Geology (GEOL)

Courses

GEOL A111 Planet Earth **3 Credits**
Introduces physical geology, study of earth and its materials. Includes processes that operate on and within earth. Formation of common rocks and minerals, and basics of mineral and rock identification and classification.
Registration Restrictions: MATH A055 or higher
Attributes: UAA Natural Sciences GER.

GEOL A111L Planet Earth Laboratory **1 Credit**
Introduces students to laboratory skills in physical geology. Emphasizes practical skills such as the identification and classification of minerals and rocks. Covers the proper use and interpretation of topographic and geologic maps, and remote sensing data. Applies lab skills to solve real-world problems in the geosciences. Includes on-site interpretation of geology on a field trip led by the instructor.
Prerequisites: GEOL A111 with a minimum grade of C or concurrent enrollment.
Attributes: UAA Natural Sci Lab Only GER.

GEOL A115 Dangerous Earth **3 Credits**
Introduces the study of applied environmental geology with a focus on geologic processes and linkages to how humans interact with the geologic environment. Includes both internal and external Earth processes and related topics such as climate change, earthquakes, volcanic eruptions, coastal processes, and mineral and energy resources.
Registration Restrictions: MATH A055 or higher
Attributes: UAA Natural Sciences GER.

GEOL A115L Dangerous Earth Laboratory **1 Credit**
Investigates problems in environmental geology related to volcanic and earthquake hazards, surface and groundwater pollution, landslides, coastal processes, and waste disposal with emphasis on the local areas in Alaska. Includes several local field trips.
Registration Restrictions: MATH A055 or higher
Prerequisites: GEOL A115 with a minimum grade of C or concurrent enrollment.
Attributes: UAA Natural Sci Lab Only GER.

GEOL A121 Physical Geology for Science and Engineering Majors **4 Credits**
Development of applied geology skills through the study of Earth, its materials, and processes operating on and within the planet. Laboratory training in geologic maps and identification and interpretation of minerals and rocks.
Registration Restrictions: MATH A055 or higher. Declared major in science or engineering and instructor approval.

GEOL A178 Introduction to Oceanography **3 Credits**
Study of the oceans combining insights from geological, chemical, physical and biological oceanography. Topics include plate tectonics and the evolution of the ocean basins, the chemical composition of seawater, forces acting on water to generate waves and currents, interrelationships among physical, chemical and biological processes, and complex societal issues such as global climate change, fisheries management and pollution.
Registration Restrictions: Placement into Quantitative Skills GER
Crosslisted With: BIOL A178
Attributes: UAA Natural Sciences GER.

GEOL A179 Introduction to Oceanography Laboratory **1 Credit**
Laboratory exercises designed to illustrate principles and concepts developed in the lecture (BIOL/GEOL A178).
Registration Restrictions: Placement into Quantitative Skills GER
Crosslisted With: BIOL A179
Prerequisites: BIOL A178 with a minimum grade of D or concurrent enrollment or GEOL A178 with a minimum grade of D or concurrent enrollment.
Attributes: UAA Natural Sci Lab Only GER.

GEOL A190 Introductory Topics in Geology **1-3 Credits**
Introductory study of a selected topic in geology.
Special Note: May be repeated with change of topic.

GEOL A221 Journey Through Time **4 Credits**
Introduces the history of the Earth through geologic time, emphasizing North America. Includes major events in plate tectonics, the evolution of life forms and interpretation of the rock record. Lab includes invertebrate fossil identification, geologic map interpretation, stratigraphic principles and field trip.
Prerequisites: (GEOL A111 with a minimum grade of C and GEOL A111L with a minimum grade of C) or (GEOL A115 with a minimum grade of C and GEOL A115L with a minimum grade of C) or (GEOL A121 with a minimum grade of C) and (MATH A105 with a minimum grade of C or ALEKS Overall Test 1 with a score of 055 or ALEKS Overall Test 2 with a score of 055 or ALEKS Overall Test 3 with a score of 055 or ALEKS Overall Test 4 with a score of 055 or ALEKS Overall Test 5 with a score of 055).
Attributes: UAA Natural Science w/ Lab GER.

