

# GEOL-GEOLOGY

## **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-NS].

## **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 1023 Geology of National Parks 3 Credit Hours**

The amazing landforms and geologic features within the National Parks have a story to tell about their geologic history and tectonic setting, and are important for illustrating and describing concepts related to Earth processes and geologic time. This course blends an introduction to geology with geologic concepts as they apply to selected National Parks. (F, Sp) [II-NS].

## **GEOL 1024 The History of the Earth and Life 4 Credit Hours**

Origin of the Earth/solar system. Rocks and minerals; geologic time; plate tectonics/continental drift. The ocean-atmosphere system; climate change over time; biological evolution. 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. No student may earn credit for both GEOL 1024 and GEOL 1124 (Sp) [II-NSL].

## **GEOL 1033 Earth, Energy, Environment 3 Credit Hours**

Explores Earth and its energy resources. Introduces physical geology and the link to global energy resources: their origin, properties, abundance, distribution in and on Earth, and environmental challenges. Emphasizes the advantages, disadvantages, and misconceptions of each energy resource. Also explores hydrogen as an energy resource, critical minerals and metals for energy applications, and possible methods to capture and store CO<sub>2</sub>. (Sp) [II-NS].

## **GEOL 1034 Native Science and Earth Systems of North America 4 Credit Hours**

0 to 4 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-NSL].

## **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-NSL].

## **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-NSL].

## **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 Dinosauria. May not be counted for major coursework in Biology or Geology. (F) [II-NS].

## **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-NSL].

## **GEOL 2224 Introduction to Mineral Sciences 4 Credit Hours**

Prerequisite: GEOL 1114, CHEM 1315, and MATH 1823/1914 or concurrent enrollment. 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)

## **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-NS].

**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-NS].

**GEOL 3033 Earth Resources and the Environment****3 Credit Hours**

Prerequisite: 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-NS].

**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-NS].

**GEOL 3114 Structural Geology****4 Credit Hours**

Prerequisite: GEOL 2224 and PHYS 2514. An introduction to the fundamental concepts of structure and deformation in the lithosphere. It discusses recognition, interpretation, and mechanics (stress, strain) of faults, folds, structural features of igneous and metamorphic rocks, and introduces regional structural geology and tectonics. Laboratory includes techniques of structural analysis, recognition, and interpretation of structures on geologic maps, and construction of interpretive cross sections. (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 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 in the fossil record. Biostratigraphy. 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 4106 Digital Geologic Methods 6 Credit Hours**  
Prerequisite: GEOL 3123; senior standing or departmental permission. This six-week online synchronous course covers a range of tectonic and lithologic processes on Earth and other planetary bodies. Students will become proficient in remote field techniques to create geologic maps, cross-sections, and stratigraphic columns. Students will create cohesive narratives of field areas, and understand the different driving forces of tectonics, volcanism, and sedimentation in current and ancient environments. (Su)
- GEOL 4113 Depositional Systems and Stratigraphy 3 Credit Hours**  
(Slashlisted with GEOL 5113) Prerequisite: 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, biostratigraphy, magnetostratigraphy, and sequence stratigraphy. Field trip; students will be charged transportation costs. Laboratory. No student may earn credit for both 4113 and 5113. (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, amount 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 GEOL 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 4223 Principles of Geochemistry (Slashlisted with 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 4423 Subsurface Methods 3 Credit Hours**  
Prerequisite: junior standing or permission of instructor/department. Concepts and methods of subsurface geoscience data analysis, modeling, and interpretation. Data integration (core, well logs, 3-D seismic, outcrops) to evaluate, map, model, and interpret subsurface geological characteristics and formation property heterogeneity. Application to subsurface reservoirs and aquifers related to energy (oil, gas, geothermal, hydrogen), water, and CO2 storage. (Fall) (F)
- 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 GEOL 5513) Prerequisite: GEOL 3513; MATH 2423 or MATH 2924; or permission of instructor. Advanced course on biological evolution emphasizing mathematical and computational approaches to the fossil record. Biodiversity through time, origination and extinction dynamics; Models of trait evolution (Brownian motion, Ornstein Uhlenbeck processes, and beyond), Markov processes; Phylogeny inference, parsimony, likelihood, and Bayesian approaches; Paleobiological contributions to understanding major features of evolution and the history of life, punctuated equilibrium, levels of selection. No student may earn credit for both 4513 and 5513. (Irreg.)
- 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 4553 Paleoecology 3 Credit Hours**  
(Slashlisted with GEOL 5553) Prerequisite: GEOL 3513 or instructor permission. Over millions of years, the interactions of organisms with each other and with their changing environments have had a profound effect on the history of Earth and life. This course will focus on modern and ancient ecological processes, how they scale over geological timescales, and how fossil data are collected, analyzed, and synthesized to address paleoecological questions. Laboratory work included. No student may earn credit for both 4553 and 5553. (Sp)

