GEOL599: Subduction

**Instructors** Profs. Thorsten Becker (ZHS269; (213)740-8365; twb@usc.edu), Meghan Miller (ZHS103; (213)740-6308; msmiller@usc.edu). David Okaya

**Times** Spring 2012; Class meets Thursdays 1:30-4:15pm, 3 units, Location: ZHS264

**Objective** Subduction of oceanic lithosphere plays an integral part in driving plate tectonics, continental formation and deformation, carbon and volatile cycles, and so controls the geological evolution of Earth.

The objective of this seminar is to take stock of what’s been done in terms of geodynamic modeling and structural seismology, and, more importantly, identify a few new avenues how we can make progress on subduction science, both from a fundamental level, and in terms of understanding the dynamics of data-rich “natural laboratories” such as Japan (particularly after Tohoku), the United States (after and during EarthScope USArray), and the MARGINS/GeoPRISM sites.

After a series of introductory classes, we will focus on a subset of the wide field of subduction research, the topics of subduction initiation and the interactions of subduction with overriding plate deformation.

The class targets graduate students from all Earth science fields, applied math, and engineering and will include reading and in-class discussion of the recent literature and classic papers. We will have student presentations, and students are expected to work on a term paper. The latter can be a research project (preferred), or an in-depth review of a subject area.

**Recommended preparation** GEOL440, GEOL534.

**Grading**

- 40% student presentations
- 50% final project
- 10% class participation
Syllabus

Jan 19  Introduction. Student presentations on Becker and Faccenna (2009) and Billen (2008)
   Additional reading: Forsyth and Uyeda (1975); Uyeda and Kanamori (1979)

Jan 26  Presentation by John Crowley on Plate force balance.

Feb 2 (DO lead)  Kinematics and slab dip. Student presentations on Heuret and Lallemand (2005); Heuret et al. (2007); Lallemand et al. (2005)
   Additional reading: Tovish and Schubert (1978); Hager and O’Connell (1978); Jarrard (1986); King (2001); Heuret et al. (2011)

Feb 9 (TWB lead)  Rheology. Student presentations on Billen and Hirth (2005); van Hunen and van den Berg (2008)

Feb 16  Viscous bending. Student presentations on Conrad and Hager (1999); Ribe (2010)
   Additional reading: Bellahsen et al. (2005); Buffett and Rowley (2006); Buffett and Becker (2012); Capitanio et al. (2011)

Feb 23  Initiation of subduction I. Discussion of Gurnis et al. (2000)
   Additional reading: Regenauer-Lieb et al. (2001); Kemp and Stevenson (1996); Toth and Gurnis (1998); Gerya (2011)

Mar 1  Initiation of subduction II. Student presentation on Nikolaeva et al. (2010); Leng and Gurnis (2012)
   Additional reading: Lévy and Jaupart (2012); Nikolaeva et al. (2011); van Hunen and van den Berg (2008)

Mar 8 (MSM lead)  Convergence velocity and trench migration. Student presentations on Schellart et al. (2007); Miller et al. (2006)
   Additional reading: Stegman et al. (2006); Funiciello et al. (2008); Royden and Husson (2006); Bevis (1986)

Mar 23  Slab overriding plate coupling: Student presentations on Bostock et al. (2002); Royden and Papanikolaou (2011)
   Additional reading: Rondenay et al. (2001)

Mar 29 (DO lead)  Slab overriding plate interactions. Presentation on Wallace et al. (2009).
   Additional reading: Faccenna et al. (2006); Capitanio et al. (2011)

Apr 5  Flat slabs. Student presentations on Anderson et al. (2007); Kim et al. (2010).
   Additional reading: Skinner and Clayton (2011)
Apr 12 (MSM lead) Flat slab dynamics. Student presentations on van Hunen et al. (2002a,b) and Manea et al. (2012)
Additional reading: Olbertz et al. (1997); Manea and Manea (2010)

Apr 19 (TWB lead) Overriding plate deformation. Student presentations on Whittaker et al. (2007); Capitanio et al. (2010)

May 10 Final project presentations.

Textbooks
No text book is required, but the first two strongly recommended.

- Ranalli, G. Rheology of the Earth. Chapman & Hall, 1995. (Somewhat out of date but highly useful, PDF may be available.)
- Davies, G. F., Dynamic Earth: Plates, plumes, mantle convection, Cambridge University Press, 1999. (Nice narrative of one of the traditional views on mantle dynamics.)
- Malvern, L. E., Introduction to the mechanics of a continuous medium, Prentice Hall, Inc., 1969. (Classic continuum mechanics text, very useful for more comprehensive background reading.)
- Karato, S.-i., Deformation of Earth Materials, Cambridge University Press, 2008. (Somewhat of an update of Ranalli with a slightly different angle.)

Statement for Students with Disabilities
Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.
Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one’s own academic work from misuse by others as well as to avoid using another’s work as one’s own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS.gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

References


