

# COURSE SYLLABUS

**GEO 5690/6690**

**Geodynamics**

**Spring 2023**

**MWF 13:30–14:20 Geol 301b**

Professor: Tony Lowry (Department of Geology)  
• Geology Bldg Room 106 (Phone: 435-557-6780)  
• Email: [tony.lowry@usu.edu](mailto:tony.lowry@usu.edu)  
• Office Hours: MWF 9:30–15:30 (or by appt)

Course Text: Geodynamics: 2<sup>nd</sup> Edition. D.L. Turcotte and G. Schubert, Cambridge (NY)  
Course Website: <http://aconcagua.geol.usu.edu/%7Earlowry/Geodyn/index.html>

## CONCEPTUAL & SKILL OBJECTIVES

**Primary:** Earth as a complex system; Earth materials; Earth structure; Applying strong quantitative skills

**Secondary:** Properties of Earth's interior and structural features, including processes that influence plate tectonics and geologic hazards of our region; Pathways, fluxes, and influence of water and other fluids in Earth's subsurface

## COURSE DESCRIPTION

This course introduces (and surveys current literature on) geodynamics, the study of dynamical processes of the solid Earth. Geodynamics is rooted in fundamental physics and treats planetary processes as transfer of energy, redistribution of mass, and changes in material properties in a highly multidisciplinary fashion. Energy in the Earth's interior is dominantly thermal, gravitational potential, and strain potential (but others can be important)! Consequently much of this course will deal with inter-relationships of heat transfer, gravity, mass density and mass flux.

The course incorporates both introductory materials and frontier papers relating to geodynamics of the lithosphere and asthenosphere. Your assignments will include solving problem sets and doing some relatively simple modeling exercises using standard codes (which we will learn together as a group), reading and discussing the physics, measurements and observations informing current papers, and providing discussion materials for a paper. Graduate students taking the 6690 course also are required to develop a semester research project on a topic of your choosing (presumably, something related to your thesis research). I will attempt to skew the course materials a bit toward the thesis topics and/or interests of students taking the course.

### About the professor:

I am a geophysicist. My research focuses on measuring and understanding how and why planets deform, and particularly the rheological relationships that modulate processes of ductile flow, fault slip, earthquakes and volcanism. Elements of my research also have implications for mass transfer in the atmosphere, hydrosphere and cryosphere.

**(Very Approximate) Schedule of Topics:**

<b>Dates</b>	<b>Topic</b>	<b>Reading</b>
9–13 Jan	Introduction to the course: Isostasy & Lithosphere	T&S 73-79
18–20 Jan	Lithosphere as thermal boundary layer: Conductive heat transfer; radiogenic heating Time-dependence (cooling & heating); Temperature and density	T&S 132-162 T&S 171-177
23–27 Jan	Advective heat transfer processes	T&S 162-171; 179-183
30 Jan– 3 Feb	Intro Asthenosphere: The adiabat; fluid flow  Convection; plumes Asthenosphere = Convection?	T&S 185-190; 226-238 254-261; 266-280
6–10 Feb	Subduction as downwelling	T&S 244-249
13–17 Feb	Delamination and drips as downwelling Rheology	T&S 292-323
20–24 Feb	Frictional rheology: seismogenic layer = lithosphere?	T&S 339-355
27 Feb– 3 Mar	Flexural Isostasy (Lithosphere as strong layer)	T&S 105-130
13–17 Mar	Flexural strength as lithosphere	
20–24 Mar	Rheology; Rheological implications of flexural rigidity	
27–31 Mar	Lithosphere = Tectonic Plate? Viscoelasticity: Asthenosphere from rebound?	T&S 238-241
3–7 Apr	Postseismic deformation: Asthenosphere from rebound?	
10–14 Apr	Major element chemistry: Lithosphere as tectosphere Geochemistry: Asthenosphere as mixed reservoir	T&S 410-427
17–21 Apr	Mineral Thermodynamics; Equations of State and lithology	
24 Apr	Special topics?	
28 Apr	Final Semester Projects Presentations	1:30-3:30

**Write-up of Semester Projects Due 3 May at class-time**

Updated course schedule and powerpoint lectures will be at

<http://aconcagua.geol.usu.edu/%7Earlowry/Geodyn/index.html>

<b>Grading:</b>	<b>UG</b>	<b>Grad</b>
Exercises	50%	30%
Class discussions/discussion leads	50%	30%
<u>Semester Project and Presentation</u>		<u>40%</u>

***Notice to students with disabilities:*** Students with physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations in accordance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973. If you have a disability that will likely require some accommodation by the instructor, you must contact the instructor and document the disability through the Disability Resource Center (DRC) in Room 101 of the University Inn, 797-2444 voice, 797-0740 TTY, or toll free at 1-800-259-2966, preferably during the first week of the course. Any requests for special considerations relating to attendance, pedagogy, taking of examinations, etc. must be discussed with and approved by the instructor. In cooperation with the Disability Resource Center, course materials can be provided in alternative formats--large print, audio, diskette or Braille.