

## Upper Division and Graduate Earth & Planetary Science Courses

The upper division and graduate courses listed below are taken from the UNM 2006-2007 Catalog, and represent our current listing of courses. Please note that not all courses are offered every year, and some courses are not offered on a regular basis. Please consult the "Current Course Information" on our web site for the schedule of classes offered in the current semester.

The key to the symbols used in the listing may be found at the end of the document. Please consult UNM's complete catalog or the degree requirements given on our web page (<http://epswww.unm.edu>) for more detailed information. While we have attempted to be accurate here, we are not responsible for errors in these listings; the UNM Catalog (<http://www.unm.edu/~unmreg/catalog.htm>) is the authoritative source for this information. Questions regarding listed courses may be directed via Email to [epsdept@unm.edu](mailto:epsdept@unm.edu).

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### **\*\*300. Topics in Geology. (1-4 to a maximum of 6) Δ**

Summary of specific areas of geology, designed especially for earth science teachers and other nontraditional students. Subjects may vary from year to year; lectures normally supplemented by laboratory exercises.

### **\*\*301. Mineralogy/Earth and Planetary Materials. (3)**

Introduction to crystallography, crystal chemistry and their relation to physical and chemical properties of materials. Overview of major structure types and crystal chemistry/ occurrence of common rock-forming minerals. EPS majors must enroll in 301 and 302L in the same semester.

Prerequisite: CHEM 121L. {Fall}

### **\*\*302L. Mineralogy Laboratory. (2)**

Laboratory exercises in crystallography and crystal chemistry. Hand specimen identification of the common rock-forming minerals. {Fall}

### **\*\*303L. Igneous and Metamorphic Petrology. (4) Selverstone**

Introduction to processes leading to formation of igneous and metamorphic rocks. Emphasis on plate tectonic settings and interactions between physical and chemical processes.

Prerequisites: 301 and 302L and (MATH 162 or CHEM 121L).

{Spring}

### **\*\*304L. Sedimentology and Stratigraphy. (4) Elrick**

Introduction to origin, petrology and stratigraphic occurrence of sedimentary rocks.

Prerequisites: 201L and CHEM 121L, 303L. {Fall}

### **\*\*307L. Structural Geology. (4) Geissman, Karlstrom**

Nature and origin of rock structures and deformation; map and stereographic projection problems; stress and strain.

Pre- or corequisite: 303L. Prerequisites: 304L, and PHYC 151 or 160. {Spring}

### **310L. New Mexico Field Geology. (4) Geissman, Karlstrom**

Scientific method based on field observation, analysis of geologic phenomena and geologic history of New Mexico. Written report for each 4-hour field trip to outcrops in the Albuquerque area.

Prerequisites: 101 or ENVS 101, and EPS 105L, or ENVS 102L.

**\*\*319L. Introductory Field Geology. (4) Geissman**

Principles and techniques of basic field mapping, layout, preparation, and presentation of maps and cross-sections; construction of geologic reports.

Prerequisites: 304L and 307L. Offered as a 3-week summer course (20 consecutive days).

**\*\*333. Environmental Geology. (3) Smith**

Earth processes and anthropogenic environmental factors and their cycles. Physical and chemical aspects of environmental change will be considered.

Prerequisite: 101 or ENVS 101, C or better in MATH 150.

**352. Global Climate Change. (3) Gutzler**

(Also offered as GEOG 352.) Comparison of natural and anthropogenic causes of large-scale climate change. Factors influencing development of mitigation of adaptation policies.

Restriction: permission of instructor.

**\*\*365. Exploring the Solar System. (3) Agee**

Survey of space exploration past, present, and future. Detailed overview of solar system formation, the Sun, the planets and their moons, asteroids, comets, meteorites and astrobiology.

Recommended: 101 or ENVS 101.