GEOL A225 Earth Surface Processes **3 Credits**
Introduces the identification and mapping of landforms, and quantitative study of processes that shape the earth's surface. Combines theory, field observations, basic data analysis, and modeling to investigate geomorphic systems that affect humanity.
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A310 Professional Practices in Geology **3 Credits**
Introduces workplace ethics, responsibilities, and expectations of geologists in a professional role. Practices research methods, writing, and presentation techniques in the geosciences. Includes research design, proposal writing, resume and job applications, scientific writing, critical review, and oral presentation techniques.
Registration Restrictions: BS Geological Science majors only
Prerequisites: (GEOL A111 with a minimum grade of C and GEOL A111L with a minimum grade of C) or (GEOL A115 with a minimum grade of C and GEOL A115L with a minimum grade of C) or (GEOL A121 with a minimum grade of C) and (WRTG A211 with a minimum grade of D or WRTG A212 with a minimum grade of D or WRTG A213 with a minimum grade of D or WRTG A214 with a minimum grade of D or WRTG A2W with a minimum grade of D).

GEOL A315 Geological Data Visualization and Analysis **3 Credits**
Introduces different types of geological data and basic computational methods for visualization and analysis. Provides skills to understand the nature of geoscience datasets and perform quantitative interpretation to fully understand many subject areas in geosciences.
Prerequisites: GEOL A225 with a minimum grade of C.

GEOL A320 Volcanology **3 Credits**
The description and classification of volcanoes, volcanic eruptions, and volcanic deposits. Includes the history of volcanic studies, myths, and legends. Emphasis on the dynamics of volcanic eruptions, pyroclastic rocks, lava flows, and volcanic hazard assessment.
Prerequisites: GEOL A221 with a minimum grade of D.

GEOL A321 Mineralogy **4 Credits**
Covers crystallography, including external form and internal order. Includes crystal chemistry, atomic structure, crystal structure, and compositional variation, nature and origin of physical properties of minerals. Mineral association, occurrence and paragenesis. Introduces x-ray crystallography and optical mineralogy. Laboratory includes determinative crystallography, optical mineralogy and systematic determinative mineralogy.
Prerequisites: ((GEOL A111 with a minimum grade of C and GEOL A111L with a minimum grade of C) or (GEOL A115 with a minimum grade of C and GEOL A115L with a minimum grade of C) or GEOL A121 with a minimum grade of C) and (CHEM A105 with a minimum grade of C and CHEM A105L with a minimum grade of C) and (PHYS A123 with a minimum grade of C and PHYS A123L with a minimum grade of C) and (MATH A105 with a minimum grade of C or ALEKS Overall Test 1 with a score of 055 or ALEKS Overall Test 2 with a score of 055 or ALEKS Overall Test 3 with a score of 055 or ALEKS Overall Test 4 with a score of 055 or ALEKS Overall Test 5 with a score of 055).

GEOL A322 Igneous and Metamorphic Petrology **4 Credits**
Covers identification and classification of igneous and metamorphic rocks, interpretation of textures, structures, and mineralogy of rocks. Includes the study of chemical and physical principles controlling the formation of rocks, importance of various rock types in economic and industrial arenas. Extensive study of hand specimens with emphasis on composition, texture and structure.
Prerequisites: GEOL A310 with a minimum grade of C and GEOL A321 with a minimum grade of C.

GEOL A325 Geology of Ore Deposits **3 Credits**
Genesis, tectonic setting and properties of selected metallic ore deposits. Significant hand sample identification and paragenetic associations of ore minerals and certain ore deposits including mafic layered intrusions, hydrothermal deposits, massive sulfides, and porphyry deposits. Emphasis on origin and transport of ore bearing fluids and deposition of ore minerals.
Prerequisites: GEOL A322 with a minimum grade of D.

GEOL A331 Sedimentology and Stratigraphy **4 Credits**
Surveys sediments including origins, classification, transportation, composition, structures, and diagenesis. Includes stratigraphic principles of lithostratigraphy, biostratigraphy, magnetostratigraphy, chronostratigraphy, and seismic stratigraphy. Lab includes grain size analysis, sedimentary structures, correlation, and field practicum.
Prerequisites: GEOL A225 with a minimum grade of C and GEOL A310 with a minimum grade of C.

