

Earth and Environmental Sciences

Chair

- David W. Peate

Undergraduate major: geoscience (BA, BS)

Undergraduate minor: geoscience

Graduate degrees: MS in geoscience; PhD in geoscience

Faculty: <https://ees.uiowa.edu/people>

Website: <https://ees.uiowa.edu/>

Courses

Earth and Environmental Sciences Courses

Not all courses are offered every year.

EES:1000 First-Year Seminar 1-2 s.h.

Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities). Requirements: first- or second-semester standing.

EES:1030 Introduction to Earth Science 3-4 s.h.

Relationships between plate tectonics, geologic time, and the rock cycle with volcanoes and igneous, sedimentary, metamorphic rocks; fossils; radioactive isotopes; landscape evolution; mountain building; natural resources; their impacts on civilization. GE: Natural Sciences with Lab; Natural Sciences without Lab. Same as CEE:1030.

EES:1031 Introduction to Earth Science Laboratory 1 s.h.

Laboratory component of EES:1030. Requirements: completion of 3 s.h. in EES:1030 or CEE:1030. GE: Natural Sciences Lab only. Same as CEE:1031.

EES:1040 Evolution and the History of Life 3-4 s.h.

Fossils over the past 3.5 billion years, origin and evolution of life, evolutionary radiations and mass extinctions, the invasion of land, dinosaurs, the age of mammals, relationship between biological systems and environmental change in earth history. GE: Natural Sciences with Lab; Natural Sciences without Lab.

EES:1050 Introduction to Geology 4 s.h.

Minerals, rocks, and rock-forming processes (including volcanoes and sedimentary environments); surface processes (rivers, groundwater, glaciers, deserts, ocean shorelines), major earth processes (continental drift, plate tectonics, earthquakes, mountain building); impact on civilization. Offered fall semesters. GE: Natural Sciences with Lab.

EES:1060 Big Ideas: Origins of the Universe, Earth, and Life 3 s.h.

Origin of the universe, the biochemistry of life, and the origin of life on Earth; for non-science majors. Recommendations: first-year or sophomore standing. GE: Natural Sciences without Lab. Same as ASTR:1060, BIOL:1060.

EES:1070 Age of Dinosaurs 4 s.h.

Origin and evolutionary history of dinosaurs; diversity of dinosaurian groups, their geographic distributions and paleoecology; origins of flight among dinosaurs; environmental context, including other animals and plants that lived alongside dinosaurs; the so-called extinction of dinosaurs and radiation of modern forms; the role dinosaurs play in the interaction between science and the popular media. Offered fall semesters. GE: Natural Sciences with Lab.

EES:1080 Introduction to Environmental Science 3-4 s.h.

Biological and physical character of the Earth; interaction of humans with the environment, including impacts on ecosystems, climate, natural processes, resources; alternative options, including sustainability, waste management, energy, land reform. GE: Sustainability. GE: Natural Sciences with Lab; Natural Sciences without Lab. Same as ENVS:1080.

EES:1081 Introduction to Environmental Sciences Laboratory 1 s.h.

Laboratory component of EES:1080. Requirements: completion of 3 s.h. in EES:1080 or ENVS:1080; or 3 s.h. of transfer equivalent. GE: Natural Sciences Lab only. Same as ENVS:1081.

EES:1085 Fundamentals of Environmental Science 4 s.h.

Interdisciplinary study of how Earth's natural systems interact, how these systems affect society, and how they respond to human activity; how environmental problems can be solved and avoided by drawing upon knowledge in disciplines as diverse as ecology, anthropology, economics, chemistry, and political science; blended instructional environment, including traditional lectures, discussions in TILE classrooms, laboratory, online learning, peer-reviewed writing exercises, and service learning. Offered fall semesters. GE: Sustainability. GE: Natural Sciences with Lab. Same as ENVS:1085.

EES:1115 The History of Oil 3 s.h.

Historical perspective on business, science, geology, technology, politics, environment, and culture of the global oil industry; the rise of oil as the most influential international business of the last 150 years, the material foundation of economies, a major force in world politics, a shaper of daily life, and a guide to understanding Earth's deep history. Offered fall semesters. GE: Sustainability. GE: Historical Perspectives. Same as ENVS:1115, GEOG:1115, HIST:1115.