**\*400. Topics in Earth & Planetary Sciences. (1-4 to a maximum of 6) Δ**

**401./501. Colloquium. (1 to a maximum of 2) †**

Current topics in geology. For graduate students, may be repeated once for credit towards degree. See description for 490.

Restriction: junior standing. **Offered on CR/NC basis only.**

**405L./505L. Stable Isotope Geochemistry. (3) Sharp**

Examinations of principles governing the distribution of stable isotopes in geological materials and their applications in understanding geochemical processes.

Prerequisite: CHEM 121L and MATH 163.

**407L./507L. Thermodynamics and Physical Foundations of Geochemistry. (4) Sharp**

Thermodynamics and application to geologic systems, phase equilibria, phase rule, ideal and nonideal solutions.

Prerequisite: 303L and CHEM 121L and MATH 163.

**410./510. Fundamentals of Geochemistry. (3) Asmeron**

Geochemistry of igneous, metamorphic and sedimentary rocks. Geochemical methodology.

**\*411L. Invertebrate Paleontology. (4) Kues**

General principles and familiarization with diagnostic features of fossils. Introduction to environmental implications. 8 hrs. of EPS or BIOL recommended.

**415./515. Geochemistry of Natural Waters. (3) Crossey**

Principles of aqueous chemistry and processes controlling the composition of natural waters: streams, lakes, groundwater and the oceans.

Prerequisites: 304L or CHEM 122L.

**420L./520L. Advanced Field Geology. (4) Karlstrom**

Advanced geological field techniques; special field problems concentrating on the tectonic evolution of the Rocky Mountain region.

Prerequisite: 319L. Offered as a 3-week course (20 consecutive days). {Summer}

**421L./521L. Metamorphism. (4)** Selverstone

Metamorphic petrology and its applications to interpretation of tectonics processes. Discussions include thermochemistry, phase equilibria, thermobarometry, P-T paths and behavior of metamorphic fluid phase.

**427./527. Geophysics. (3)** Geissman, Huestis, Roy

(Also offered as PHYC 327.) Applications of gravity, magnetics, seismology, heat flow to the structure, constitution and deformation of earth. Related aspects of plate tectonics and resource exploration.

Prerequisites: (101 or ENVS 101) and MATH 163 and PHYC 161.

**433./533. Statistics and Data Analysis in Earth Science. (3)**

Selected mathematical methods of geological data analysis, including elementary statistics, matrix algebra, multivariate data analysis and Fourier analysis.

Prerequisites: MATH 163, knowledge of a computing language.

**436./536. Climate Dynamics. (3)** Gutzler

A quantitative introduction to the Earth's climate system, emphasizing processes responsible for maintaining the current climate and governing climate change on global and regional scales, including interactions between the atmosphere, ocean and biosphere.

Prerequisites: MATH 162, PHYC 160.

**\*439. Paleoclimatology. (3)** Fawcett

History of the Earth's climate. Examination of methods in climactic reconstruction and mechanisms of climactic change. Emphasis on Pleistocene and Holocene climactic records.

Prerequisites: 101 or ENVS 101.

**443./543. [\*443L.] Aquifers and Reservoirs. [Subsurface Geology.] (3)**

Approaches of describing, evaluating, and modeling aquifer and reservoir character, focusing primarily on sedimentary systems. Techniques include well log analysis, cross-section construction, structure and isopach map contouring, and geostatistical simulation.

Prerequisite: 101. Recommended: 304L.

**445./545. Topics in Sedimentology and Stratigraphy. (1- 4 to a maximum of 6) Δ** Smith, Elrick

Variable course content depending on student interest. Topics may include physical sedimentology, sequence stratigraphy, basin analysis, cycle stratigraphy and chemostratigraphy.

**450L./550L. Volcanology. (4)** Fischer

Characteristics and mechanism of volcanic systems, volcanism in various continental and marine tectonic settings. Laboratory to include field and laboratory examination of volcanic rocks and structures and models of volcanic processes.

Prerequisite: 303L.