GEOL A333 Earthquakes and Seismic Hazards **3 Credits**
Examines the geology of earthquake-prone regions in all tectonic settings and the impact that earthquakes have on society in terms of hazard assessment and preparation. Addresses fundamental reasons for failure along a fault surface in order to explain when, where and why earthquakes occur. Examines seismic waves, how they are measured, and the information they contain regarding the style of faulting that produced the earthquake. Also considers the study of ancient earthquakes, or paleoseismology, and its usefulness in predicting future earthquakes. Introduces deterministic and probabilistic methods of assessing the seismic hazard in active fault environments for enhanced earthquake preparation in high risk locations.
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A335 Structural Geology **4 Credits**
Covers fundamental concepts of rock deformation: description and formation of geologic structures; brittle and ductile deformation; characteristic structures in different tectonic environments; concepts of stress, strain and brittle failure mechanics; and salt tectonics. Laboratory includes analysis of structure contours, geologic maps and cross sections, stereonets, kinematic analysis, and the Mohr circle technique.
Prerequisites: GEOL A331 with a minimum grade of C and PHYS A123 with a minimum grade of C and PHYS A123L with a minimum grade of C and (MATH A152 with a minimum grade of C or MATH A155 with a minimum grade of C).

GEOL A345 Hydrogeology **3 Credits**
Comprehensively covers the fundamentals of hydrogeology, including physical and hydraulic properties of subsurface aquifers, Darcy's Law and the groundwater flow equation, hydraulic head, storage and effective stress, regional groundwater flow, aquifer hydraulics, and water well design and development.
Special Note: Laboratory time will be used to enhance data analysis, mathematical and problem-solving skill sets.
Prerequisites: GEOL A315 with a minimum grade of C and GEOL A331 with a minimum grade of C and (MATH A251 with a minimum grade of C or MATH A251F with a minimum grade of C).

GEOL A350 Geomorphology **4 Credits**
Study of landforms and processes that affect their development, including tectonics, geologic structures, bedrock lithology, streams, glaciers, groundwater, and oceans. Laboratory focuses on formation and genesis of landforms based on evidence from topographic maps and aerial photography.
Prerequisites: GEOL A221 with a minimum grade of D.

GEOL A361 Earth Resources and Society **3 Credits**
A global-scale investigation of the state of water, energy and mineral resources and the linkages to society and the environment. Review of historical sources, uses and demands on water, energy and mineral resources and the connection to human population growth over time. Investigation of the scientific and social motivations for shifting how humans use water, energy and mineral resources.
Registration Restrictions: Junior or higher standing and completion of Tier 1 GER courses.
Prerequisites: (GEOL A111 with a minimum grade of C or GEOL A115 with a minimum grade of C or GEOL A121 with a minimum grade of C or GEOL A221 with a minimum grade of C) and (ENVI A211 with a minimum grade of C or ENVI A212 with a minimum grade of C).
Attributes: UAA Integrative Capstone GER.

GEOL A381 Kenai Peninsula Field Studies **3 Credits**
Nine-day field excursion from Anchorage to Portage, Kenai, Nikiski, Homer and Seward, Alaska, to explore gold mining; oil and gas exploration and production; Tertiary coal, fossils and paleoenvironments; coastal geomorphology; glacial history; and plate tectonics of the Kenai Peninsula. Includes a full-day boat excursion in Kenai Fjords National Park.
Special Note: Students are required to provide their own food, transportation, and field and camping gear.
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A382 Geologic Field Studies **3 Credits**
Field excursion within the United States or another country to study the local and regional geology. Field notes, rock and outcrop descriptions, mapping and field exercises required.
Special Note: May be repeated for a maximum of 9 credits with change of subtitle. Students may be required to provide their own transportation depending on location of field trip.
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A426 Mineral Resources **3 Credits**
Mineral resource genesis, classification, exploration, development and associated environmental factors, with a focus on metallic and non-metallic minerals. Specific analysis of mineral resource availability, exploration techniques, viability of extraction and processing, and assessment of environmental implications of extraction. Includes one or more case studies of existing exploration and/or mining sites.
Special Note: Not available for credit to students who have completed GEOL A626.
May Be Stacked With: GEOL A626
Prerequisites: GEOL A322 with a minimum grade of C and GEOL A461 with a minimum grade of C.

