## Geology (GEOL)

### Courses

**GEOL A111 Physical Geology 3 Credits**
Introduction to physical geology, study of earth and its materials. 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 Physical Geology Laboratory 1 Credit**
Laboratory skills in physical geology. The identification and classification of minerals and rocks. The use and interpretation of maps and remote sensing techniques, and application of lab skills to interpret evidence of geologic processes. Includes a field trip led by the instructor.

*Prerequisites*: GEOL A111 with a minimum grade of C or concurrent enrollment.  
*Attributes*: UAA Natural Science Lab Only GER.

**GEOL A115 Environmental Geology 3 Credits**
An introduction to the study of applied environmental geology with a focus on geologic processes and linkages to how humans interact with the geologic environment. Both internal and external Earth processes and related topics such as earthquakes and volcanic eruptions as well as coastal processes and mineral and energy resources will be included.

*Registration Restrictions*: MATH A055 or higher  
*Attributes*: UAA Natural Sciences GER.

**GEOL A115L Environmental Geology Laboratory 1 Credit**
Investigation of 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. Several local field trips are included.

*Registration Restrictions*: MATH A055 or higher  
*Prerequisites*: GEOL A115 or concurrent enrollment.  
*Attributes*: UAA Natural Science 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 Fundamentals of Oceanography 3 Credits**
Principles of oceanography, with emphasis on the ocean's biological, physical, chemical, and geological processes, and how ocean processes affect the atmosphere.

*Registration Restrictions*: Placement into MATH A105 or higher.  
*Crosslisted With*: BIOL A178  
*Attributes*: UAA Natural Sciences GER.

**GEOL A179 Fundamentals of Oceanography Laboratory 1 Credit**
Laboratory exercises designed to illustrate principles and concepts developed in BIOL A178/GEOL A178.

*Registration Restrictions*: Placement into MATH A105 or higher.  
*Crosslisted With*: BIOL A179  
*Attributes*: UAA Natural Science 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 Historical Geology 4 Credits**
Introduces the history of the earth through geologic time, emphasizing North America. Includes major events in plate tectonics, 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 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 or WRTG A212 or WRTG A213 or WRTG A214 or WRTG A215).

**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.
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) 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.

GEOL A331 Sedimentology and Stratigraphy 3 Credits
Survey of sediments including origins, classification, transportation, composition, structures, and diagenesis. Stratigraphic principles including 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 A332 Sedimentary Petrology Laboratory 1 Credit
Introduction to elastic petrology, carbonate petrology and sedimentary petrography. Emphasis on hand sample identification and petrographic techniques.
Prerequisites: GEOL A321 with a minimum grade of C and GEOL A331 with a minimum grade of C or concurrent enrollment.

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 mechanisms; and salt tectonics. Laboratory includes analysis of structure contours, geologic maps and cross sections, stereonets, kinematic analysis, and the Mohr circle technique.
Prerequisites: GEOL A311 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 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.

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.

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) and (ENVI A211 with a minimum grade of C or ENVI A212 with a minimum grade of C or GEOL A221 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 A380 Anchorage Field Studies 3 Credits
Field experience focusing on the Anchorage area. Field trips to Anchorage, Eagle River, Turnagain, and Matanuska Valley to investigate the geologic history, glacial history, plate tectonics, and environmental concerns. Local rocks, formations, fossils, glacial landforms and structures will be examined. Five full day field trips.
Prerequisites: GEOL A221.
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 A430 Sedimentology 3 Credits
Survey of sediments, including origins, classification, transportation, composition, structures and diagenesis. Lab analysis of grain size, sedimentary structures, concretions and hand samples. Includes field labs.
Special Note: Students are required to provide their own transportation to field locales.
Registration Restrictions: Junior standing or higher
Prerequisites: GEOL A310 with a minimum grade of C and (STAT A253 with a minimum grade of C or STAT A307 with a minimum grade of C).