**453L./553L. Field Studies in Volcanology. (4)** Fischer, Goff, Smith

**Upper Division and Graduate Earth & Planetary Science Courses**

Field interpretations of volcanic and pyroclastic rocks; applications to petrology, economic geology, geothermal energy. Base: Young Ranch, Jemez volcanic field.

Prerequisite: 319L. {Three summer weeks}

**455L./555L. Computational and GIS Applications in Geomorphology. (3)** Scuderi  
Techniques in acquisition, processing, analysis and display of digital, aerial photo and remote-sensing data; regional quantitative morphometry; use of topography and geology with GIS in landscape evolution and analysis.

Prerequisites: (101 or ENV5 101) and 433 and 481L.

**457L./557L. Mathematical Modeling in the Geosciences. (3)** Fawcett

Introduction to basic numerical modeling techniques with broad application to dynamic systems in the geosciences including sedimentology, geochemistry, hydrology, climatology and paleoclimatology.

Prerequisites: MATH 163 and PHYC 160.

**462./562. Hydrogeology. (3)** Campana, Weissmann

Hydrologic and geologic factors controlling groundwater flow, including flow to wells.

The hydrologic cycle; interactions between surface and subsurface hydrologic systems; regional flow systems. Groundwater geochemistry and contaminant transport.

Prerequisites: (105L or ENV5 102L) and MATH 162 and CHEM 121 and PHYS 160.

**465./565. Mars Evolution. (3)** Agee

Formation, evolution, and composition of Mars Atmosphere, surface, and interior processes. Martian meteorites. The search for life on Mars. Mars missions past and present and NASA's plans for future exploration of Mars.

Recommended: 365

**467./567. Environmental Mechanics. (3)**

Introduction to stress and strain, dimensional analysis, fluid flow and heat transfer with applications to problems in the earth and environmental sciences.

Prerequisites: MATH 163 and PHYC 160.

**472./572. Subsurface Fate and Transport Processes. (3)**

Physicochemical, hydrogeological, biological and mathematical aspects of chemical fate and transport in subsurface porous and fractured media. Introduction to multiphase and nonaqueous phase flow.

Prerequisites: (462 or C E 441) and (MATH 163 or 181). {Spring}

**476./576. Physical Hydrology. (3)**

Quantitative treatment of the hydrologic cycle—precipitation, evapotranspiration, runoff and subsurface flow; global change and hydrology; catchment and hillslope hydrology; hydrologic system—ecosystem interactions; hydrology and water resources management.

Prerequisites: MATH 163 and PHYC 160. Restriction: junior or senior standing. {Fall}

**481L./581L. Geomorphology and Surficial Geology. (4)** Meyer

Origin and development of landforms with emphasis on weathering, soils, hillslope processes, fluvial systems and surficial geology; occasional field trips.

Prerequisites: (101 and 105L) or (ENV5 101 and 102L).

**482L./582L. Geoarchaeology. (3)** Smith

(Also offered as ANTH 482L.) Application of geological concepts to archaeological site formation with emphasis on pre-ceramic prehistory of the southwestern United States.

Quaternary dating methods, paleoenvironment, landscape evolution, depositional environments. Quaternary stratigraphy, soil genesis, sourcing of lithic materials, site formation processes. Required field trip.

Prerequisites: 101, and 105L, and ANTH 121L, and ANTH 220, and at least junior standing. {Spring}

**485L./585L. Soil Stratigraphy and Morphology. (3) McFadden**

Application of soils studies to stratigraphic analysis and mapping of Quaternary deposits and geomorphic surfaces; survey of soil classifications; field description of soil profiles; development of soil chronosequences and catenas.

Prerequisite: 101 or ENVS 101.

**\*488L. Scanning Electron Microscopy. (3) Spilde**

Introduction to the theory and operation of the scanning electron microscope. Topics covered: basic electron optics, electron-specimen interaction, image formation and interpretation, digital image analysis, X-ray spectroscopy and introductory energy dispersive analysis.

