UTD	**Course**	GEOS 5375 - TECTONICS
	Professor	Dr. Robert J. Stern
	Term	Spring 2008
	Meetings	TR 2:30-4:00 FO2.604

Professor's Contact Information

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General Course Information

Pre-requisites, Co-requisites, & other restrictions	Structural Geology
Course Description	Study of the earth's present tectonic environments, including geochemistry, sedimentology, and structure; application of present tectonic environments towards the reconstruction of ancient crustal events; consideration of temporal aspects of crustal evolution. Oral and written presentations required. Prerequisite: Structural geology. (3-0) T
Learning Outcomes	Students will learn the various modes of formation and deformation of Earth's crust and lithosphere
Required Texts & Materials	Kearey & Vine (1996) Global Tectonics (Second Edition, Blackwell)
Recommended	

Important Message: Tectonics is a wonderfully interdisciplinary field, not only because it draws from so many disciplines but also because it is a common concern of academia, governmental agencies interested in natural hazards, and the mineral and hydrocarbon industries. It is my favorite class to teach. There is a lot of reading in this course and much of your grade is based on your term paper. I guarantee you that the more you read, the more you will get out of this class! Beware; you must keep up with the readings if you are to do well in this class.

Grading

20% on midterm (March 4; covers readings and lecture)
15% on oral presentation
35% on term paper OR Wikipedia entry*- due on the last day of class (April 24)
30% on final exam (Last day of class, April 24)

I am also willing to discuss credit for paper and presentation for installing GMT installation and tutoring interested users. Talk to me if interested.

* Wikipedia topic must be a STUB or NEW ENTRY pertaining to some topic in the broad realm of Tectonics. At least 4 self-drafted figures must be included.

- Selection of the term paper/Wikipedia entry topic must be done in consultation with RJS. A one paragraph explanation of the topic must be submitted by March 4 (5% of grade). The term paper and oral presentation should focus on understanding an *active* tectonic feature or process. The oral presentation and paper MUST include 1) a section using inferences from compilations of global plate motion, including both NUVEL-1A (DeMets et al., 1990, Geophys. J. Int'l. 101, 425-478; DeMets et al. 1994. Geophys. Res. Lett. 21, 2191-2194) and its GPS-based companion REVEL (J.Geophys. Res. 107, B4, 10.1029/2000JB000033, 2002); and 2) a section using inferences based on active seismicity. Here are a few suggestions for topics:

  Tectonics of the Afar Triple Junction
  The San Andreas Fault System
  The Alpine Fault Zone, New Zealand
  The Dead Sea Transform
  New Guinea Collision Zone
  India-Asia collision zone
  IBM-Japan Collision zone
  Australia-Indonesia collision zone
  New Guinea-Philippine Sea Plate collision zone
  The Arabia-Iran collision zone
  Development of an Accretionary prism (Nankai Trough or Central America)
  Escape tectonics in Anatolia and the Aegean
  Opening of the Red Sea
  Opening of the Gulf of California
  The East African Rift
  The Mariana Trough, Lau Basin, or East Scotia Back-Arc Basins

- If you choose to do a term paper, this should be about 15 pages long (including figures and references) and is due on the last day of class (April 24). It should include an abstract (300 words), references (in the style of J. Geophys. Research), and figures. You must also submit evidence that you carried out a comprehensive literature search (a print-out of your literature search will do). References should be up-to-date as possible, and at least half of the figures should be drafted by you.
- Turn in two copies of the paper if you want one back with my comments.
- The oral presentation consists of a 20 minute talk followed by 10 minutes of questions. The presenter will be graded on scientific quality, preparation (practice your talk!), quality of visual aids, keeping to time, and answers to questions. The rest of the class will be graded on whether or not you participate in the discussion by asking questions.

Please bring your required textbook (Kearey & Vine) to class. The readings are assigned for each week below, please do them before class and be prepared to discuss the material. There are some additional readings, taken from various journals. These are marked with '*' below. References marked with '**' are available as pdfs from the CD-ROM I will

distribute. Below are the reading assignments. Be sure and try to keep up – there are about 1000 pages of reading, only ~70 pages a week – 10 pages a day – not that much IF you keep up!