EES:1170 Geology of the U.S. National Parks 2 s.h.

Geologic features, geologic history, important biological and archaeological characteristics, with emphasis on features that caused certain areas to be included in national park system.

EES:1179 Geology of National Parks: Preparation and Planning 1 s.h.

Preparation for a national park field trip offered in EES:1180; students learn about locations; basic safety rules; camping skills; administrative work, including defensive driver training; investigation of national parks, national monuments, and protected lands; basic geology.

EES:1180 Geology of National Parks: Field Trip 2 s.h.

Observation, interpretation of prominent geologic, geomorphic, biological features; semester-break or semester-end visits to different parks or groups of parks each year. Offered spring semesters. Prerequisites: EES:1179.

EES:1290 Energy and the Environment 3 s.h.

Scientific concepts related to potentially significant energy sources of the 21st century; environmental impacts, positive and negative, of each energy source as well as geologic and geographical distributions and applications. GE: Natural Sciences without Lab.

- EES:1400 Natural Disasters** **3 s.h.**
How earth-atmosphere-hydrosphere-space systems produce events catastrophic to humans on the scale of individual lives to civilizations; root causes of earthquakes, landslides, volcanic eruptions, floods, hurricanes, tsunamis, tornadoes, and asteroid impact, and their local, national, and global impact; spatial and temporal occurrences of these hazards; methods and processes for hazard preparedness, response, and recovery; social, economic, and policy aspects that affect and compound the magnitude of disasters associated with natural phenomena; case studies drawn from contemporary and ancient societies. GE: Sustainability. GE: Natural Sciences without Lab.
- EES:2001 Second-Year Field Trip for Earth and Environmental Sciences** **1 s.h.**
Opportunity for students to begin developing an appreciation of earth system and earth history scales; application of classroom learning to field-based inquiry; real-world examples of introductory course material in an outdoor classroom setting. Prerequisites: EES:1030 or EES:1050 or EES:1080 or ENVS:1080. Requirements: geoscience or environmental sciences major. Same as ENVS:2001.
- EES:2010 Interdisciplinary Environmental Seminar** **1 s.h.**
Discover research, explore careers, and build connections. Requirements: first- or second-year standing. Same as ENVS:2010, GEOG:2010.
- EES:2020 Earth's Climate System** **3 s.h.**
Overview of climate science and how we understand Earth's climate system through interconnected relationships between oceans, atmosphere, biosphere, and geosphere; introduction to climate archives, systems science, climate modeling, and mechanisms responsible for ancient and modern climate change. Recommendations: EES:1030, EES:1050, EES:1080, EES:1085, or GEOG:1020. Same as ENVS:2020.
- EES:2190 Directed Study** **arr.**
Special topics, independent research.
- EES:2200 Historical Geology** **4 s.h.**
Framework of earth history that is essential to understand how the earth system works; investigation of physical, biological, atmospheric, oceanographic, and chemical history of the earth to prepare for further earth and environmental science courses. Prerequisites: EES:1030 or EES:1050 or EES:1080 or ENVS:1080 or EES:1085 or ENVS:1085. Same as ENVS:2200.
- EES:2310 Introduction to Climatology** **3 s.h.**