GEOL A436 Petroleum Geology **3 Credits**
Formation of hydrocarbons, their migration and accumulation in the context of the petroleum system, and their exploration and extraction. Includes an introduction to subsurface datasets used in the petroleum industry and how to integrate them. Conventional and unconventional petroleum systems are discussed in the class using examples from Alaska and around the world.
Special Note: Not available for credit to students who have completed GEOL A636.
May Be Stacked With: GEOL A636
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A437 Depositional Systems and Dynamic Stratigraphy **3 Credits**
Advanced skills in sedimentary geology that can be applied in oil/gas, hydrology, and mining. Includes greater detail in depositional environments, characteristics of resultant sedimentary deposits, and sequence stratigraphy using various geologic datasets. Emphasis on hands-on application of course concepts in outcrop, core and well-log data.
Special Note: Not available for credit to students who have completed GEOL A637.
May Be Stacked With: GEOL A637
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A438 Advanced Sedimentary Petrology **3 Credits**
Advanced concepts in sedimentary petrography and petrology, including a survey of diagenesis. Topics include advanced rock classification, grain identification in thin section, cement identification, sedimentary fabric, paragenetic sequence and provenance analysis, and porosity estimation in carbonate and clastic sedimentary rocks. Emphasis on hands-on description, interpretation and applications.
Special Note: Not available for credit to students who have completed GEOL A638.
May Be Stacked With: GEOL A638
Prerequisites: GEOL A321 with a minimum grade of C and GEOL A431 with a minimum grade of C.

GEOL A441 Paleoclimatology **3 Credits**
Examines the fundamentals of climate science, changes in Earth's climate, and methods used to reconstruct past climates. Use of paleoclimate data from proxy records like cores of ice, peatland and ocean sediments, and tree rings to help understand how Earth's atmosphere, oceans and land interact with climate through time.
Special Note: Not available for credit to students who have completed GEOL A641.
May Be Stacked With: GEOL A641
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A444 The Cryosphere **3 Credits**
Examines the components of the cryosphere: sea ice, freshwater ice, snow, glaciers, permafrost and ice sheets. Addresses how the cryosphere is changing, including interconnections with Earth systems such as climate. Explores various datasets and models, from the Arctic to the Antarctic, to learn about the fundamental geoscience processes that govern this critical Earth system component.
Prerequisites: GEOL A225 with a minimum grade of C.

GEOL A445 Geothermal Energy **3 Credits**
Comprehensive coverage of geothermal systems and relevant processes including conductive and convective heat flow, subsurface fluid flow, geothermal exploration, resource assessment, structural settings favorable for geothermal reservoirs, microseismicity, well scaling and corrosion, power generation, and enhanced geothermal systems.
Special Note: Not available for credit to students who have completed GEOL A645.
May Be Stacked With: GEOL A645
Prerequisites: CHEM A105 with a minimum grade of C and GEOL A221 with a minimum grade of C and (MATH A251 with a minimum grade of C or MATH A251F with a minimum grade of C) and PHYS A124 with a minimum grade of C.

GEOL A448 Structural Geology and Geomechanics **3 Credits**
Examines the classification, origin, and evolution of all types of rock fractures with application to structural analysis, oil and gas reservoirs, resource recovery, engineering geology, hydrogeology, and hazards analysis. Applies continuum and rock mechanics principles to brittle deformation, including rock strength and failure criteria, stress states in the lithosphere, stress tensors, and linear elastic fracture mechanics theory.
Special Note: Students may need to provide their own transportation to a field trip location. Not available for credit to students who have completed GEOL A648.
May Be Stacked With: GEOL A648
Prerequisites: GEOL A335 with a minimum grade of C.

GEOL A454 Glacial and Quaternary Geology **3 Credits**
Examines glacial processes of erosion and deposition, and the modern and ancient landforms produced by ice. Topics include Quaternary history of glaciers, climate fluctuation, changes in terrestrial and marine environments, and evidence and techniques used to reconstruct past environments. Weekend field trip required.
Special Note: Not available for credit to students who have completed GEOL A654. Students are required to provide their own transportation to field locales.
May Be Stacked With: GEOL A654
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A458 Geology of Alaska **3 Credits**
Alaskan geology including physiographic provinces, earthquakes, volcanoes, plate tectonics, resources, glaciers, permafrost, rivers, coasts and wind. Emphasis on processes, landforms and differences between specific areas in Alaska.
Special Note: Students are required to provide their own transportation for optional field trips. Not available for credit to students who have completed GEOL A658.
May Be Stacked With: GEOL A658
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A461 Geochemistry **3 Credits**
Introduction to principles and applications of inorganic geochemistry. Emphasis on crystal structures and substitution in crystals, equilibrium geochemistry, dissociation of acids and bases, and mineral stability. Applying the laws of thermodynamics, Eh-pH diagrams, and oxidation-reduction reactions to geologic problems. Principles of radioactivity and geochronometers for age determination. A review of applications of stable isotopes to geologic problems.
Special Note: Not available for credit to students who have completed GEOL A661.
Registration Restrictions: BS Geological Science majors
May Be Stacked With: GEOL A661
Prerequisites: CHEM A106 with a minimum grade of C and GEOL A322 with a minimum grade of C.