Prerequisite: PHYC 161.

**\*490. Geologic Presentation. (1)**

Student review of geologic literature; preparation and critique of oral presentations.

Pre- or corequisite: 304L. Corequisite: 401.

**491–492. Problems. (1-3, 1-3)**

**493. Independent Study. (3)**

Independent study for departmental honors.

Prerequisite: candidacy for honors in Earth and Planetary Sciences.

**495. Senior Thesis. (3) †**

Prerequisite: candidacy for honors in Earth and Planetary Sciences.

Prerequisite: 493.

**501./401. Colloquium. (1 to a maximum of 2) † Δ**

Current topics in geology. For graduate students, may be repeated once for credit towards degree. See description for 490. Offered on CR/NC basis only.

**503. Organic Geochemistry. (3) Crossey**

Fundamentals of organic geochemistry; global carbon cycle; formation of hydrocarbons; environmental fate of organic compounds in the surface environment.

**505L./405L. Stable Isotope Geochemistry. (3) Sharp**

Examinations of principles governing the distribution of stable isotopes in geological materials and their applications in understanding geochemical processes.

Prerequisite: CHEM 121L and MATH 163.

**506L. Mathematical Crystallography. (4)**

Basic principles of crystallographic calculations including the derivation of point groups and space groups.

Prerequisite: MATH 314.

**507L./407L. Thermodynamics and Physical Foundations of Geochemistry. (4)**

Sharp

Thermodynamics and application to geologic systems, phase equilibria, phase rule, ideal and nonideal solutions.

Prerequisite: 303L and CHEM 121L and MATH 163.

**508L. Paleomagnetism and Applications to Geological Problems. (3)** Geissman  
Discussion of the source, origin and application of geologically important magnetizations in rocks. Experience in field sampling and data collection and analysis.

Prerequisites: 307L, and PHYC 152L.

**509. Environmental Geochemistry. (3)** Asmerom, Crossey

Topical examination of geochemical aspects of environmental issues, with emphasis on critical phenomena of societal relevancy.

Restriction: permission of instructor.

**510./410. Fundamentals of Geochemistry. (3)** Asmerom

Geochemistry of igneous, metamorphic and sedimentary rocks. Geochemical methodology.

**511. Sedimentary Geochemistry. (3)** Crossey

The application of geochemical principles to surface and subsurface processes in sedimentary systems.

**512L. High-temperature Geochemistry. (3)**

Applications of thermodynamics to the study of metamorphic and igneous processes and of high-temperature gases.

Pre- or corequisites: 304L, 407L.

**513. Planetary Materials and the Evolution of the Solar System. (3)**

Discussion of the origin and evolution of the planets, including planet Earth, based on study of lunar samples, terrestrial samples and meteorites; theory; earth based observations; and space missions.

**514. Precambrian Geology. (3)**

An interdisciplinary course which evaluates the first 3,500 million years of earth history.

Initial lectures focus on methodology (geochemistry, geochronology, petrology, structure), followed by discussion of specific Archean and Proterozoic geologic terrains.

Prerequisite: 307L.

**515./415. Geochemistry of Natural Waters. (3)** Crossey

Principles of aqueous chemistry and processes controlling the composition of natural waters: streams, lakes, groundwater, and the oceans.

**516. Selected Topics in Geomorphology. (3, no limit) Δ** McFadden, Meyer

**517L. Instrumental Methods in Geochemistry. (2-4 to a maximum of 8) [2-4] † Δ**

Principles and applications of selected instrumentation methods in analytical geochemistry. Instrumentation methods discussed each year may vary. This is a hands-on course that is designed to train scientists in instrumentation use applicable to their research and to provide them valuable tools for future employment.

Prerequisite: permission of instructor.

**518L. Electron Microprobe Analysis. (3)**

Theory and practice of electron microprobe analysis emphasizing geological materials.

