

**Descriptions – Geography
of
Courses**

446. Production Cartography
Winter. 4(2-4) GEO 223 or approval of department.

Deals with the technical aspects of map and graphics production both as a sequence of operations and as a series of problems of organizations. Theoretical and applied aspects, process photography, typography, and proofing.

451. Climatic Patterns and Atmospheric Circulation
Winter. 4(3-0) GEO 206 or approval of department.

Relationship between weather, climate, and upper air flow, with emphasis on this climatology of North America.

458. Geography for Teachers
Winter. 3(3-0)

Problems and practices of teaching geography in elementary and secondary schools.

466. Social and Spatial Approaches to Community Service
Spring. 3(3-0) GEO 201 or S W 205 or approval of department. Interdepartmental with the School of Social Work.

Analysis of major themes in social service planning: communities and neighborhoods, public policy administration, social service networks, location of public facilities, evaluation and accountability of service systems.

470. Geography of Health and Disease
Fall, Winter. 3(3-0)

Spatio-environmental concepts and the techniques applied to health problems: disease transmission cycles, community nutrition and health-care planning.

801. Seminar in Cultural Geography
Fall. 3(3-0) Approval of department.

Theory, methodology, and techniques in cultural geography.

805. Seminar in Urban Geography
Spring. 3(3-0) Approval of department.

Selected research topics on the geography of the city.

809. Seminar in Transportation Geography
Winter. 3(3-0) Approval of department, GEO 409.

Selected research topics.

810. Seminar in Historical Geography
Winter. 3(3-0) Approval of department.

Approaches in research in historical geography.

811. Advanced Quantitative Methods in Geographic Research
Winter. 4(2-4) Approval of department, GEO 427.

Statistical and mathematical approaches to spatial distributions and areal data.

812. Regional Seminar
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 9 credits. Approval of department.

Selected research topics in regional geography.

818. Readings in Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 15 credits. Approval of department.

825. History and Philosophy of Geography
Fall. 3(3-0) Approval of department.

Analysis of the monographic and serial literature dealing with the theory and evolution of geographic science.

826. Research Design in Geography
Winter, Spring. 3(3-0) Approval of department.

Formalized approach to research and writing in geography: Identification of geographic problems and their relative importance, structuring and stating hypotheses, data acquisitions, and tests for validity.

828. Seminar in Recreation Geography
Spring. 3(3-0) GEO 309 or approval of instructor.

Selected current problems in recreation geography in the U.S. and abroad.

834. Seminar in Physical Geography
Winter, Spring. 3(3-0) May reenroll for a maximum of 9 credits. Approval of department.

Analysis of classical and contemporary problems in physical geography treated as follows: climatology (winter), biogeography (spring), geomorphology (spring).

835. Seminar in Location Theory
Fall. 3(3-0) Approval of department, GEO 435.

Recent developments and research in location analysis and regional science.

836. Population Geography Seminar
Spring. 3(3-0) Approval of department.

Studies of particular topics and problems in population geography.

IDC. Sub-Saharan Africa Seminar
For course description, see Interdisciplinary Courses.

846. Seminar in Cartography
Winter. 3(3-0) May reenroll for a maximum of 12 credits. Approval of department.

Selected research topics in cartographic theory and map design.

850. Advanced Field Techniques
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits.

Instruction and practical training in the selection, data-gathering, on-site analysis, and presentation of geographic field problems.

870. Seminar in Medical Geography
Winter. 3(3-0)

Spatio-environmental analysis of selected health problems.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

901. Problems in Cultural Geography
Fall, Winter, Spring. Variable credit. May reenroll for a maximum of 6 credits. Approval of department.
Special research problems.

902. Problems in Physical Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits.

Supervised research in specific topics of physical geography.

906. Problems in Economic Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits. Approval of department.
Special research problems.

908. Problems in Political Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits. Approval of department.
Special research problems.

910. Problems in Historical Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 6 credits. Approval of department.
Special research problems in historical geography.

912. Independent Study in Regional Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 15 credits. Approval of department.
Individual studies in regional geography.

918. Problems in Geography
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 9 credits. Approval of department.
Research on specific geographical problems.

934. Problems in Population
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 9 credits. Approval of department.
Special research problems.