GEOL A463 Environmental Geochemistry **3 Credits**
Principles and applications of environmental geochemistry on a global scale. Geochemical cycles and chemical mass balance of elements. Chemical weathering and the composition of natural waters. Processes affecting the distribution of trace elements in geologic environments. Stable isotope fractionation and applications to modeling environmental systems. Review of specific cases of modern environmental geochemistry problems.
Special Note: Not available for credit to students who have completed GEOL A663.
May Be Stacked With: GEOL A663
Prerequisites: GEOL A461 with a minimum grade of C.

GEOL A465 Isotope Geochemistry **3 Credits**
Examine principles and applications of radiogenic and stable isotopes with emphasis on application in the hydrologic, earth, and ecosystem sciences. Focuses on both traditional and environmental aspects of isotope geochemistry and biogeochemistry and some special applications to other fields of study such as anthropology, archaeology, and forensics. A class research project will include field sampling, sample analysis, and interpretation.
May Be Stacked With: GEOL A665
Prerequisites: CHEM A106 with a minimum grade of D and GEOL A461 with a minimum grade of D.

GEOL A468 Geomicrobiology **3 Credits**
Examines the mutual interactions between geology and microbiology. Emphasizes microbial processes that affect local and global environments including biogeochemical cycles, co-evolution, microbe-mineral interactions and life in extreme environments.
Crosslisted With: MBIO A468
Prerequisites: MBIO A340 with a minimum grade of C or GEOL A360 with a minimum grade of C.
Attributes: UAA Integrative Capstone GER.

GEOL A476 Applied Geophysics **3 Credits**
Overview of geophysical techniques used for subsurface visualization, mapping and interpretation, with applications to natural resource exploration, geotechnical investigations and environmental studies. Techniques include gravity, magnetic, electric, seismic and well logging. Applications of mathematics and physics-based principles to image shallow and deep subsurface at local and regional scales.
Special Note: Not available for credit to students who have completed GEOL A676.
Registration Restrictions: Instructor permission required for non-majors. Background in calculus-based mathematics or physics is required for geology non-majors.
May Be Stacked With: GEOL A676
Prerequisites: GEOL A335 with a minimum grade of C and (MATH A251 with a minimum grade of C or MATH A251F with a minimum grade of C) and PHYS A124 with a minimum grade of C and PHYS A124L with a minimum grade of C.

GEOL A477 Integrated Subsurface Mapping and Analysis **3 Credits**
Integration of different geologic and geophysical data for subsurface interpretation and energy exploration. Application of state-of-the-art technologies on real datasets for subsurface mapping, quantitative basin analysis, technical assessment of hydrocarbon prospects, and uncertainty analysis in active and team-based learning environments.
Special Note: Optionally, a group of five students may be selected to participate in the nationally competitive Imperial Barrel Award (IBA) competition organized by the American Association of Petroleum Geologists. GEOL A476 or GEOL A676 is recommended prior to enrollment in this course, but not required. Not available for credit to students who have completed GEOL A677.
May Be Stacked With: GEOL A677
Prerequisites: GEOL A315 with a minimum grade of C and GEOL A335 with a minimum grade of C.

GEOL A480 Geologic Field Methods **3 Credits**
Introduces principles and applications of basic geologic field methods including construction of bedrock geologic maps and cross-sections. Emphasizes field note taking, geologic mapping, stratigraphic section measurement and construction. Requires students to complete several field projects including written summary reports.
Special Note: Students may be required to provide their own transportation to and from field sites.
Prerequisites: GEOL A310 with a minimum grade of C and GEOL A322 with a minimum grade of C and GEOL A335 with a minimum grade of C and GEOL A350 with a minimum grade of C.