Introduction to atmospheric processes that determine weather and climate; flow of energy through the atmosphere, distribution and movement of moisture and air, and atmospheric disturbances such as cyclones, hurricanes and tornadoes, and climate change. Recommendations: GEOG:1020 or similar earth systems science course. Same as GEOG:2310.
- EES:2410 Mineralogy** **4 s.h.**
Physical, chemical, and optical properties of minerals; phase relations; structures; associations; diagnostic features for identification. Offered fall semesters. Prerequisites: (CHEM:1110 or CHEM:1070) and (EES:1050 or EES:1030).
- EES:2831 Geologic Field Methods** **3 s.h.**
Basic methods of geologic fieldwork in southwest Montana using topographic maps and GPS to locate oneself, identifying geologic map units (including superficial deposits), recognizing geologic contacts, constructing stratigraphic sections, measuring planar structures, and making geologic maps complete with a legend and cross-section. Offered summer sessions. Prerequisites: EES:1400 or EES:1080 or EES:1030 or EES:1050.
- EES:3001 Third-Year Field Trip for Earth and Environmental Sciences** **1 s.h.**
Opportunity for students to apply their major coursework to real-world problems; field trip to visit parks, mines, and/or quarries in Missouri and Arkansas that illustrate many of the lessons learned in EES:2410 and EES:3500. Prerequisites: EES:1030 or EES:1050 or EES:1080 or ENVS:1080 or EES:2410. Requirements: geoscience or environmental sciences major, and junior standing. Same as ENVS:3001.
- EES:3003 Natural History Research Collections** **3 s.h.**
Techniques, methods, and issues specific to natural history research collections; practice in preparing and cleaning specimens; role of natural history specimens in modern scientific research. Recommendations: basic understanding of the diversity of plants and animals and natural history museum collections, MUSM:3001 or MUSM:3200, and BIOL:1411 or BIOL:1412; or other experience. Same as MUSM:3003.
- EES:3010 Interdisciplinary Environmental Seminar** **1 s.h.**
Role of sciences in environmental issues and problems; progression from observation to evaluation to design of better questions and experiments. Requirements: third- or fourth-year standing. Same as ENVS:3010, GEOG:3003.
- EES:3020 Earth Surface Processes** **3 s.h.**
Basic geomorphic and environmental processes that shape the earth's surface; emphasis on erosion, transport, deposition by land mass movement (creep, landslides, earth flow), fluid agents (wind, water, ice); methods used to study these processes. Recommendations: EES:1050 or EES:1080 or ENVS:1080 or GEOG:1020 or EES:1085 or ENVS:1085. Same as ENVS:3020, GEOG:3020.
- EES:3050 Geology of Iowa** **2 s.h.**
Exploration of geologic history responsible for landscape, soil, rocks, fossils, water, and natural resources of Iowa; background of Iowa's natural history; preparation for K-12 educators to deliver earth and environmental science content in their own classrooms, utilizing natural landscapes in Iowa. Same as ENVS:3050.
- EES:3051 Geology of Iowa Field Trip** **1 s.h.**
Exploration of the geologic history responsible for landscape, soil, rocks, fossils, water, and natural resources of Iowa; field-based examples of Iowa's natural history; preparation for K-12 educators to deliver earth and environmental science content in their own classrooms utilizing the natural landscapes in Iowa. Recommendations: EES:3050. Same as ENVS:3051.
- EES:3060 Ecology and Natural History of Iowa** **3 s.h.**
Plant and animal communities, landforms, and geologic history of Iowa; local area fieldwork; students learn identification and survey techniques, and interact with local naturalists.