Jan. 8: **Introduction & Overview (plus: Accessing Georef and Electronic Journals)**
Kearey & Vine: Chapter 1 (7p)
**Tackley 2000. 'Mantle Convection and Plate Tectonics: Toward an Integrated Physical and Chemical Theory' Science 288, 2002-2007. (Tackley.pdf)
**Scotese 2004. A Continental Drift Flipbook. J. Geology 112, 729-741 (Scotese04.pdf)
33 pages of reading

Jan. 10: **Geophysical Techniques**
Kearey & Vine: Chapter 2 (34p)
**Morris, 2003. A paleomagnetic and rock magnetic glossary. Tectonophysics 377, 211-228 (PaleoMagGlossary.pdf)
**Müller, Roest, Royer, Gahagan, and Sclater, 1997. Digital isochrons of the world's ocean floor. J Geophys. Res. 102, 3211-3214. (Digital Isochrons.pdf)
Go to http://wwwneic.cr.usgs.gov/neis/epic/epic.html and generate a rectangular map (map output option) of earthquakes over the region 10°-30°N, 130°-150°E (IBM arc area)
54 pages of reading

Jan. 15: **Principal Tectonic Features of Earth, Venus, and Mars**
*Lowman, 1989. "Comparative Planetology and the Origin of Continental Crust." Precambrian Research 44, 171-195.
**Phillips and Hansen, 1998. "Geologic Evolution of Venus: Rises, Plains, Plumes, and Plateaus" Science 279, 1492-1497. (Venus.pdf)
**Zuber, 2001. "The Crust and mantle of Mars" Nature 412, 220-227. (Mars.pdf)
38 pages of reading

Jan. 17: **Plate Kinematics**
Kearey & Vine Chapter 3 (16 p)
Look at powerpoint presentation "atlas_1999.ppt"
*DeMets et al., 1990, "Current Plate Motions" Geophys. J. Int'l. 101, 425-478;
*DeMets et al. 1994. "Effect of Recent revisions to the Geologic Time Scale on estimates of current plate motions" Geophys. Res. Lett. 21, 2191-2194.
**Sella et al., 2002. "REVEL: A model for current plate velocities from space geodesy" J.Geophys. Res. 107, B4, 10.1029/2000JB000033, 2002 (REVEL.pdf)
**Bird, 2003. "An updated digital model of plate boundaries" Geochemistry, Geophysics, Geosystems v. 4, no. 3, 1027, doi:10.1029/2001GC000252
156 pages of reading

Jan. 22: **What is Crust? What is Lithosphere?**
Kearey & Vine Chapter 4 (13p)
**Anderson, D.L. (1995) "Lithosphere, asthenosphere, and perisphere" Reviews of Geophysics v.33, p. 125-149. (Anderson95.pdf)

**Rudnick, 1995. "Making Continental Crust" Nature 378, 571-578 (MakingContCrust.pdf)
**Mooney, Laske, and Masters 1998 CRUST 5.1: A global crustal model at 5° x 5° JGR 103, B1, 727-748 (Mooney98.pdf)
Go to < http://quake.wr.usgs.gov/research/structure/CrustalStructure/database/index.html> and look at histograms for continental crustal thickness.
Go to < http://www.ngdc.noaa.gov/mgg/global/crustage.HTML> and look at maps of oceanic crust age.
44 pages of reading

Jan. 24: **Strength of the Crust and Lithosphere**
Kearey & Vine Chapter 5 (27 p)
**Maggi, Jackson, McKenzie, and Priestley, 2000. Earthquake focal depths, effective elastic thickness, and the strength of the continental lithosphere. Geology 28, 495-498 (Maggi.pdf)
**Jackson, 2002. Strength of the continental lithosphere: Time to abandon the jelly sandwich? GSA Today, 4-9 (Jackson.pdf)
35 pages of reading

Jan. 29: **What Drives The Plates?**
Kearey & Vine, Ch. 11 (21 p)
** Conrad and Lithgow-Bertelloni (2002) How mantle slabs drive plate tectonics Science, vol. 298, no.5591, pp.207-209, 04 Oct 2002 (Conrad.pdf)
3 pages of reading

Jan. 31: **Subduction Zones**
Kearey & Vine Chapter 8 (36 pages)
**Stern (2003) "Subduction Zones" Reviews of Geophysics, 40, 4 (38 pages) (SubZonesRoG.pdf)
74 pages of reading

Feb. 5: **Subduction Zones** (continued)
**Clift and Vannucchi, 2004. Controls on Tectonic Accretion versus Erosion in Subduction Zones: Implications for the Origin and Recycling of the Continental Crust. Reviews of Geophysics, 42, RG2001, doi:10.1029/2003RG000127. (Clift&Vannu.04.pdf)
**von Huene, Ranero, and Vannucchi, 2004. Generic model of Subduction erosion. Geology 32, 913-916.
41 pages of reading

Feb. 7: **Rifts**
Kearey & Vine Chapter 10 (39 pages)
*Sengor and Burke, 1978."Relative Timing of Rifting and Volcanism on Earth and its Tectonic Implications" Geophys Res Lett. 5, p. 419-421
*Busby and Ingersoll: "Chapter 3: Continental Rifts and Proto-Oceanic Troughs"