GEOL A481 Alaskan Field Investigations **3 Credits**
Field excursion in southern and central Alaska. Mapping of sedimentary, metamorphic, and volcanic rocks. Mapping of Quaternary deposits from aerial photography. Construction of stratigraphic sections. Use of appropriate field techniques and tools. Exploration of Alaskan coal and gold mining, permafrost environments, Pleistocene glacial environments, tectonics and volcanic hazards.
Special Note: Course fees cover lodging and camping fees. Students required to provide own food, transportation, field and camping gear.
Prerequisites: GEOL A350 with a minimum grade of D and GEOL A480 with a minimum grade of D.

GEOL A482 Geologic Field Investigations **3 Credits**
Field excursion within the United States or another country to conduct field exercises on bedrock and/or surficial mapping, generate cross-sections from maps, measure and draw stratigraphic sections, and learn regional geology and tectonic settings.
Special Note: Course counts as credit toward the major even if field camp taken elsewhere. Students may be required to provide their own transportation depending on location of field trip.
Prerequisites: GEOL A480 with a minimum grade of C.

GEOL A490 Advanced Topics in Geology **1-4 Credits**
Detailed study of a selected topic in geology.
Special Note: May be repeated for credit with change of subtitle. Not available for credit to students who have completed GEOL A690 with same subtitle.
May Be Stacked With: GEOL A690
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A492 Geology Seminar **1 Credit**
Lecture series with invited professional geologists, discussion of relevant professional papers and research. Topical nature of material.
Special Note: May be repeated under different subtitles for a maximum of 3 credits.
Prerequisites: GEOL A221 with a minimum grade of D.

GEOL A495 Geology Internship **1-3 Credits**
Work experience in an approved position with supervision and training in various agencies and businesses. Exposes student to work environment beyond the campus setting, to acquire essential practical skills and enhance self-confidence and career direction.
Special Note: May be repeated, but only 3 credits count toward major requirements.
Registration Restrictions: Junior standing

GEOL A498 Student Research **1-3 Credits**
Student research conducted on specific subjects in geology. Research topic to be approved and directed by a faculty member in the Department of Geological Sciences.
Special Note: May be repeated for a maximum of 6 credits.
Registration Restrictions: Faculty permission.

GEOL A499 Senior Thesis **3 Credits**
Planning, preparation and completion of senior thesis for the BS in Geological Sciences.
Special Note: May be repeated for a maximum of 6 credits.
Registration Restrictions: Senior standing and faculty permission.

GEOL A623 Advanced Igneous and Metamorphic Petrology **3 Credits**
Igneous and metamorphic processes and the evolution of the lithosphere. Application of field, petrographic and chemical data to models of petrogenesis and metamorphism.
Registration Restrictions: Graduate standing or instructor permission.

GEOL A626 Advanced Mineral Resources **3 Credits**
Mineral resource genesis, classification, exploration, development and associated environmental factors, with a focus on metallic and non-metallic minerals. Specific analysis of mineral resource availability, exploration techniques, viability of extraction and processing, and assessment of environmental implications of extraction. Includes one or more case studies of existing exploration and/or mining sites.
Special Note: Not available for credit to students who have completed GEOL A426.
Registration Restrictions: Graduate standing or instructor permission.
May Be Stacked With: GEOL A426

GEOL A636 Advanced Petroleum Geology **3 Credits**
Advanced study of the formation of hydrocarbons, their migration and accumulation in the context of the petroleum system, and their exploration and extraction. Emphasizes interpretation of subsurface data used in the petroleum industry and their integration. Conventional and unconventional petroleum systems from Alaska and around the world included.
Registration Restrictions: Graduate standing
Special Note: Not available for credit to students who have completed GEOL A436.
May Be Stacked With: GEOL A436

GEOL A637 Advanced Depositional Systems and Dynamic Stratigraphy **3 Credits**
Advanced skills in sedimentary geology that can be applied in oil/gas, hydrology, and mining. Includes greater detail in depositional environments, characteristics of resultant sedimentary deposits, and sequence stratigraphy using various geologic datasets. Emphasis on hands-on application of course concepts in outcrop, core and well-log data.
Special Note: Not available for credit to students who have completed GEOL A437.
Registration Restrictions: Graduate standing
May Be Stacked With: GEOL A437

