

Graduate Courses 2022-2024

Fall 2022

Course	Course Title	Units	Instructor	Breadth area
GEL 214	Active Tectonics	3	Oskin	3
GEL 251	Isotopes in Cosmochemistry and Geochemistry	3	Mukhopadhyay	4
GEL 262	Paleobiology Seminar	3	Motani	1
GEL 290	Seminar	1	Rudolph	N/A
GEL 294	Structure & Tectonics forum	1	Roeske	N/A
GEL 298	Planetary Geology and Geophysics CRN: 35263	3	Stewart	6 or 7
GEL 390	Methods of Teaching Geology	2	Billen	N/A

Winter 2023

Course	Course Title	Units	Instructor	Breadth area
GEL 230	Geomorphology & River Management	3	Pinter	5
GEL 240	Geophysics of the Earth	3	Rudolph	6
GEL 281	Instrumental Techniques	3	Yin	N/A
GEL 290	Seminar	1	TBD	N/A
GEL 298	Planetary Impact Processes	3	Stewart	7

Spring 2023

Course	Course Title	Units	Instructor	Breadth area
GEL 205	Advanced Field Stratigraphy Topic: Tracing geobiological influences on the rock record of eastern California	3	Sumner	1 or 2
GEL 253	Petrology seminar Topic: Balancing science and disaster response during volcanic eruptions (and other natural hazards)	3	Cooper	4
GEL 298	Aqueous Geochemistry	3	Atekwana	4
GEL 290	Seminar	1	TBD	N/A
GEL 294	Structure & Tectonics forum	1	Roeske	N/A

Fall 2023

Course	Course Title	Units	Instructor	Breadth area
GEL 227	Stable Isotopes Biogeochemistry	4	Atekwana	4
GEL 240	Geophysics of the Earth	3	Stewart	6
GEL 298	TBD	TBD	Mukhopadhyay	TBD
GEL 290	Seminar	1	TBD	N/A
GEL 294	Structure & Tectonics forum	1	Roeske	N/A
GEL 390	Methods of Teaching Geology	2	Billen	N/A

Winter 2024

Course	Course Title	Units	Instructor	Breadth area
GEL 218	Analysis of Structures in Deformed Rocks	3	Cowgill	3
GEL 298	Planet Formation	TBD	Stewart	7
GEL 2XX	Topics in Terrestrial Paleoclimatology	TBD	Montañez	TBD
GEL 290	Seminar	1	TBD	N/A

Spring 2024

Course	Course Title	Units	Instructor	Breadth area
GEL 219	Fracture & Flow of Rocks	3	Billen	3 or 6
GEL 232	Oceans and Climate Change	3	Hill	2
GEL 251	Isotope Geochemistry & Cosmochemistry	3	Yin	4
GEL 253	Petrology seminar	3	Ratschbacher	4
GEL 290	Seminar	1	TBD	N/A
GEL 294	Structure & Tectonics forum	1	Roeske	N/A

Course Descriptions

Fall 2022

GEL 214: Active Tectonics (Oskin)

Graduate course breadth area: #3

Active Tectonics is lecture, project, and problem-set based course on tectonic processes taught through the lens of active systems. The course examines the interplay of tectonics and surface processes through observations, quantitative analytical, and numerical modeling techniques. Problem sets emphasize quantitative problem solving in structural geology, tectonics, geomorphology and Quaternary geochronology. We will also work on one or more group projects that vary from year to year, ideally with a fieldwork component.

GEL 251: Isotopes in Cosmochemistry and Geochemistry (Mukhopadhyay)

Graduate course breadth area: #4

Description coming soon.

GEL 262: Paleobiology Seminar (Motani)

Graduate course breadth area: #1

Description coming soon.

GEL 290: Seminar (TBD)

Does not count as a breadth or general course for graduate degree requirements.

GEL 294: Structure & Tectonics forum (Roeske)

Does not count as a breadth or general course for graduate degree requirements.

This on-going discussion group meets once/week to discuss a paper selected by participants in the group. The theme of the articles varies each quarter; the seminar's goal is to emphasize breadth and

we read and discuss a range of articles that cover the diverse interests of members of the group. As an example, we have recently read articles on subduction zone processes, ranging from UHP metamorphism and exhumation, to response of the upper plate to degree of coupling in the subduction zone. If schedules allow, we plan a multi-day field trip to examine rocks that may show some of the processes of interest to the group and focus the reading around the field trip.