*Buck, W.R., (1991) Modes of Continental Lithospheric Extension" J. Geophysical Research vol. 96 no. B12. P. 20,161-20,178.
**Taylor, Goodliffe, and Martinez (1999) "How continents break up: Insights from Papua New Guinea. JGR v. 104, p. 7497-7512 (PapuaJGR.pdf
73 pages of reading

Feb. 12: **Seafloor Spreading**
Kearey & Vine Chapter 6 (19 pages)
**MacDonald "Mid-Ocean Ridges" proof of Encarta Encyclopedia article published by Microsoft (MacDonald Ridges.pdf)
40 pages of reading

Feb. 14: **Seafloor Spreading** (continued)

Feb. 19: **Passive Continental Margins**
Wikipedia Entry "Passive Margin"
*Busby and Ingersoll: "Chapter 4: Continental Terraces and Rises"(30 pages)
**Skogseid 2001. "Volcanic Margins: Geodynamic and Exploration Aspects" Marine and Petroleum Geology, 18: 457-461. (Skogseid.pdf)
**Berndt, Planke, Alvestad, Tsikalas, and Rasmussen. 2001. Seismic volcanostratigraphy of the Norwegian margin: Constraints on tectonomagmatic break-up processes. J. Geol. Soc. London 158, 413-426 (VoringMargin.pdf)
47 pages of reading

Feb. 21: **The Texas Passive Continental Margins**

Feb 26: **Transform Faults and Triple Junctions**
Kearey & Vine Chapter 7 (16p)
Go to < http://emvc.geol.ucsb.edu>;
then "Downloads", "Regional Geoogic Histories" to get a good idea how the San Andreas fault formed, look at Quicktime animations:
Pacific Hemisphere Plate, 80 Ma to Present
N.E. Pacific and W. North America Plate History, 38 Ma to Present
Plate Tectonic History of Southern California, 20 Ma to Present
38 pages of reading

Feb. 28: **Back-Arc Basins**
*Busby and Ingersoll: "Chapter 8: Interarc and Back-arc Basins"
31 pages of reading

Mar. 4: **Mid-term**

March 6: **Subduction Initiation and Ophiolites**
** Stern, R.J. 2004. Subduction Initiation: Spontaneous and Induced. Earth Planet. Sci. Lett. 226, 275-292 (SubInit04.pdf)
17 pages of reading

March 11 & 13: Spring Break, no classes

March 18: **When Did Plate Tectonics begin?**
Kearey & Vine Ch. 12 (39p)

March 20: **Collisions** Kearey & Vine Chapter 9 (37p)
*Cloos, M. (1993) "Lithospheric buoyancy and collisional orogenesis: Subduction of oceanic plateaus, continental margins, island arcs, spreading ridges, and seamounts" Geological Society of America Bulletin, v. 105, p. 715-737.
**Mann, P., and Taira, A., 2004. Global tectonic significance of the Solomon Islands and Ontong Java convergent zone. Tectonophysics 389, 137-190
112 pages of reading

March 25: **Collisions** (continued)

March 27: **Orogenic Plateaux**

April 1: **No Class (GSA South-central)**

April 8: **Foreland Basins**
*Ingersoll and Busby: "Chapter 1: Tectonics of Sedimentary Basins"
51 pages of reading

April 10: **Supercontinent Cycle**
****Gurnis 1988. Large-scale Mantle Convection and the Aggregation and Dispersal of Supercontinents. Nature 331:695-699
*Worsley, T. R., Nance, R D., Moody, J. B. 1986"Tectonic cycles and the history of the Earth's biogeochemical and paleoceanographic record"Paleoceanography, 1, 233-263.
35 pages of reading

April 15: **Mantle Plumes and Large Igneous Provinces**
**Beyene and Abdelsalam 2005. Tectonics of the Afar Depression: A review and synthesis. Journal of African Earth Sciences 41, 41-59
**Courtillot, Davaille, Bsse, and Stock. 2003. Three distinct types of hotspots in the Earth's mantle. EPSL 205, 295-308 (Plumes EPSL03.pdf)
**Abbott and Isley, 2002. "The intensity, occurrence and duration of superplume events and eras over geological time" J. Geodynamics 34, 265-307 (Abbott.pdf)
**Kerr, White, and Saunders, 2000. LIP Reading: Recognizing Oceanic Plateaux in the Geological Record" J. Petrology 41, 1041-1056. (LIP Reading.pdf)
60 pages of reading

Apr. 17: Student Presentations

April 22: Student Presentations

April 24: **Final Exam**