GEOL A638 Applied Sedimentary Petrology and Diagenesis **3 Credits**
Advanced concepts in sedimentary petrography and petrology, including diagenesis. Topics include advanced rock classification, grain identification in thin section, cement identification, sedimentary fabric, paragenetic sequence and provenance analysis, and porosity estimation in carbonate and clastic sedimentary rocks. Emphasis on hands-on description, interpretation and applications.
Special Note: Not available for credit to students who have completed GEOL A438.
Registration Restrictions: Graduate standing
May Be Stacked With: GEOL A438

GEOL A640 Advanced Hydrogeology **4 Credits**
Comprehensive coverage of the fundamentals of hydrogeology including physical and hydraulic properties of subsurface aquifes, Darcy's Law and the groundwater flow equation, hydraulic head, storage and effective stress, regional groundwater flow, aquifer hydraulics, and water well design and development. Laboratory time will be used to enhance data analysis, mathematical and problem-solving skill sets.
Registration Restrictions: Graduate standing

GEOL A641 Paleoclimatology **3 Credits**
Examines the fundamentals of climate science, changes in Earth's climate, and methods used to reconstruct past climates. Use of paleoclimate data from proxy records like cores of ice, peatland and ocean sediments, and tree rings to help understand how Earth's atmosphere, oceans and land interact with climate through time.
Special Note: Not available for credit to students who have completed GEOL A441. Graduate students have additional student learning outcomes and course expectations.
May Be Stacked With: GEOL A441

GEOL A645 Advanced Geothermal Energy **3 Credits**
Comprehensive coverage of geothermal systems and relevant processes including conductive and convective heat flow, subsurface fluid flow, geothermal exploration, resource assessment, structural settings favorable for geothermal reservoirs, microseismicity, well scaling and corrosion, power generation and enhanced geothermal systems.
Registration Restrictions: Graduate standing
Special Note: Not available for credit to students who have completed GEOL A445.
May Be Stacked With: GEOL A445

GEOL A648 Advanced Structural Geology and Geomechanics **3 Credits**
Classification, origin and evolution of all types of rock fractures with application to structural analysis, oil and gas reservoirs, resource recovery, engineering geology, hydrogeology and hazards analysis. Application of continuum and rock mechanics principles to brittle deformation, including rock strength and failure criteria, stress states in the lithosphere, stress tensors and linear elastic fracture mechanics theory.
Special Note: Students may need to provide their own transportation to a field trip location. Not available for credit to students who have completed GEOL A448.
Registration Restrictions: Graduate standing or instructor permission.
May Be Stacked With: GEOL A448

GEOL A654 Glacial and Quaternary Geology **3 Credits**
Examines glacial processes of erosion and deposition, and the modern and ancient landforms produced by ice. Topics include Quaternary history of glaciers, climate fluctuation, changes in terrestrial and marine environments, and evidence and techniques used to reconstruct past environments. Independent research project and weekend field trip required.
Special Note: Students are required to have background in physical and historical geology and to provide their own transportation to field locales. Not available for credit to students who have completed GEOL A454.
Registration Restrictions: Graduate standing or instructor approval.
May Be Stacked With: GEOL A454

GEOL A658 Advanced Geology of Alaska **3 Credits**
Alaskan geology including physiographic provinces, earthquakes, volcanoes, plate tectonics, resources, glaciers, permafrost, rivers, coasts and wind. Emphasis on processes, landforms and differences between specific areas in Alaska. Independent research and professional presentation required.
Registration Restrictions: Graduate standing
Special Note: Students are required to provide their own transportation for optional field trips. Not available for credit to students who have completed GEOL A458.
May Be Stacked With: GEOL A458

GEOL A661 Advanced Geochemistry **3 Credits**
Introduction to principles and applications of inorganic geochemistry. Emphasis on crystal structures and substitution in crystals, equilibrium geochemistry, dissociation of acids and bases, and mineral stability. Applying the laws of thermodynamics, Eh-pH diagrams, and oxidation-reduction reactions to geologic problems. Principles of radioactivity and geochronometers for age determination. A review of applications of stable isotopes to geologic problems.
Special Note: Not available for credit to students who have completed GEOL A461.
Registration Restrictions: Graduate standing or instructor permission
May Be Stacked With: GEOL A461