970. Problems in Medical Geography
Fall, Winter, Spring. Variable credit. May reenroll for a maximum of 6 credits. Approval of department.
Selected research topics in medical geography.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

GEOLOGY

GLG

College of Natural Science

200. The Geology of Man's Environment
Fall, Winter, Spring, Summer. 3(3-0)
Not open to Geology majors. Credit will be given in only one of the following: GLG 200, GLG 201, GLG 306.

Man and his geologic environment: earthquakes, volcanoes, landslides, subsidence, flooding, coastal erosion, hydrology and human use, waste disposal, geologic aspects of environmental health, resources and energy, environmental law.

200L. Laboratory–Geology of Man’s Environment

Fall, Winter, Spring, Summer. 1(0-3) GLG 200 or concurrently.

Laboratory study of geologic processes associated with environmental hazards. Emphasis placed on land-use planning, applying geologic criteria to evaluate land potentials.

201. Earth Processes

Fall, Winter, Spring. 4(4-2) Credit will be given for only one of the following: GLG 200, GLG 201, GLG 306.

Physical processes concerning evolution of Earth and its environments. Conservation and interaction of energy and matter through time. Laboratory stresses interpretation of process through studies of geologic data.

202. Evolution of the Earth

Fall, Winter, Spring. 4(4-2) GLG 200; or GLG 201; or GLG 306.

Integration of physical, chemical and biological processes from which man’s present environment has evolved; problems and controversies in the development of ideas of geologic and organic evolution.

205. Oceanology–The Marine Environment and Man

Fall. 3(3-0)

Physical oceanography, including origin, hydrologic, chemical, geological properties; and environmental quality of the oceans. Man-sea interactions are emphasized including resource utilization and pollution.

221. Minerals, Rocks and Fossils

Spring 3(2-3) Not open to majors.

Description, occurrence and identification of minerals, rocks, fossils, and additional features of especial significance to general science teachers and other earth science interest groups.

282. Energy Resources of the Earth

Winter. 3(3-0)

World energy resources of petroleum, coal, and atomic fuel. Social, political, economic and environmental problems of fuels.

300. Solar System Geology

Winter. 4(4-0) AST 119 or AST 217 or AST 229; GLG 200 or GLG 201.

The origin, relationships, make-up and features of the bodies in the solar system emphasizing recent space exploration results and developing theories.

302. Vertebrate Life of the Past

Fall. 3(3-0) One course in a physical or biological science or Juniors. Interdepartmental with the Department of Zoology.

Fossil vertebrates from fish to man.

304. Geology of Michigan

Fall. 3(3-0) GLG 200 or GLG 201 and/or GLG 202; or approval or department.

A historical accounting of the physical, historical and economic geology of Michigan and its environs; a course designed for students seeking an overall picture of the rather unique Michigan geological environment.

306. Engineering Geology

Fall, Spring. 3(3-2) Credit will be given for only one of the following: GLG 200, GLG 201, GLG 306. Sophomore Engineering students.

Fundamental principles of geology as applied to civil engineering practice. Minerals and rocks, aerial photographs, topographic and areal geologic maps and geologic cross sections studied in laboratory. Source of geologic literature and maps.

307. Geology Central Appalachians

Winter. 1(0-2) GLG 200, or GLG 201, or GLG 202, or concurrently.

General geology of the Central Appalachians. A preparatory course for GLG 308. Field excursions—Central Appalachians during spring vacation.

308. Field Excursion–Central Appalachians

Spring. 2 or 3 credits. GLG 307.

Training in stratigraphic, sedimentological, paleontologic, and structural principles as applied to field methods.

321. Mineralogy

Fall. 5(4-4) One term of chemistry.

Basics of crystallography, crystallography, and crystal chemistry. The classification, occurrence, composition and identification of minerals. Mineral genesis.

323. Introduction to Optical Mineralogy

Winter. 1(0-3) GLG 321.

Basic principles underlying the use of the polarizing microscope. Recognition and understanding fundamental optical properties. Identification of minerals and texture in thin sections of rocks.

327. Introduction to Geochemistry

(495.) Winter. 3(3-0) CEM 152, GLG 321.

Geochemical evolution of the universe, solar system, earth. Application of crystal field theory and thermodynamics to the solution of geological problems. Factors affecting the distribution of elements on earth. Principles of isotope geology.