Prerequisite: permission of instructor and a demonstrated need for the use of instrument.

**519L. Selected Topics in Geochemistry. (2-4 to a maximum of two times) Δ**

Prerequisite: permission of instructor. {Offered upon demand}

**520L./420L. Advanced Field Geology. (4)** Karlstrom

Advanced geological field techniques; special field problems concentrating on the tectonic evolution of the Rocky Mountain region.

Prerequisite: 319L. Offered as a 3-week course (20 consecutive days). {Summer}

**521L./421L. Metamorphism. (4) Selverstone**

Metamorphic petrology and its applications to interpretation of tectonics processes. Discussions include thermochemistry, phase equilibria, thermobarometry, P-T paths and behavior of metamorphic fluid phase.

**522. Selected Topics in Geophysics. (3, no limit) Δ Geissman, Roy**

Prerequisite: permission of instructor.

**523. Topics in Tectonics. (3, no limit) Δ**

Prerequisite: permission of instructor.

**526L. Advanced Structural Geology. (4) Karlstrom**

Study of the processes and products of rock deformation at all scales: lithosphere, mountain belts and microstructures.

Prerequisite: 307L.

**527./427. Geophysics. (3) Geissman, Roy**

(Also offered as PHYC 327.) Applications of gravity, magnetics, seismology, heat flow to the structure, constitution and deformation of earth. Related aspects of plate tectonics and resource exploration.

Prerequisites: (101 or ENVS 101) and MATH 163 and PHYC 161.

**531L. Igneous Petrology. (4)**

Discussion of the properties, generation, emplacement and differentiation of magma; applications of physical/chemical principles to the study of igneous rocks.

Prerequisite: 303L.

**533./433. Statistics and Data Analysis in Earth Science. (3)**

Selected mathematical methods of geological data analysis, including elementary statistics, matrix algebra, multivariate data analysis and Fourier analysis.

Prerequisites: knowledge of a computing language.

**534. Radiogenic Isotope Geochemistry. (3) Asmerom**

Examination of principles governing the abundance of naturally occurring radiogenic isotopes and their use in the study of global geochemical processes.

**535. Freshwater Ecosystems. (3)**

(Also offered as BIOL 535.) Integration of physical and chemical components of drainage basins and groundwater systems with biological metabolism, growth and reproduction along functional gradients of stream, wetland, reservoir, lake and groundwater ecosystems.

Prerequisites: (MATH 162 or 180) and CHEM 122L and BIOL 495. {Spring}

**536./436. Climate Dynamics. (3) Gutzler**

A quantitative introduction to the Earth's climate system, emphasizing processes responsible for maintaining the current climate and governing climate change on global and regional scales, including interactions between the atmosphere, ocean and biosphere.

MATH 162 and PHYC 160 recommended.

**538L. Analytical Electron Microscopy. (3)**

*Principles and practical techniques of transmission and analytical electron microscopy for materials characterization. Topics covered include: diffraction and phase contrast image formation, selected area and convergent beam electron diffraction; energy-dispersive x-ray spectroscopy.*

*Prerequisites: 587 and 518L.*

**540. Carbonate Sedimentology and Stratigraphy. (4) Elrick**

*Carbonate depositional processes (ancient and modern), facies patterns, associated rock types, and basin analysis. Includes laboratories covering skeletal and grain types, cements and carbonate diagenesis.*

*Prerequisite: 304L.*

**543./443. [\*443L.] Aquifers and Reservoirs. [Subsurface Geology.] (3)**

*Approaches of describing, evaluating, and modeling aquifer and reservoir character, focusing primarily on sedimentary systems. Techniques include well log analysis, cross-section construction, structure and isopach map contouring, and geostatistical simulation.*

*Prerequisite: 101. Recommended: 304L.*

**544L. Sedimentary Petrology. (4) Crossey**

*The mineralogy and chemistry of clastic sedimentary rocks. Examination of provenance and diagenesis through field and laboratory exercises.*