GEOL A663 Environmental Geochemistry **3 Credits**
Principles and applications of environmental geochemistry on a global scale. Geochemical cycles and chemical mass balance of elements. Chemical weathering and the composition of natural waters. Processes affecting the distribution of trace elements in geologic environments. Stable isotope fractionation and applications to modeling environmental systems. Review of specific cases of modern environmental geochemistry problems. Independent research project required.
Special Note: Students are required to have background in physical and historical geology. Not available for credit to students who have completed GEOL A463.
Registration Restrictions: Graduate standing or instructor approval
May Be Stacked With: GEOL A463

GEOL A665 Isotope Geochemistry **3 Credits**
Principles and applications of radiogenic and stable isotopes with emphasis on applications in the hydrologic, earth and ecosystem sciences. Focus on both traditional and environmental aspects of isotope geochemistry and biogeochemistry and some special applications to other fields of study such as anthropology, archaeology and forensics. A class research project will include field sampling, sample analysis and interpretation. Independent research project required.
Registration Restrictions: Graduate standing
May Be Stacked With: GEOL A465
Prerequisites: CHEM A106 with a minimum grade of D and GEOL A461 with a minimum grade of D.

GEOL A676 Applied Geophysics **3 Credits**
Overview of geophysical techniques used for subsurface visualization, mapping and interpretation, with applications to natural resource exploration, geotechnical investigations and environmental studies. Techniques include gravity, magnetic, electric, seismic and well logging. Applications of mathematics and physics-based principles to image shallow and deep subsurface at local and regional scales.
Special Note: Not available for credit to students who have completed GEOL A476.
Registration Restrictions: Graduate standing or instructor permission.
May Be Stacked With: GEOL A476

GEOL A677 Integrated Subsurface Mapping and Analysis **3 Credits**
Integration of different geologic and geophysical data for subsurface interpretation and energy exploration. Application of state-of-the-art technologies on real datasets for subsurface mapping, quantitative basin analysis, technical assessment of hydrocarbon prospects, and uncertainty analysis in active and team-based learning environments.
Special Note: A group of five students will be selected to participate at the Imperial Barrel Award (IBA) competition organized by the American Association of Petroleum Geologists (AAPG). Not available for credit to students who have completed GEOL A477.
May Be Stacked With: GEOL A477

GEOL A678 Petroleum Geophysics and Petrophysics **3 Credits**
Principles and methods in seismic analysis and petrophysics, with emphasis on hydrocarbon exploration from conventional and unconventional reservoirs and CO2 storage. Extensive practical training on 2D/3D seismic data analysis, and integration with petrophysical logs to interpret structural and stratigraphic features, analyze subsurface lithology, pore fluid, and map reservoir geobodies.
Registration Restrictions: Graduate standing or instructor permission. Basic understanding of structural geology and/or stratigraphy required.

GEOL A688 Professional Project **3 Credits**
Individualized professional project in an area of geological sciences as related to the profession. Project topic must be approved by the graduate committee.
Registration Restrictions: Graduate standing or instructor permission.

GEOL A689 Geology Graduate Professional Practices **3 Credits**
Professional development of graduate students in preparation for careers in the geosciences.
Registration Restrictions: Graduate students must take this course by the end of the second semester of their degree program.

GEOL A690 Graduate Topics in Geology **1-4 Credits**
Intensive study of narrowly defined topic in geology with emphasis on current problems. Independent research project required.
Special Note: Students are required to have background in physical and historical geology. May be repeated for a maximum of 9 credits with change of subtitle. Not available for credit to students who have completed GEOL A490 with the same subtitle.
Registration Restrictions: Graduate standing or instructor approval.
May Be Stacked With: GEOL A490

GEOL A698 Directed Research **1-6 Credits**
Thesis-specific research for the Master of Science in Applied Geological Sciences. Research topic must be approved by thesis advisor.
Special Note: May be repeated for a maximum of 9 credits.
Registration Restrictions: Graduate standing and permission of thesis advisor

GEOL A699 Graduate Thesis **1-3 Credits**
Preparation and completion of thesis for the Master of Science in Applied Geological Sciences.
Special Note: May be repeated for a maximum of 3 credits.
Registration Restrictions: Graduate standing and permission of graduate advisor required.