335. Fossil Plants, Their History and Paleocology

Spring. 3(3-0) One course in geology or botany or biology or approval of department. Interdepartmental with the Department of Botany and Plant Pathology.

History of plants through geologic time; their form and evolution; how and where found, identified and reconstructed; their use in determining ancient geographic patterns, paleoenvironments, paleoclimates and community structure. Field trip.

337. The Fossil Record of Organic Evolution

Spring. 3(3-0) One course in a natural science; Juniors. Interdepartmental with the Department of Zoology.

The direct evidence for organic evolution in the fossil record. Evolution of life from prebiological systems to man. Impact of fossil discoveries on human thought.

344. Field Geology–Summer Camp

Summer. 9 credits. GLG 351, GLG 363, GLG 392. Trigonometry; GLG 437, GLG 446 recommended.

Methods and techniques of geological surveying and mapping. Field interpretation of geological phenomena in igneous, metamorphic and sedimentary rocks in northern Michigan and Wisconsin.

A. Introduction to Field Techniques
3 credits.

Introduction to field techniques with stress in those that apply to sedimentary rocks. Stratigraphic correlation.

B. Methods of Geological Mapping
4 credits.

Plane table surveys, aerial photo and reconnaissance mapping. Examination and interpretation of structural and textural relationships in igneous and metamorphic rocks.

C. Geologic Interpretation of Selected Areas

2 credits.

Independent mapping and interpretation.

351. Structural Geology

(451.) Fall. 4(2-6) GLG 202; MTH 111.

Description, classification, and origin of secondary structures such as folds, faults, joints, cleavages, foliations and lineations. Three-dimensional visualization stressed in economic laboratory problems involving descriptive geometry, stereographic projections, areal, and structural geologic maps.

363. Lithology

Spring. 4(3-4) GLG 321, GLG 323, GLG 327.

Processes that form igneous and metamorphic rocks, origin, distribution, variation and occurrence of rock. Study of rock properties in the field, in laboratory, and with the microscope.

375. Introduction to Geophysics

Winter. 3(3-0) GLG 201; MTH 111; PHY 239 or PHY 289.

Earth’s interior, lithospheric tectonics, and geophysical exploration including: refraction seismology, gravity, magnetism, earth’s internal structure, global seismicity, plate tectonics, structure of plate margins, and planetary geology.

392. Sedimentology

Spring. 3(2-3) GLG 323, GLG 327.

Grain and aggregate properties of sediments; relationships of these properties to processes in the environment of deposition and to the pre-depositional and post-depositional history.

400H. Honors Work

Fall, Winter, Spring. Variable credit. Honors College student or 3.00 grade-point average, or approval of chairperson; written proposal approved by faculty sponsor and chairperson.

403. Fluvial Geomorphology

Fall. 4(3-4) Junior majors in GLG, C E, and CSS; one course in physical geology and junior standing in geology, civil engineering or soil science.

Quantitative analyses of the fluvial processes associated with the development of drainage basin morphology, with emphasis on stream bed erosion and sediment transport. Field trips are required.

411. Hydrogeology

Winter. 3(3-2) One term of geology and trigonometry.

Principles of the sources, occurrence, and movement of ground water. Surface and subsurface investigations of ground water and elementary ground water hydrology.

413. Glacial Geology

Spring. 4(3-4) GLG 201.

Geological aspects of glaciers and glaciation. Theories of ice ages through geologic time. Origin and development of glacial geomorphic features. Character and chronology of the Pleistocene. Laboratory techniques, with field trips to observe glacial materials and features of Michigan.

