UT GEOL 371T/391: Tectonic Geodynamics

Spring 2021

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Overview

We discuss the processes that determine the evolution of the solid Earth system, combining views from the fields of tectonics, structural geology, and geodynamics, i.e. the continuum mechanics analysis that underpins all of this. This course is not just about the *how* but the *why* of plate motions, subduction, orogeny, and lithospheric deformation including topography. We will integrate geophysical and geological constraints from key regional settings to global scales to explore the links between theory and observations.

This class is for undergraduate and graduate students from the Earth sciences and related fields. In particular, it is intended to provide all undergraduate majors and grad students within the Lithosphere and Deep Earth (LDE) program of DGS with a foundation to appreciate the dynamical processes shaping the solid Earth.

Format: The class consists of a mix of lectures, homework assignments, discussions of reading with student presentations, and a few, simple numerical exercises using Matlab or similar software.

Prerequisites: A basic, kinematic understanding of plate tectonics. Some exposure to Earth science, physics, and math a plus, but no classes required.

Logistics

Instructors:

Thorsten Becker, twb@ig.utexas.edu, JGB 4.220AA (online)
office hours: TBD

Claudio Faccenna claudio.faccenna@jsg.utexas.edu, JGB 5.226B (online)
office hours: TBD

Lecture time: **M-W 11-12:30 (tentatively/TBD)** online via Canvas)
Location: Online via Zoom/Canvas

Grading:

- homework (50%). *Homework is due the evening of the day of class the week after (flexibility because of special circumstances)*
- Student presentation of review topic, to be discussed with instructor (50%)

Textbook:

None required. Lecture notes on Canvas and at:

http://www-udc.ig.utexas.edu/external/becker/preprints/tectonic_geodynamics_draft1220.pdf

Suggested background reading:

- *Dynamic Earth: Plates, plumes, and paradigms,* G. Davies. Cambridge University Press, 1999.
- *Rheology of the Earth*, Ranalli, G., 2nd edition, Chapman and Hall. (Out of press, local copies might be available)
- *Geodynamics*. Turcotte and Schubert, Cambridge University Press (any edition)

Syllabus

Week	Date	Topic	Instructor
1	Jan 18	Introduction	
		Earth in the Solar System	
2	Jan 25	Topography and isostasy	
		Potential fields	
3	Feb 1	Seismic structure	
		Thermal state and budgets	
4	Feb 8	Kinematics of a continuum	
		Geodesy-GPS, InSAR	
5	Feb 15	Dynamics of a continuum	
		Seismotectonics	
6	Feb 22	Rheology	
		Strength of the lithosphere	
7	Mar 1	Fluid mechanics	
		Stokes flow	
8	Mar 8	Steady-state heat transport	
		Time-dependent heat transport	
Spring break	*Mar 15*		
9	Mar 22	Thermal convection	
		Mantle convection	
10	Mar 29	Subduction and the mantle wedge	
		Plate driving forces	
11	Apr 5	Subduction evolution	
		Back-arc and arcs	
12	Apr 12	Orogeny	
		Supercontinental cycles	
13	Apr 19	Dynamic Topography	
		Mantle evolution	
14	Apr 26	Student presentations	

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Recordings:
Class recordings are reserved only for the use of members of this class (students, TAs, and the instructor) and only for educational purposes. Recordings should not be shared outside the class in any form. Violation of this restriction could lead to Student Misconduct proceedings.