*Prerequisite: 304L.*

**545./445. Topics in Sedimentology and Stratigraphy. (1- 4 to a maximum of 6) Δ**

*Smith, Elrick*

*Variable course content depending on student interest. Topics may include physical sedimentology, sequence stratigraphy, basin analysis, cycle stratigraphy and chemostratigraphy.*

**547–548. Seminar. (2-3, 2-3, no limit) Δ**

**550L./450L. Volcanology. (4) Fischer**

*Characteristics and mechanism of volcanic systems, volcanism in various continental and marine tectonic settings. Laboratory to include field and laboratory examination of volcanic rocks and structures, models of volcanic processes.*

*Prerequisite: 303L.*

**551–552. Problems. (1-3, 1-3)**

*Maximum of three units of problems can count toward M.S. or Ph.D. course requirements.*

**553L./453L. Field Studies in Volcanology. (4) Fischer, Goff, Smith**

*Field interpretations of volcanic and pyroclastic rocks; applications to petrology, economic geology, geothermal energy. Base: Young Ranch, Jemez volcanic field.*

*Prerequisite: 319L. {Three summer weeks}*

**555L./455L. Computational and GIS Applications in Geomorphology. (3) Scuderi**

*Techniques in acquisition, processing, analysis and display of digital, aerial photo and remote-sensing data; regional quantitative morphometry; use of topography and geology with GIS in landscape evolution and analysis.*

*EPS 101 or ENVS 101 and EPS 433 and 481 recommended.*

**557L./457L. Mathematical Modeling in the Geosciences. (3) Fawcett**

*Introduction to basic numerical modeling techniques with broad application to dynamic systems in the geosciences including sedimentology, geochemistry, hydrology, climatology and paleoclimatology.*

**558. Geomicrobiology. (3) Dahm, Crossey**

*(Also offered as BIOL 558.) The role of microbes in mineral precipitation, dissolution and diagenesis; interactions between microbes and geochemistry/mineralogy.*

**562./462. Hydrogeology. (3) Weissmann**

*Hydrologic and geologic factors controlling groundwater flow, including flow to wells. The hydrologic cycle; interactions between surface and subsurface hydrologic systems; regional flow systems. Groundwater geochemistry and contaminant transport.*

*Prerequisites: 105L or ENVS 102L, and MATH 162 and CHEM 121 and PHYS 160.*

**564. Geological Fluid Mechanics. (3)**

*Examination of fluid behavior within a geological context. Dimensional analysis and similitude; mass, momentum and energy conservation; inviscid and viscous flows; turbulence; and thermally-driven flows. Applications to problems in the earth and environmental sciences.*

*Prerequisites: MATH 264 and PHYC 161. {Spring}*

**565./465. Mars Evolution. (3) Agee**

*Formation, evolution, and composition of Mars Atmosphere, surface, and interior processes. Martian meteorites. The search for life on Mars. Mars missions past and present and NASA's plans for future exploration of Mars.*

*Recommended: 365*

**566. Selected Topics in Hydrogeology. (1-3 to a maximum of 6) Δ Weissmann**

*Variable course content depending upon student demand and instructor availability.*

*Prerequisite: permission of instructor.*

**567./467. Environmental Mechanics. (3)**

*Introduction to stress and strain, dimensional analysis, fluid flow and heat transfer with applications to problems in the earth and environmental sciences.*

*MATH 163 and PHYC 160 recommended.*

**570. Physical Climatology. (3) Gutzler**

*(Also offered as GEOG 570.) Theory and observation of the Earth's climate system. Radiative transfer, conservation of heat and momentum, maintenance of circulation systems, mechanisms of climate change.*

*Prerequisites: (436 or 536 or GEOG 351) and MATH 163 and PHYC 161.*

**572./472. Subsurface Fate and Transport Processes. (3)**

*Physicochemical, hydrogeological, biological and mathematical aspects of chemical fate and transport in subsurface porous and fractured media. Introduction to multiphase and nonaqueous phase flow.*