Descriptions – Geology

of

Courses

- 426. Optical and X-ray Mineralogy**
Fall. 4(3-4) GLG 321, PHY 239 or PHY 289.
Theory, principle and application of the polarizing microscope and X-ray diffractometer in mineral analysis.
- 430. Vertebrate Paleontology**
Winter. 4(3-3) ZOL 428 or approval of department. Interdepartmental with the Department of Zoology.
Fossil vertebrates with emphasis on the evolution of major groups. Laboratories on modern techniques and on the identification and interpretation of fossils.
- 437. Invertebrate Paleontology**
Fall. 4(3-4) GLG 202 or ZOL 303 or approval of department. Interdepartmental with the Department of Zoology.
Systematics and evolution of marine invertebrates; uses of fossils in correlation and delineation of geologic time; structure and morphology of fossils as related to evolutionary development.
- 438. Paleocology**
Spring. 4(3-4) GLG 202 or ZOL 389 or approval of department. Interdepartmental with the Department of Zoology.
Distribution and abundance of marine fossils; response of skeletal morphology to environmental conditions; uses of fossils in reconstructing ancient climates and depositional environments.
- 445. Field Studies**
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 12 credits. Approval of department.
Advanced geologic or geophysical field studies.
- 446. Principles of Stratigraphy**
Fall. 3(3-0) GLG 437, GLG 392 or approval of department.
Covers principles of stratigraphy and application and exemplification of these principles to known geologic occurrences.
- 462. Petrology**
Winter. 4(3-4) GLG 363, GLG 426.
Introduction to the chemical and physical processes that are responsible for the origin and evolution of igneous and metamorphic rocks. Laboratory studies of rock suites that illustrate basic processes in petrology.
- 474. Exploration Geophysics**
Fall. 4(3-2) GLG 201 or GLG 306; GLG 375; MTH 214; PHY 239 or PHY 289.
Techniques used in geophysical exploration, with application in petroleum prospecting, minerals exploration, and engineering. Includes gravity, magnetic, seismic, electrical and other methods, and well logging. Interpretation of geophysical data.
- 475. Solid Earth Geophysics**
Winter. 3(3-0) GLG 201 or GLG 306; GLG 375; MTH 215; PHY 289; MTH 310 recommended.
Geophysics, including Earth's composition and structure, its dynamic character, radioactivity and age determinations, seismicity and seismology, gravity and magnetic fields, heat flow, physical properties of earth materials.
- 478. Exploratory Seismology**
(872.) Spring of odd-numbered years. 4(2-4) GLG 474.
Theory and technique of field seismic exploration methods. An associated geophysical survey will be conducted and a report prepared.
- 479. Tectonophysics**
Spring. 3(3-0) GLG 351; GLG 474 or GLG 475.
Tectonics of crustal plates emphasizing sea-floor spreading and continental drift. Tectonics of plate margins, plate kinematics, observational seismology, inter- and intra-plate stresses, and paleo-continental reconstructions.
- 482A. Mineral Resources**
Spring of odd-numbered years. 4(4-0) GLG 321, GLG 351.
Genesis, distribution, and classification of ore deposits. Emphasis on metallic ores. Global patterns and tectonic relationships.
- 482B. Mineral Resources Evaluation**
Spring of even-numbered years. 3(3-0) GLG 321, GLG 351, approval of department.
Emphasis on practical applications of geoscience to mineral resources and the extractive industries. Aspects of exploration and development of reserves including evaluation, grade estimation, drilling, recovery, and beneficiation.
- 483. Petroleum Geology**
Fall. 4(3-2) Approval of department.
Fundamental principles of the origin, migration and accumulation of petroleum. Exploration techniques to include well drilling, electric and radioactivity well logging, surface and subsurface exploration methods, seismic surveys, land leasing and oil field development. Laboratory study of well log plotting and subsurface mapping technique.
- 484. Applied Petroleum Geology**
Winter. 4(1-6) GLG 483.
Microscopic examination of well cuttings, practice in the use of electric and radioactivity logs, exploration for petroleum in selected areas by subsurface mapping techniques, economics of petroleum exploration. Field trips.
- 493. Carbonate Sedimentology**
Fall. 3(2-3) GLG 327, GLG 392.
Genesis of carbonate sediments including discussion of carbonate-secreting organisms, effects of environment on mineralogy, depositional environments and diagenesis.
- 497. Geochemistry**
Spring. 3(3-0) GLG 201; CEM 152 or approval of department.
Oxidation-reduction systems, chemical weathering, stable and unstable isotopes, the geochemistry of ore-forming solutions, and the behavior of trace components in silicate melts.
- 800. Special Problems**
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
Special problems in hydrogeology, geomorphology and glacial geology, mineralogy and crystallography, petrology, paleontology, structural geology, and petrofabrics, stratigraphy, aerogeology, geophysics, economic geology, petroleum geology, sedimentation, and geochemistry.
- 810. Seminar**
Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 12 credits.
Seminar relating to current research in geology.
- 825. Clay Mineralogy**
Winter. 4(3-4) CSS 840, CSS 850 or approval of department. Interdepartmental with the Department of Crop and Soil Sciences.
Structures and properties of clays; their origin, occurrence, and utilization. Methods of studying clays including x-ray diffraction, differential thermal analysis, infrared absorption and other chemical and physical techniques.
- 830. Paleobotany**
Fall. 4(3-4) Approval of department. Interdepartmental with and administered by the Department of Botany and Plant Pathology.
Survey of fossil plants: their preservation, occurrence, geology, paleogeography, paleoecology, evolutionary history, classification and representative types. One weekend field trip to fossil plant locality.
- 831. Palynology**
Spring. 4(3-4) Approval of department. Interdepartmental with the Department of Botany and Plant Pathology.
An introduction to the principles and techniques of spore and pollen analysis, both fossil and recent, and utilization of plant micro-fossils for stratigraphic determinations and paleoecologic interpretations of most sedimentary accumulations and rocks. Includes certain algae, protozoans, similar organisms of uncertain affinity and dissociated fragments of larger organisms.
- 833. Advanced Invertebrate Paleontology**
B. Quantitative Paleontology
Fall. 3(2-4) GLG 437 or GLG 438. Interdepartmental with the Department of Zoology.
Application of mathematical tools to paleontological problems, including statistical applications and numerical taxonomy; computer applications.
C. Paleocology
Fall. 3(2-4) GLG 437 or GLG 438. Interdepartmental with the Department of Zoology.
Advanced problems in population, community, and province level paleoecology, primarily of marine invertebrates, including study of taxonomy, diversity, and adaptation.
D. Developmental Paleontology
Fall. 3(2-4) GLG 437 or GLG 438, ZOL 317 or approval of department. Interdepartmental with the Department of Zoology.
Application of the principles of development to the ontogeny and phylogeny of fossil invertebrates as known from skeletal morphology.
E. Evolutionary Paleontology
Fall. 3(2-4) GLG 437 or GLG 438. Interdepartmental with the Department of Zoology.
Aspects of evolutionary biology that can be studied in the fossil record, with emphasis on marine invertebrates.
- 834. Advanced Vertebrate Paleontology**
Winter of even-numbered years. 3(3-0) GLG 430 or approval of department. Interdepartmental with the Department of Zoology.
Recent advances and controversial issues in vertebrate paleontology including origin, classification, phylogeny, and stratigraphic relationships of fossil vertebrates.
- 838. Advanced Paleobotany**
Winter. 3(2-4) Approval of department. Interdepartmental with and administered by the Department of Botany and Plant Pathology.
Morphology, anatomy, phylogenetic relationship and classification of fossil plants. Microscopic analysis of tissues and organs prepared by thin section, transfers, peels, polished and etched surfaces, and macerations.