GEL 298: Planetary Geology & Geophysics (Stewart)

Graduate course breadth area: #6 or #7

Principles of planetary science. Planetary dynamics, including orbital mechanics, tidal interactions and ring dynamics. Theory of planetary interiors, gravitational fields, rotational dynamics. Physics of planetary atmospheres. Geological processes, landforms and their modification. Methods of analysis from Earth-based observations and spacecraft.

This course meets at the same time as GEL 163 and includes additional homework assignments.

GEL 390: Methods of Teaching Geology (Billen)

Does not count as a breadth or general course for graduate degree requirements.

Description coming soon.

Winter 2023

GEL 230: Geomorphology & River Management (Pinter)

Graduate course breadth area: #5

The course – widely known as “Ecogeo” – is a multidisciplinary study of the ecology, geomorphology, and management of rivers, floodplains, and watersheds. Each year, a single river is selected, and the course focuses on an intensive study of that system. The course involves classroom instruction during the academic quarter, research and research papers focused on the study river, culminating with a 7-10+ day rafting trip during which students collect and analyze field data and/or synthesize the multidisciplinary science, management, and policy of the river.

GEL 240: Geophysics of the Earth (Rudolph)

Graduate course breadth area: #6

This course presents foundational concepts in geophysics at a level accessible to all graduate students in the EPS department. Topics to be covered include the geophysical constraints on the large-scale structure and dynamics of Earth and planetary interiors such as seismology, gravity, heat flow, magnetic field, and geodesy. We will explore the physics of the processes that shape planetary surfaces and interiors including impact events, differentiation, mantle convection, and tectonics. The course will include a computer laboratory with hands-on programming activities in Python that reinforce the concepts covered in lecture.

Format: Lectures, weekly problem sets/labs, midterm, final

Note: This course is one of several regular 'core classes' being developed to strengthen our graduate curriculum.

GEL 281: Instrumental Techniques (Yin)

Graduate course breadth area: N/A

Description coming soon.

GEL 290: Seminar (TBD)

Does not count as a breadth or general course for graduate degree requirements.

GEL 298: Planetary Impact Processes (Stewart)

Graduate course breadth area: 7

Planetary impact processes, including impact cratering mechanics and thermodynamics, catastrophic disruption, including introduction to hydrocodes, equations of state and state-of-the art in experimental capabilities.

Spring 2023

GEL 205: Advanced Field Stratigraphy (Sumner)

Graduate course breadth area: #1 or 2

Topic: Tracing geobiological influences on the rock record of eastern California.

This course will include ~7 days of fieldwork in areas between Mono Lake and the Death Valley area over spring break followed by 1 hour weekly meetings during spring quarter. Fieldwork will focus on identifying and interpreting interactions between life and sedimentary systems in rocks ranging in age from Neoproterozoic to Cambrian with a few examples of recent deposits. Students will collect stratigraphic data and samples during fieldwork that will be analyzed during spring quarter for student-defined projects. Some reading will be assigned prior to fieldwork, and students participating in fieldwork are required to enroll in the spring quarter course.

GEL 253: Petrology seminar (Cooper)

Graduate course breadth area: #4

Topic: Balancing science and disaster response during volcanic eruptions (and other natural hazards)

Data collected during well-observed eruptions can lead to dramatic increases in our understanding of volcanic eruptions. However, the necessary shift to issues of public safety and hazard mitigation during a crisis means that scientific opportunities may be sacrificed. Thus, maximizing the scientific gains from eruptions requires planning and coordinating science activities among governmental organizations and academia before and during volcanic eruptions. The Community Network for Volcanic Eruption Response ([CONVERSE](#)) is an NSF-funded organization that is coordinating planning and strategic efforts through workshops and scenario-based activities, and is in the planning stages of building an NSF-funded Center around these topics.