- EES:3070 Marine Ecosystems and Conservation** 3 s.h.
Introduction to ocean ecosystems, including coral reefs, mangroves, estuaries and salt marshes, sandy and rocky shores, seagrass and kelp beds, the deep sea, plankton; biodiversity of each ecosystem; interrelationship of biota and physical/chemical environment; interactions among organisms, including food webs and symbiosis; local and global threats such as overfishing, pollution, ocean acidification, global warming, sea level change; ongoing biodiversity crisis, solutions for conservation problems.
- EES:3080 Introduction to Oceanography** 2 s.h.
Descriptive, chemical, physical, biological, geological aspects of oceans; impact on weather, climate, shorelines, food supply, other aspects of civilization. Offered spring semesters. Recommendations: knowledge of basic chemistry, biology, physics, earth science.
- EES:3100 Earth and Planetary Remote Sensing** 4 s.h.
Remote sensing of the earth's surface from aircraft, satellites; aerial photograph interpretation; remote sensing systems, methods, data analysis using electromagnetic spectrum and digital processing techniques, including visible, infrared, microwave radiation; remote sensing applied to geologic and environmental problems. Prerequisites: EES:1030 or EES:1050 or EES:1080 or EES:1085. Same as ENVS:3100.
- EES:3110 Chemical Evolution of the Oceans** 3 s.h.
Investigation of various physicochemical states oceans have assumed over the past 4 billion years of Earth history; use of isotope geochemistry as a proxy for ancient ocean conditions; focus on integrated Earth system science, paleoceanographic and paleoclimate modeling, role of chemical stratigraphy in deciphering past climate states of ocean-atmosphere system; relationship between chemical changes in ocean/atmosphere and biological systems of the Earth. Same as ENVS:3110.
- EES:3150 Sustainability Project** arr.
Individual or collective project related to sustainability under the direction and supervision of a faculty member; involves regularly scheduled meetings, data collection and interpretation, and a final project report.
- EES:3160 Field Trip** 1-3 s.h.
Field trip to an area of geologic interest, such as localities in the Midwest, Hawaii, Grand Canyon (Arizona), Rio Grande Rift (New Mexico), Death Valley (California, Nevada), Appalachian Mountains (Virginia), as well as international destinations such as the Caribbean and China; preceded by weekly discussions of destination's geology.
- EES:3190 Directed Study** arr.
Special topics, independent research.
- EES:3200 Collection Care and Management** 3 s.h.
How a museum's management policy relates to its administrative, legal, and ethical obligations to its collections; acquisitions, deaccessions, collection use, data standards, storage environment, health, safety, documentation. Same as MUSM:3200.
- EES:3210 Principles of Paleontology** 3 s.h.
Patterns of evolution in fossil record; species and analysis of their evolutionary relationships; paleoecology, paleocommunity evolution; evolutionary radiation and mass extinctions; large-scale relationships between biodiversity and climatic change. Offered fall semesters.
- EES:3220 Evolution of the Vertebrates** 4 s.h.
Evolutionary history of vertebrates revealed by fossils and information from living animals; biogeographic, stratigraphic, paleoecological aspects of selected groups, especially mammals and dinosaurs; transitions from aquatic to terrestrial life, origins of flight, major events in vertebrate history (including mass extinctions and explosive radiations). Requirements: introductory course in geoscience, bioscience, or physical anthropology.
- EES:3300 Sedimentary Geology** 4 s.h.
Basic concepts of sedimentology, stratigraphy, depositional environments, sedimentary petrology; hands-on analyses of sediments and sedimentary rocks, including thin-section petrography; lecture/laboratory. Offered fall semesters.
- EES:3360 Soil Genesis and Geomorphology** 3 s.h.
Introduction to soil genesis, soil geomorphology, and classification including the basics of soil profile description and soil-landscape, soil-vegetation, and soil-climate relationships; emphasis on study of soils as the interface between living and non-living Earth systems and the role of soils in sustaining ecosystems and human societies; short field excursions and a weekend field trip. Requirements: college earth science and chemistry. Same as GEOG:3360.
- EES:3380 Fluvial Geomorphology** 3 s.h.
Hydrologic principles, stream channel processes, and fluvial geomorphology within drainage basin systems; spatial and temporal variations in water distribution, analysis of hydrological data, flow mechanisms, sediment transport, forecasting procedures, hydrograph construction, modeling. Requirements: EES:3020 or another 3000-level geology or hydraulics course. Same as CEE:3328.
- EES:3390 Integrated Watershed Analysis** 3 s.h.
Integration of existing knowledge of physical, hydrological, and environmental processes with management issues and challenges in water resources and environmental management; aspects of water quantity and quality, water use and treatment; basin management issues related to forestry, agriculture, urbanization, floods, droughts.
- EES:3500 Igneous and Metamorphic Petrology** 4 s.h.
Nature, origin, and petrography of igneous and metamorphic rocks in hand specimen and thin-section. Offered spring semesters. Prerequisites: (MATH:1010 or MATH:0100 or MATH:1020 or MATH:1850) and (EES:1050 or EES:1030) and (CHEM:1110 or CHEM:1070) and EES:2410.
- EES:3770 Global Stratigraphy** 3 s.h.
Types of stratigraphy (e.g., biostratigraphy, lithostratigraphy, sequence stratigraphy, chemostratigraphy, magnetostratigraphy, cyclostratigraphy, chronostratigraphy) that share a number of procedures and practices and how differences cloud understanding of Earth history; central role of stratigraphy in modern geoscience pursuits; issue of time in stratigraphic record as an organizing theme for investigation of comparative stratigraphy.
- EES:3840 Structural Geology** 4 s.h.
Rock deformation; description, classification of geologic structures such as faults and folds; processes that generate geologic structures; solution of structural problems; interpretation of geologic maps. Prerequisites: EES:1030 or EES:1050.