*Prerequisites: (462 or CE 441) and (MATH 163 or 181). {Spring}*

**574L. Hydrogeology Laboratory. (1) Weissmann**

*Laboratory and field exercises in subsurface hydrology: physical properties of porous media, flow net analysis, groundwater basin storage and recharge, pump and piezometer tests, well design, sampling.*

*Pre- or corequisite: 462 or C E 441.*

**575. Advanced Volcanology. (3)**

## Upper Division and Graduate Earth & Planetary Science Courses

Dynamics of volcanic eruptions, monitoring of volcanic hazards, geothermal energy, epithermal, numerical and analytical research techniques.

Prerequisite: 450L.

### **576./476. Physical Hydrology. (3)**

(Also offered as WR 576.) Quantitative treatment of the hydrologic cycle—precipitation, evapotranspiration, runoff and subsurface flow; global change and hydrology; catchment and hillslope hydrology; hydrologic system—ecosystem interactions; hydrology and water resources management.

Prerequisites: upper-division standing, MATH 163, PHYC 160. {Fall}

### **580. Advanced Hydrogeology. (3)**

Advanced treatment of subsurface fluid flow and other transport phenomena through granular and fractured media.

Prerequisites: (462 or C E 441) and MATH 264.

### **581L./481L. Geomorphology and Surficial Geology. (4) Meyer**

Origin and development of landforms with emphasis on weathering, soils, hillslope processes, fluvial systems and surficial geology; occasional field trips. Intro to Geology or Environmental Science recommended.

### **582L./482L. Geoarchaeology. (3) Smith**

(Also offered as ANTH 582L.) Application of geological concepts to archaeological site formation with emphasis on pre-ceramic prehistory of the southwestern United States. Quaternary dating methods, paleoenvironment, landscape evolution, depositional environments. Quaternary stratigraphy, soil genesis, sourcing of lithic materials, site formation processes. Required field trip.

Prerequisites: 101, 105L, ANTH 121L, ANTH 220 and at least junior standing in EPS or Anth. {Spring}

### **584. Soil Genesis. (3) McFadden**

Processes of physical and chemical weathering; influence of soil parent materials, climate topography and time on soil formation; application of soil studies to geologic problems.

Prerequisites: 101 or ENVS 101, 481L.

### **585L./485L. Soil Stratigraphy and Morphology. (3) McFadden**

Application of soils studies to stratigraphic analysis and mapping of Quaternary deposits and geomorphic surfaces; survey of soil classifications; field description of soil profiles; development of soil chronosequences and catenas.

Prerequisites: 101 or ENVS 101. EPS 481L recommended.

### **587. Advanced Mineralogy. (3) Brearley**

Crystallographic principles; structure, chemistry, physical properties of rock forming minerals.

Prerequisites: 301, 302L, CHEM 122L.

### **599. Master's Thesis. (1-6)**

Offered on a CR/NC basis only.

### **699. Dissertation. (3-12)**

Offered on a CR/NC basis only.

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**Key to Symbols used in course descriptions:**

**Upper Division and Graduate Earth & Planetary Science Courses**

- \* *Course allowed for graduate credit to students enrolled in a graduate program. Normally, a graduate student enrolled in a starred course numbered below 500 is required to do extra work.*
- \*\* *Available for graduate credit except for graduate majors in the department.*
- † *May be repeated for credit with permission of department chairperson (or dean).*
- Δ *May be repeated for credit because subject matter varies.*
- L *Part of the course is laboratory work; hours of lecture and laboratory are given at end of description.*
- ( ) *Semester hours' credit; credit-hours separated by a hyphen (1-3) indicates variable credit in the course.*
- [ ] *Former course number or title.*
- { } *Session in which course is expected to be offered. Session offered for other courses not indicating this information must be obtained from department chairperson.*