The purpose of this course is to learn about volcanic eruption response and scientific efforts during eruptions. This will involve some lectures covering the basics of volcanic eruptions, hazards, and monitoring, and participating in a short volcanic eruption scenario. In addition, this course will be run in conjunction with similar courses at other institutions involved in CONVERSE (e.g., UC Berkeley, Lamont-Doherty Earth Observatory, University of Hawaii, University of New Mexico) and for 5-6 weeks of the course students will work with counterparts at these other institutions to develop materials for future eruption scenario exercises, as well as sharing input and ideas about how to maximize the science that can be done under these circumstances and how science can inform response efforts. Depending on the interests and expertise of students in the course, we will expand the scope of the topics covered to include other natural hazards and responses during the time when the course does not overlap with other institutions.

CONVERSE website: <https://volcanoreponse.org>

GEL 298: Aqueous Geochemistry (Atekwana)

Graduate course breadth area: #4

The goal of this course is to discuss factors that affect the chemical composition of natural waters: (1) understanding of the main classes of reactions that control the behavior of major chemical species in natural waters and (2) learn to use some geochemical “tools” (including sampling and analyses equipment, software, etc.) to study major reactions in natural waters i.e., perform simple geochemical modeling. Students will acquire a basic understanding of the main classes of reactions, knowledge of the factors regulating chemical processes in natural waters, as well as the ways in which these processes influence the behavior of the major chemical species. Knowledge of a few basic pieces of information concerning the system of interest (e.g., temperature, pH, redox conditions, soil/sediment/rock composition, etc.) should allow students to readily apply such understanding to new situations to make reasonable predictions about the chemical composition of natural waters, and about the transport and fate of chemical species in natural waters.

GEL 290: Seminar (TBD)

Does not count as a breadth or general course for graduate degree requirements.

GEL 294: Structure & Tectonics forum (Roeske)

Does not count as a breadth or general course for graduate degree requirements.

This on-going discussion group meets once/week to discuss a paper selected by participants in the group. The theme of the articles varies each quarter; the seminar's goal is to emphasize breadth and we read and discuss a range of articles that cover the diverse interests of members of the group. As an example, we have recently read articles on subduction zone processes, ranging from UHP metamorphism and exhumation, to response of the upper plate to degree of coupling in the subduction zone. If schedules allow, we plan a multi-day field trip to examine rocks that may show some of the processes of interest to the group and focus the reading around the field trip.

Fall 2023

GEL 227: Stable Isotopes Biogeochemistry (Atekwana)

Graduate course breadth area: #4

Stable Isotopes biogeochemistry is an important discipline within the earth sciences. The use of stable isotopes is widespread from studies that seek to understand natural variations in isotopes in geologic system to those that relate to human perturbation of the world's ecosystems. This course is an introduction to the basic principles of stable isotope. Students will study of the production, distribution, and use of select naturally occurring stable isotopes applied to geology, hydrology, biogeochemistry, and environmental change. The main objective of this course is to provide an elementary understanding of the principles and application of stable isotope in earth and environmental systems. The course will focus on commonly used light stable isotopes (e.g., H, C, N, O and S). The course will also cover other stable and radioactive isotopes as appropriate. At the end of the course, students should have a working knowledge of the principles of stable isotopes and be able to apply their use in geologic studies and in their research.

GEL 240: Geophysics of the Earth (Stewart)

Graduate course breadth area: #6

This course presents foundational concepts in geophysics at a level accessible to all graduate students in the EPS department. Topics to be covered include the geophysical constraints on the large-scale structure and dynamics of Earth and planetary interiors such as seismology, gravity, heat flow, magnetic field, and geodesy. We will explore the physics of the processes that shape planetary

surfaces and interiors including impact events, differentiation, mantle convection, and tectonics.

The course will include a computer laboratory with hands-on programming activities in Python that reinforce the concepts covered in lecture.

Format: Lectures, weekly problem sets/labs, midterm, final

Note: This course is one of several regular 'core classes' being developed to strengthen our graduate curriculum.

GEL 298: TBD (Mukhopadhyay)

Graduate course breadth area: #TBD

Description coming soon.

GEL 290: Seminar (TBD)

Does not count as a breadth or general course for graduate degree requirements.

GEL 294: Structure & Tectonics forum (Roeske)

Does not count as a breadth or general course for graduate degree requirements.

