Syllabus
ESS 502: Solid Earth
Winter, 2009

Instructor: Ken Creager kcc@ess.washington.edu

Reference Texts: C.M.R. Fowler, The Solid Earth: An introduction to global geophysics
D. L. Anderson, Theory of the Earth (on-line)

Grades will be based on weekly writing assignments (40%), participation in class discussion (20%) and two (PowerPoint) group projects (40%).

Description: Large-scale internal earth processes are explored through ongoing scientific controversies. Topics covered include: Earth as a heat engine and chemical processing factory, style of mantle convection, origin and evolution of Earth's magnetic field, and the process and hazards of Cascadia subduction. Geophysical concepts of seismology, fluid dynamics, heat flow, gravity and geomagnetism, will be introduced through lecture, reading and problem sets. Small group discussion and weekly writing will focus on the analysis and critique of ideas presented in selections from the scientific literature. Topics 1 through 3 will take about 6 weeks, topic 4 will be 4 weeks.

Topic 1: Earth's magnetic field: origin and evolution, rock record, reconstruction of plate motions.

***Concepts*:** rock magnetism, geodynamo, geomagnetism, magnetic field reversals.

Topic 2: Earth as a heat engine and chemical processing factory.

Concepts: Plate tectonics, thermal, chemical, and mechanical boundary layers: lithosphere, asthenosphere, tectosphere , crust, mantle, heat flow, isostacy, rheology, plate bending, continuum mechanics, radiogenic heat sources.

Topic 3: Style of mantle convection: whole-mantle versus layered convection? Is there a stealth layer? Do mantle plumes originate from the lower-most mantle or the upper mantle?

Concepts: Seismicity, focal mechanisms, seismic tomography, mineralogical phase transitions, fluid dynamics, heat flow, chemical/isotope reservoirs.

Topic 4: The process and hazards of Cascadia Subduction: megathrust earthquakes, intraslab earthquakes, discovery of deep tremor and slow-slip earthquakes, Olympic versus Cascade mountains, sedimentary basins, water, water everywhere.

Concepts: Physics of earthquakes, fast vs slow earthquakes, tsunamis, geodesy, role of mineral hydration in inducing earthquakes and modifying rheology

Learning Goals:

- Learn fundamental geophysical principals that underlie ongoing scientific controversies
- Read, analyze and critique scientific papers and hypotheses
- Effectively communicate scientific concepts to peers
- Understand the distinction and use of data and models
- Gain an appreciation for the importance of multidisciplinary approaches
- Recognize the human dimension in underlying global scale Earth processes