843. Paleozoic Stratigraphy
Winter of even-numbered years. 4(5-0)
GLG 446, GLG 392.

Classification, distribution, paleogeography, paleontology, interrelation, and structural setting of stratigraphic units within the Paleozoic systems. Laboratory work involves construction of correlation charts, structure and restored sections, paleogeologic, paleogeographic, and lithofacies maps, and study of certain key fossils.

844. Mesozoic and Cenozoic Stratigraphy
Winter of odd-numbered years. 3(3-0)
GLG 446.

Stratigraphy and paleontology with emphasis on tectonics and sedimentation.

852. Structure of Ore Bodies
Winter of even-numbered years. 3(2-4)
GLG 451, MTH 214.

Mathematics and physics applied to problems in structural geology.

861. Evolution of the Earth's Crust and Mantle
Fall. 3(3-0) GLG 462.

The composition, mineralogy and petrology of the Earth's mantle and crust. Plate tectonics and its relationship to earlier models of geosynclines, orogenic cycles, continental drift, etc.

862. Petrology-Igneous
Spring of even-numbered years. 2 to 4 credits. May reenroll for a maximum of 8 credits. GLG 462. Must enroll for laboratory with initial registration.

Physical and chemical principles involved in the origin of igneous rocks. Application of experimental techniques in petrology.

863. Petrology-Metamorphic
Spring of odd-numbered years. 2 to 4 credits. May reenroll for a maximum of 8 credits. GLG 462. Must enroll for laboratory with initial registration.

Origin and classification of metamorphic rocks. Study includes thin section investigation of the metamorphic textures and mineral associations and the physical-chemical principles involved in their development.

