USC University of Southern California

GEOL 440: Geophysics and Geoengineering

Description

Units: 4
Term: Spring 2024

Lectures: Tu/Th 2:00-3:20 pm
Location: ZHS 200 (Zumberge Hall, first floor)

Labs: Fri 1:00-2:50 pm
Location: ZHS B65 (Zumberge Hall, downstairs)

Field trip 1: January 8-13, 2024.
Location: Mojave National Preserve.

Field trip 2: TBD.
Location: Mojave National Preserve.

Instructor: Sylvain Barbot (sbarbot@usc.edu)
Office Hours: (upon appointment).

Teaching Assistant: Binhao Wang (binhaowa@usc.edu)

Holidays and recess:
Martin Luther King's Birthday: Monday, January 15.
President's Day: Monday, February 19.
Spring Recess: March 10-17
Additional break: April 7-21

Course Description

The course provides a quantitative introduction to important concepts of geophysics. We will define plate tectonics and the lithological, mechanical, and thermal properties of the oceanic and continental lithospheres. We will describe the deformation that occurs at active plate boundary through faulting, folding, and volcanic unrest. Elements of data analysis will be covered in the labs, including building maps, time-series analysis, Fourier methods, solving partial differential equations, and least-squares fitting. The course includes two field trips to Catalina and the Mojave National Preserve, illustrating subduction, volcanism, and surface processes.

Field Trip

We will spend a few days in the field to explore some of the geological wonders of Southern California. The first field trip is at Catalina Island from January 8 to January 13. We will conduct gravity and active seismic surveys of the Catalina greenschist and blueschist. We will hike canyons and beaches where serpentinite, greenschist, blueschist, and amphibolite are exposed. Some outcrops expose fault zone structures with a rich mineralogy representative of modern subduction zones.

The second field trip will expose you to faulting and folding processes of deformation and volcanic activity (lava tubes, lava lakes, cinder cones). We will also look for 500 My-old fossils of vertebrates. This will involve two nights of camping in the desert. Transportation is with department vehicles.

Learning Objectives

By the end of this course, the students will be introduced to a quantitative description of Earth's dynamic processes, including deformation, heat transport, and wave propagation. The students will be familiarized with data processing techniques, including time series analysis, data fitting, and map design.

Prerequisites:

Prerequisite: MATH 126. Corequisite: PHYS 135B or PHYS 152.

Communication

Regular communication will be conducted through Blackboard (https://blackboard.usc.edu).

Examinations

The grades will be based on attendance (50%) and lab work (50%).

Required Materials

Access to a Posix computer with scientific computing tools (Matlab, Python) is required.

Assignments

There will be no assignments outside those provided in the labs.

Academic integrity

University policies on academic dishonesty are printed in SCAMPUS. Because cheating negatively affects everyone in the class, we will follow USC guidelines and report all academic misconduct. USC policies on cheating are strict and the minimum punishment is failure in the class and possible expulsion. Please don't make us have to turn you in! And remember that even the appearance of impropriety can be a concern.
More information at https://policy.usc.edu/scampus/.

Classroom norms

Student participation during lecture and laboratories and encouraged. Always feel free to ask questions and clarifications. Active participation in the laboratories is absolutely necessary.

Lecture outline

01-06 Plate tectonics, structure of the lithosphere, oceanic and continental crusts.
07-14 Tectonic deformation, types of faults, faulting and folding, volcanisms, earthquakes.
15-20 Wave propagation, seismic sources.
21-24 Heat transport, heat flow, mantle convection.

Lecture content is subject to change without warning.

Textbook

Turcotte, D.L. and Schubert, G., 2002. Geodynamics. Cambridge university press.