EES:4001 Fourth-Year Field Trip for Earth and Environmental Sciences 2 s.h.

Application of core course learning to real-world examples; students develop a broader understanding of interrelated aspects of earth and environmental sciences as truly integrated scientific endeavors; field trip to Big Bend National Park to highlight a wide range of geoscience and environmental science studies and provide students an opportunity to apply all aspects of their training to the amazing geologic landscape of southwest Texas; capstone field experience for students heading into their senior year. Prerequisites: EES:2831. Requirements: geoscience or environmental sciences major, and senior standing. Same as ENVS:4001.

EES:4200 Museum Object Preservation 3 s.h.

Detailed study of specific types of museum objects, their materials, and care; topics include care, storage, and preservation of paper, books, photographs, works of art, electronic media, textiles, furniture, archaeological artifacts, and natural history specimens; students complete a curatorial project and gain hands-on practice in basic object cleaning and making enclosures and supports; for students planning museum careers or taking care of collections as part of their professional responsibilities. Same as MUSM:4200.

EES:4230 Special Topics 1-3 s.h.

Contemporary issues in earth sciences.

EES:4410 Analytical Methods Seminar 2 s.h.

Theory and practice of analyzing chemical, isotopic, and mineralogical compositions of rocks, inorganic materials, and waters; use of modern analytical instruments. Offered spring semesters. Prerequisites: CHEM:1070 or CHEM:1110.

EES:4490 Elements of Geochemistry 3 s.h.

Introduction to application of chemical principles to solution of geologic problems concerning earth and environmental processes; origin of elements, chemical differentiation of Earth and the solar system, geochronology, application of radiogenic and stable isotopes, chemical equilibrium, elementary thermodynamics and kinetics, carbonate and silicate stability relationships, chemical weathering, adsorption, trace element behavior, oxidation-reduction reactions, characterization of surface and ground waters, and ocean chemistry. Prerequisites: (EES:1030 or EES:1050) and (CHEM:1070 or CHEM:1110).

EES:4520 Isotope Geochemistry 3 s.h.

Radiogenic and stable isotope systematics, applications to geological, cosmological, and environmental problems. Prerequisites: (EES:1030 or EES:1050) and (CHEM:1070 or CHEM:1110). Recommendations: EES:2410.

EES:4630 Hydrogeology 4 s.h.

Foundational concepts of physical hydrogeology including water cycle and hydrologic balance, hydrogeologic properties of porous media and fractured rock, Darcy's law, flow systems, and hydrogeologic characterization methods; students practice quantitatively evaluating groundwater flow problems through regular problem sets and hands-on labs. Prerequisites: MATH:1850 or MATH:1550.

EES:4640 Contaminant Hydrogeology 3 s.h.

Introduction to controls on contaminant transport in groundwater systems (e.g., advection, dispersion, diffusion, reaction/transformation); variety of models used to practice quantitatively evaluating contaminant behavior; survey of common contaminants in groundwater through discussion of published case studies; overview of standard and leading edge characterization and remediation methods.

EES:4660 Groundwater Modeling 3 s.h.

Groundwater flow and contaminant transport modeling; numerical methods, applications of groundwater modeling to water supply, groundwater resources evaluation, remediation design using software; GMS (MODFLOW, MODPATH, and MT3D). Prerequisites: MATH:1860 and EES:4630. Same as CEE:4104.

EES:4680 Field Methods in Hydrologic Science 3 s.h.

Collection and interpretation of physical hydrology and hydraulics field measurements; basic data quality assurance and quality control; hands-on experience with field equipment and data collection. Prerequisites: EES:4720 or EES:2831 or EES:3020 or EES:3360 or EES:3300 or EES:3380 or ENGR:2510 or EES:4800 or EES:4630 or CEE:3371 or EES:4790 or EES:3390.

EES:4720 Paleoclimatology 3 s.h.

Introduction to glaciers and glacial and interglacial Earth systems; linkages among glacial, oceanic, and atmospheric systems and their effects on landscapes and biota over the past 2 million years; how oceans, atmosphere, and glaciers interact and landscape effects of past glacial and interglacial cycles. Requirements: physical geology or physical geography or anthropology.

EES:4750 Mineral and Petroleum Exploration Geology 3 s.h.

Fundamentals of resource exploration philosophy and methods, with project-based presentation of techniques and strategies for mineral exploration and petroleum exploration; integration and evaluation of geological, geochemical, and geophysical techniques for mineral exploration; hydrocarbon systems and seismic interpretation for petroleum exploration. Corequisites: EES:3500 and EES:3840.