870. Topics in Geophysics
Spring. 1 to 3 credits. May reenroll for a maximum of 12 credits. Approval of department.

Topics and problems in geophysics, such as tectonophysics, terrestrial heat flow, processing and analysis of geophysical data, geomagnetism, paleomagnetism, high-pressure geophysics.

873. Seismology I
Fall of even-numbered years. 3(3-0)
MTH 215 or concurrently; PHY 289 or concurrently.

Theory and application of seismic wave propagation in earth materials.

874. Seismology II
Winter of odd-numbered years. 3(3-0)
GLG 873 or approval of department.

Continuation of GLG 873.

875. Advanced Geophysical Exploration I
Fall of odd-numbered years. 4(3-2)
GLG 474.

Theory and technique of gravity and magnetic methods, and their use in geophysical exploration. Associated practical exercises.

876. Advanced Geophysical Exploration II
Winter of even-numbered years. 4(3-2)
GLG 474, MTH 214.

Methods and techniques in geophysical exploration, including electrical, electromagnetic, radioactivity, magnetotelluric, and the physical principles of well logging. Associated practical exercises.

877. Geophysics of the Lithosphere II
Fall of even-numbered years. 3(3-0)
GLG 475, GLG 479.

Structure and tectonic processes at convergent and divergent plate margins. Earthquake location and prediction, thermal modelling of slabs, origin of back-arc basins, and inter- and intra-plate stresses. Regional tectonic analyses.

878. Dynamic Processes in the Earth
Fall of odd-numbered years. 3(3-0)
GLG 451, GLG 475, MTH 310 or approval of department.

Stress and strain analysis, rheology of materials, buckling and bending of strata, lithospheric stresses, geofluid dynamics, surface waves, attenuation, and other seismological topics.

884. Regional Petroleum Geology
Spring. 3(3-0) Approval of department.

Regional study of tectonics, stratigraphy and sedimentation in the U.S. and their relationship to petroleum occurrences in sedimentary basins. Analysis of petroleum distribution with emphasis on creative thinking in petroleum exploration. Practice in the analysis of petroleum possibilities in selected foreign areas.

891. Advanced Sedimentology
(891B.) Spring. 3(2-4) GLG 392.

Origin, deposition and diagenesis of sandstones. Study includes thin section, X-ray, and SEM analysis of sediments.

894. Aqueous Geochemistry
Spring. 3(3-0) GLG 497 or a course in physical chemistry or approval of department.
Nature and regulation of electrolytes in solution (fresh water, seawater, brine); activity, complexation, and redox effects. Trace metals in solution. Carbonate, silica, alumina systems. Chemical weathering and mobility of elements.

895C. Topics in Geochemistry: Analytical Geochemistry
Fall of even-numbered years. 1 to 3 credits. May reenroll for a maximum of 12 credits. GLG 462, GLG 495.

Instrumental techniques for the analysis of geological materials. Topics on application of X-ray diffraction, X-ray fluorescence, neutron activation analysis, and atomic absorption spectrometry. Recently developed techniques in geochemistry will be discussed.

896. Applied Geochemistry
Spring of even-numbered years. 3(3-0)
GLG 495 or GLG 894.

Migrations of elements in the near surface environment. Prediction of mineral deposits, hydrocarbon traps and harmful concentrations of both naturally occurring and artificially introduced hazardous elements and compounds.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

900. Special Problems
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Special problems in hydrogeology, geomorphology and glacial geology, mineralogy and crystallography, petrology, paleontology, structural geology and petrofabrics, stratigraphy, aerogeology, geophysics, economic geology, petroleum geology, sedimentation, and geochemistry.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Earth Science

E S

445. Field Studies
Fall, Winter, Spring, Summer. 1 to 9 credits.; May reenroll for a maximum of 15 credits. Approval of department.
Experience and techniques in field investigation of the near surface layers of the earth.

446. Laboratory Investigations
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 15 credits. E S 445 or concurrently.
Independent laboratory investigation of materials and phenomena obtained from field studies.

800. Problems in Earth Science
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.
Independent study in topics related to earth science education.

GERMAN

See Linguistics and Germanic, Slavic, Asian and African Languages.

GERMAN AND RUSSIAN

See Linguistics and Germanic, Slavic, Asian and African Languages.

GREEK

See Romance and Classical Languages.