GEOL A431 Stratigraphy 3 Credits
Introduction to concepts and applications in stratigraphic analyses. Includes concepts of lithostratigraphy, magnetostratigraphy, biostratigraphy, chronostratigraphy, seismic stratigraphy and sequence stratigraphy. Discussion of the completeness of the stratigraphic record and the North American Stratigraphic Code.
Registration Restrictions: Junior standing or higher
Prerequisites: GEOL A430 with a minimum grade of C.

GEOL A435 Stratigraphy and Sedimentary Petrology 3 Credits
Introduction to stratigraphy of clastic and carbonate rocks including common environments of deposition, sedimentary rock classification, sedimentary rock fabric identification and interpretation, petrographic inspection, and correlation techniques.
Prerequisites: GEOL A321 with a minimum grade of C or concurrent enrollment and GEOL A430 with a minimum grade of C or concurrent enrollment.

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 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 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 A455 Permafrost 3 Credits
Examines permafrost geomorphic processes, environments and landforms. Topics include properties of ground ice and patterned ground, permafrost landscape dynamics, engineering and environmental problems, and impacts of climate change on permafrost systems. One weekend field trip required.
Special Note: Students are required to provide their own transportation to field locales. Not available for credit to students who have completed GEOL A655.
Registration Restrictions: Instructor approval
May Be Stacked With: GEOL A655
Prerequisites: GEOL A221 with a minimum grade of C.

GEOL A456 Geoarchaeology 3 Credits
Integration of geology and archaeology. Rock identification of lithic sources, sediment analysis of site deposits, paleolandcape reconstruction, geochronology and environmental change. Response to changes in resources and climate by past societies and application to contemporary problems and issues.
Special Note: Students are required to provide their own transportation to field locales. Not available for credit to students who have completed GEOL A656.
Registration Restrictions: Junior standing or higher
May Be Stacked With: GEOL A656
Prerequisites: ANTH A211 with a minimum grade of C and GEOL A221 with a minimum grade of C.
Attributes: UAA Integrative Capstone GER.

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
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
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 and GEOL A461.

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 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
Special Note: Course fees cover lodging and camping fees. Students required to provide own food, transportation, field and camping gear.
Prerequisites: GEOL A350 and GEOL A480.
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.
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: 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 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. Laboratory time will be used to enhance data analysis, mathematical and problem-solving skill sets.
Registration Restrictions: Graduate standing

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 A655 Permafrost 3 Credits
Examines permafrost geomorphic processes, environments and landforms. Topics include properties of ground ice and patterned ground, permafrost landscape dynamics, engineering and environmental problems, and impacts of climate change on permafrost systems. One weekend field trip and independent research required.
Special Note: Students are required to have background in physical and historical geology and provide their own transportation to field locales. Not available for credit to students who have completed GEOL A455.
Registration Restrictions: Graduate standing or instructor approval.
May Be Stacked With: GEOL A455
GEOL A656 Geoarchaeology 3 Credits
Integration of geology and archaeology. Rock identification of
lithic sources, sediment analysis of site deposits, paleolandscape
reconstruction, geochronology and environmental change. Response
to changes in resources and climate by past societies and application
to contemporary problems and issues. Independent research project
required.
**Special Note:** Students are required to have background in physical and
historical geology and provide their own transportation to field locales.
Not available for credit to students who have completed GEOL A456.

**Registration Restrictions:** Graduate standing or instructor permission
**May Be Stacked With:** GEOL A456

GEOL A658 Advanced Geology of Alaska 3 Credits
Alaskan geology including physiographic provinces, earthquakes,
voleanoes, 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 and GEOL A461.

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 interdisciplinary M.S. with emphasis in Geological Sciences. Research topic must be approved by thesis advisor and committee.

**Special Note:** May be repeated for a maximum of 6 credits.

**Registration Restrictions:** Graduate standing and permission of thesis advisor.

GEOL A699 Graduate Thesis 1-6 Credits
Planning, preparation and completion of thesis for M.S. degree at graduate level.

**Registration Restrictions:** Graduate standing

**Special Note:** Permission of graduate advisor required. May be repeated for a maximum of 12 credits.