EES:4790 Applied Environmental Geology 3 s.h.

Application of geology, water, and earth processes to civil and environmental engineering practice; physical properties of rock and soil, geologic mapping and surveying, groundwater supplies and wells, stream engineering, watershed management, site investigations for environmental assessment, and geologic hazards. Prerequisites: EES:1030 or EES:1080 or EES:1050.

EES:4800 Global Geophysics 3 s.h.

Geophysics is the broad geoscience field interested in discovering the unseen characteristics of the Earth and other planets, including the internal structure of the Earth, the current motions of tectonic plates, the sources and causes of geological disasters, and the locations of economic resources; methods to accomplish these goals include seismology, gravity and magnetic studies, geodesy, and measurements of heat; course offers a broad introduction to these topics that is rooted in current and growing fields of active research. Requirements: introductory geology or physics.

EES:4820 Tectonics and Basin Analysis 3 s.h.

Dynamic processes responsible for crustal genesis, plate movements, mountain building; plate boundary zones; sedimentologic, structural, petrologic, geophysical characteristics of major tectonic settings; multidisciplinary approach; week-long field trip. Corequisites: EES:3840.

- EES:4832 Geologic Field Analysis** **3 s.h.**
Structural, stratigraphic, and regional analysis of geology in the Rocky Mountains of Montana; emphasis on making reasonable geologic interpretations from field relationships; mapping projects in vicinity of Dillon, Montana that build on experience gained in EES:2831; capstone experience dedicated to synthesizing the geology of a fold-and-thrust belt near Glacier National Park. Offered summer session. Prerequisites: EES:2831 and EES:3840.
- EES:4990 Senior Thesis in Geoscience** **arr.**
Independent research resulting in a senior thesis. Requirements: senior standing.
- EES:4999 Honors Thesis in Geoscience** **arr.**
Independent research resulting in an honors thesis. Requirements: honors standing.
- EES:5010 Geoscience Seminar Series** **1 s.h.**
Scholarly work and research in geoscience.
- EES:5015 American Association of Petroleum Geologists Fall Field Trip** **1 s.h.**
Resource-related topics in mineral and hydrocarbon exploration; tectonic settings for resources. Requirements: AAPG student chapter member or graduate standing, and basic understanding of mineralogy, petrology, and structural geology.
- EES:5380 Process Geomorphology Seminar** **1-3 s.h.**
Topics in process geomorphology ranging from fluvial dynamics to mass movement to sediment transport and related environmental processes.
- EES:5530 Geochronology** **3 s.h.**
How to evaluate published ages, and assumptions/errors involved; how to select and sample suitable materials for dating, and choose a suitable dating method and analytical technique; opportunity to develop skills for research and professional careers. Prerequisites: EES:4490 or EES:4520.
- EES:6190 Directed Study** **arr.**
Independent research.
- EES:6230 Special Topics** **1-3 s.h.**
Contemporary issues in earth sciences.
- EES:6250 Paleontology Seminar** **1-3 s.h.**
Current controversial issues in paleontology. Recommendations: EES:3210.
- EES:6390 Advanced Watershed Analysis Seminar** **1-3 s.h.**
Integration of existing knowledge of physical, hydrological, and environmental processes with management issues and challenges in water resources and environmental management; aspects of water quantity and quality, water use and treatment, and basin management issues related to forestry, agriculture, urbanization, floods, droughts.
- EES:6570 Tectonics and Petrology Seminar** **1-2 s.h.**
Topics in tectonics, structural geology, petrology.
- EES:7270 Geologic Orientation, Scholarly Integrity, and Responsible Conduct of Research** **1 s.h.**
Department degree requirements, programs; field survey of local geology; scholarly integrity; responsible conduct of research; tips for TAs; introduction to specialized facilities; for new graduate students.
- EES:7604 Principles of Scholarly Integrity** **0 s.h.**
Training in responsible conduct of research and scholarly activities; student/mentor responsibilities, authorship, plagiarism/falsification/fabrication of data, intellectual property, conflict of interest; fiscal, institutional, and societal; data handling. Requirements: postdoctoral standing in geoscience.
- EES:7990 Research: Geoscience** **arr.**
Independent research related to theses or dissertations in geoscience.