- GEOL 4613 Soil Genesis 3 Credit Hours**  
(Slashlisted with GEOL 5613) Prerequisite: GEOL 1114 or Instructor/Department Permission. This course focuses on the formation and morphology of soils - otherwise known as the field of pedology. Pedologists research the processes that generate different soils across and within landscapes. We apply this knowledge to understand the development of landforms, biogeochemical reactions across space and time, and the distribution of plant and animal species in the biosphere. No student may earn credit for both 4613 and 5613. (F)
- GEOL G4633 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 geologic and geophysical techniques to fluid flow problems. (F)
- GEOL 4663 Biogeochemistry of the Critical Zone 3 Credit Hours**  
(Slashlisted with GEOL 5663) Prerequisite: GEOL 1114 or Instructor/Department Permission. This course serves as a survey of the field of biogeochemistry through the lens of critical zone science. Biogeochemistry is the study of the fluxes and transformations of energy, water, carbon, nutrients, and other elements within and through the biosphere; critical zone science encompasses integrative works that study the near-surface interactions between rock, soil, air, water, and biota. No student may earn credit for both 4663 and 5663. (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 G4970 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 5001 Topics in Geosciences 1 Credit Hour**  
Prerequisite: Graduate standing or departmental permission. This course is a broad survey of general concepts in the geosciences, delivered at an advanced level. Students will read the professional scientific literature, participate in class discussions, and complete short writings related to readings and their own research. (F)
- 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 5041 Critical Geosciences Seminar 1 Credit Hour**  
Prerequisite: Graduate standing and permission of instructor. Directed seminar on knowledge and inquiry, profession and practice, and careers associated with 'Critical Geosciences,' including but not limited to biogeochemistry and geophysics of planetary critical zones and critical mineral/energy resources. 1 hour/week. (F, Sp)
- GEOL 5051 Organic Geochemistry Seminar 1 Credit Hour**  
Prerequisite: Graduate Standing or Departmental Permission. This seminar course engages students in examining advanced research in Organic Geochemistry, with a focus on key topics such as paleoceanography, paleoclimate, and biogeochemical cycles across ancient and modern environments. Through interactive, in-class discussions and critical analyses, students will refine their scholarly expertise while developing practical skills essential for success in both academic and industry career paths. (F, Sp)
- GEOL 5061 Topics in Critical Zone Science 1 Credit Hour**  
Prerequisite: Graduate Standing or Department/Instructor Permission. In this seminar-style class we will explore recent advances in the field of critical zone science. Critical zone science integrates the earth sciences to study the near-surface interactions between rock, water, soil, air, and biota. Therefore, we will read and discuss research articles that use such a systems-based approach to answer questions related to an array of topics. (F, Sp.) (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 GEOL 4204) 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 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 carbonates (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 5443 Formation Damage 3 Credit Hours**  
 (Crosslisted with P E and G E 5443) Prerequisite: Graduate standing. This course presents an overview of main mechanisms of formation damage (mechanical, chemical, thermal, and biological) occurring during subsurface applications, including but not limited to primary and enhanced hydrocarbon production, CO<sub>2</sub> storage, and geothermal processes. Existing theories explaining the process and methods to mitigate the formation damage will be discussed. (Irreg.)
- GEOL 5503 Clay Mineralogy 3 Credit Hours**  
 Prerequisite: Graduate Standing or Permission of Instructor. Theoretical fundamentals, methods of investigation, and applications of clay mineral structure and reactivity. Students are required to complete a hands-on original project applying methods and concepts from the course to their research.
- GEOL 5513 Evolutionary Paleobiology 3 Credit Hours**  
 (Slashlisted with GEOL 4513) Prerequisite: graduate standing or instructor permission. Advanced course on biological evolution emphasizing mathematical and computational approaches to the fossil record. Biodiversity through time, origination and extinction dynamics; Models of trait evolution (Brownian motion, Ornstein Uhlenbeck processes, and beyond), Markov processes; Phylogeny inference, parsimony, likelihood, and Bayesian approaches; Paleobiological contributions to understanding major features of evolution and the history of life, punctuated equilibrium, levels of selection. No student may earn credit for both 4513 and 5513. (Irreg.)
- 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 5553 Paleoecology 3 Credit Hours**  
 (Slashlisted with GEOL 4553) Prerequisite: Graduate Standing. Over millions of years, the interactions of organisms with each other and with their changing environments have had a profound effect on the history of Earth and life. This course will focus on modern and ancient ecological processes, how they scale over geological timescales, and how fossil data are collected, analyzed, and synthesized to address paleoecological questions. Laboratory work included. No student may earn credit for both 4553 and 5553. (F)
- GEOL 5613 Soil Genesis 3 Credit Hours**  
 (Slashlisted with GEOL 4613) Prerequisite: Graduate standing or Instructor/Department Permission. This course focuses on the formation and morphology of soils - otherwise known as the field of pedology. Pedologists research the processes that generate different soils across and within landscapes. We apply this knowledge to understand the development of landforms, biogeochemical reactions across space and time, and the distribution of plant and animal species in the biosphere. No student may earn credit for both 4613 and 5613. (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 (organic and inorganic constituents), in-situ measurement of water quality parameters, surface water discharge measurement techniques, and geophysical methods are covered. (F)

**GEOL 5663 Biogeochemistry of the Critical Zone 3 Credit Hours**  
 (Slashlisted with GEOL 4663) Prerequisite: Graduate Standing or Instructor/Department Permission. This course serves as a survey of the field of biogeochemistry through the lens of critical zone science. Biogeochemistry is the study of the fluxes and transformations of energy, water, carbon, nutrients, and other elements within and through the biosphere; critical zone science encompasses integrative works that study the near-surface interactions between rock, soil, air, water, and biota. No student may earn credit for both 4663 and 5663. (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 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 6113 Organic Geochemistry 3 Credit Hours**  
 Prerequisite: graduate standing or instructor permission. This course will introduce basic concepts, methods, and hot topics of Organic Geochemistry with a focus on lipid biomarkers, the molecular fossils that are commonly studied for tracing the metabolic activities of once living organisms and reconstructing past climates.

**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. Prerequisite: Graduate standing and permission of instructor; may be repeated. Directed research culminating in the completion of the doctoral dissertation. (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.)