This on-going discussion group meets once/week to discuss a paper selected by participants in the group. The theme of the articles varies each quarter; the seminar's goal is to emphasize breadth and we read and discuss a range of articles that cover the diverse interests of members of the group. As an example, we have recently read articles on subduction zone processes, ranging from UHP metamorphism and exhumation, to response of the upper plate to degree of coupling in the subduction zone. If schedules allow, we plan a multi-day field trip to examine rocks that may show some of the processes of interest to the group and focus the reading around the field trip.

GEL 390: Methods of Teaching Geology (Billen)

Does not count as a breadth or general course for graduate degree requirements.

Description coming soon.

Winter 2024

GEL 218: Analysis of Structures in Deformed Rocks (Cowgill)

Graduate course breadth area: #3

Description coming soon.

GEL 298: Planet Formation (Stewart)

Graduate course breadth area: #7

This course presents foundational concepts in the physics and chemistry of planet formation, focusing on the early stages of growing planets and incorporating recent observations from exoplanets. Course provides foundational material related to protoplanetary disk physics, the solar nebula chemical condensation sequence, meteorite components and chemistry, chondrules and planetesimal formation, accretion of terrestrial planets, accretion of giant planets, current grand challenges in planet formation. The material is targeted at beginning graduate students and accessible to upper-level undergraduates.

GEL 2XX: Topics in Terrestrial Paleoclimatology (Montañez)

Graduate course breadth area: #TBD

Description coming soon.

GEL 290: Seminar (TBD)

Does not count as a breadth or general course for graduate degree requirements.

Spring 2024

GEL 219: Fracture & Flow of Rocks (Billen)

Graduate course breadth area: #3 or 6

This course is designed to provide students with a strong foundation in brittle, ductile, and viscous behavior of rocks. Emphasis is on brittle/ductile behavior of the lithosphere, including the rheologies used to model earthquake rupture and mechanisms of viscous deformation. For each topic, I will present the experimental data, the equations used to describe the behavior and a discussion of the microscopic origin of the observed behavior. Weekly homework assignments emphasize foundational concepts different types of deformation. Targeted paper discussions will occur at key junctures in the course to help synthesize the topics and learn how to critically read papers establishing or applying rheological concepts. Each student will also complete a literature review-based term project on a specific type of geology of relevance to their own research.

GEL 232: Oceans and Climate Change (Hill)

Graduate course breadth area: #2

This graduate course looks at the connections between oceans, earth, and climate systems. Topics vary by year and are selected by students and faculty. Recent topics have included reconstruction of past climates of western North America through the Holocene, and the history and future of oxygen minimum zones in the ocean. Class is structured to feature peer reviewed literature as well as including elements of public science communication on oceans and climate change.

GEL 251: Isotope Geochemistry & Cosmochemistry (Yin)

Graduate course breadth area: #4

Description coming soon.

GEL 253: Petrology seminar (Ratschbacher)

Graduate course breadth area: #4

This seminar will focus on recent topics of arc magmatism with an emphasis on understanding the physical, chemical, and temporal evolution of arc magmas in the crust. Lecture and discussion topics will include differentiation processes in the crust, magma ascent and emplacement, geochronology, and the role of water in magmatic processes. In addition, the seminar will focus on introducing students to petrological tools such as geothermobarometry, trace element and isotopic studies, optical analysis of rocks, and identification of magmatic to solid-state fabrics. Lecture topics as well as papers discussed in the discussion section can be changed based on the interest of participating students.

GEL 290: Seminar (TBD)

Does not count as a breadth or general course for graduate degree requirements.

GEL 294: Structure & Tectonics forum (Roeske)

Does not count as a breadth or general course for graduate degree requirements.

This on-going discussion group meets once/week to discuss a paper selected by participants in the group. The theme of the articles varies each quarter; the seminar's goal is to emphasize breadth and we read and discuss a range of articles that cover the diverse interests of members of the group. As

an example, we have recently read articles on subduction zone processes, ranging from UHP metamorphism and exhumation, to response of the upper plate to degree of coupling in the subduction zone. If schedules allow, we plan a multi-day field trip to examine rocks that may show some of the processes of interest to the group and focus the reading around the field trip.