Michael</td>
<td>H</td>
<td>1982</td>
<td>PROFESSOR OF GEOLOGY AND GEOPHYSICS, 1994; CLYDE BECKER, SR. CHAIR IN GEOLOGY AND GEOPHYSICS, 2009</td>
<td>PhD, Univ of Arizona, 1980; MS, Univ of Arizona, 1976; BA, SUNY at Binghamton, 1972</td>
</tr>
<tr>
<td>Liu</td>
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<td></td>
<td>2017</td>
<td>ASSISTANT PROFESSOR OF GEOLOGY AND GEOPHYSICS, 2017</td>
<td>PhD, Univ of Bremen, 2011; MS, Chinese Acad of Sciences, 2007; BS, Shandong Univ, 2003</td>
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<td>Madden</td>
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<td>S</td>
<td>2013</td>
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<td>PhD, Virginia Polytechnic, 2005; BS, Michigan State Univ, 2000</td>
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<td>Mitra</td>
<td>Shankar</td>
<td></td>
<td>1999</td>
<td>PROFESSOR OF GEOLOGY AND GEOPHYSICS, 1999; ASSOCIATE DIRECTOR, ROCK MECHANICS INSTITUTE, 1999; VICTOR E. MONNETT CHAIR IN ENERGY RESOURCES, 1999</td>
<td>PhD, North Lake College, 1977; MS, Univ of Calcutta, 1972; BS, Univ of Calcutta, 1969</td>
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<td>Soreghan</td>
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<td>S</td>
<td>1996</td>
<td>WILLIAMS COMPANIES FOUNDATION PRESIDENTIAL PROFESSOR, 2001; PROFESSOR OF GEOLOGY AND GEOPHYSICS, 2008; DAVID L. BOREN PROFESSORSHIP, 2017</td>
<td>PhD, Univ of Arizona, 1992; BS, Univ of California Los Angeles, 1986</td>
</tr>
<tr>
<td>Weaver</td>
<td>Barry</td>
<td>L</td>
<td>1984</td>
<td>ASSOCIATE PROFESSOR OF GEOLOGY AND GEOPHYSICS, 1990</td>
<td>PhD, Univ of Birmingham, 1980; MS, Univ of Birmingham, 1977; BS, Durham Univ, 1976</td>
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