UTD	**Course**	GEOS 5375 - TECTONICS
	Professor	Dr. Robert J. Stern
	Term	Spring 2009
	Meetings	MW 4:00-5:30pm CBW1.202

Professor's Contact Information

Office Phone	972-883-2442
Office Location	FO3.620C
Email Address	rjstern@utdallas.edu
Office Hours	M 1:30-3:30 pm
Other Information	

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, Klepeis, & Vine (2009) Global Tectonics (Third Edition, Wiley-Blackwell)
Supplementary Materials	http://blackwellpublishing.com/kearey/

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)
5% for 1 paragraph explanation of project (due March 4)
15% on oral presentation
35% on term paper OR Wikipedia entry*- due on the last day of class (May 4)
25% on final exam (Friday, May 8)

* Wikipedia topic must be a NEW ENTRY or expansion of STUB pertaining to some topic in the broad realm of Tectonics. At least 4 self-drafted figures must be included. Beware, a good Wikipedia article is a lot of work!

- 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 (May 4). 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 a pdf and a hard copy IF you want one back with my comments.
- The oral presentation consists of a 15 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 et al., 3rd edition) to class. The second edition is not good enough, there has been a major revision. 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, which can be downloaded from the UTD library website. These are marked with '*' below. Be sure and try to keep up with the reading assignments – there are about 1000 pages of reading, only ~70 pages a week – 10 pages a day – not that much IF you keep up!

Class Schedule

Jan. 12: **Introduction & Overview (plus: Accessing Electronic Journals)**
Kearey et al.: Chapter 1 (8p)
*Tackley 2000. 'Mantle Convection and Plate Tectonics: Toward an Integrated Physical and Chemical Theory' Science 288, 2002-2007.

Jan. 14: **Geophysical Techniques**
Kearey et al.: Chapter 2 (42p)
*Morris, 2003. A paleomagnetic and rock magnetic glossary. Tectonophysics 377, 211-228

Jan. 19: **Martin Luther King Day – no class**

Jan. 21: **Principal Tectonic Features of Earth, Venus, and Mars**
Kearey et al. Ch5. (30p)

Jan. 26: **Plate Kinematics**
Kearey et al. Chapter 3 (18 p)
*Scotese 2004. A Continental Drift Flipbook. J. Geology 112, 729-741
*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
*Bird, 2003. "An updated digital model of plate boundaries" Geochemistry, Geophysics, Geosystems v. 4, no. 3, 1027, doi:10.1029/2001GC000252

Jan. 28: **What is Crust? What is Lithosphere?**
*Anderson, D.L. (1995) "Lithosphere, asthenosphere, and perisphere" Reviews of Geophysics v.33, p. 125-149.
*Mooney, Laske, and Masters 1998 CRUST 5.1: A global crustal model at 5° x 5° JGR 103, B1, 727-748
Go to <http://mahi.ucsd.edu/Gabi/rem.dir/crust/crust2.html> and look at maps showing crustal thicknessand thickness of sedimentary basins.
Go to <http://gdcinfo.agg.nrcan.gc.ca/app/agegrid_e.html> and look at Digital Isochrons of the World's Ocean Floor

Feb. 2: **No Class – RJS in Western Pacific. Work on Term Project**

Feb. 4: **No Class – RJS in Western Pacific. Work on Term Project**

Feb. 9: **Strength of the Crust and Lithosphere**
*Maggi, Jackson, McKenzie, and Priestley, 2000. Earthquake focal depths, effective elastic thickness, and the strength of the continental lithosphere. Geology 28, 495-498
*Jackson, 2002. Strength of the continental lithosphere: Time to abandon the jelly sandwich? GSA Today, 4-9

Feb. 11: **What Drives The Plates?**
Kearey et al., Ch. 12 (27p)
*Conrad and Lithgow-Bertelloni (2002) How mantle slabs drive plate tectonics Science, vol. 298, no.5591, pp.207-209, 04 Oct 2002 *
*Bird P., Z. Liu, W. K. Rucker (2008), Stresses that drive the plates from below: Definitions, computational path, model optimization, and error analysis, J. Geophys. Res., 113, B11406, doi:10.1029/2007JB005460.

Feb. 16: **Subduction Zones**
Kearey et al. Chapter 9 (36 pages)
*Stern (2003) "Subduction Zones" Reviews of Geophysics, 40, 4 (38 pages) (SubZonesRoG.pdf)

Feb. 18 **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.
*von Huene, Ranero, and Vannucchi, 2004. Generic model of Subduction erosion. Geology 32, 913-916.

Feb. 23: **No Class – RJS in San Diego; Work on Term Project**

Feb. 25: **Rifts**
Kearey et al. Chapter 7 (58 pages)
*Sengor and Burke, 1978."Relative Timing of Rifting and Volcanism on Earth and its Tectonic Implications" Geophys Res Lett. 5, p. 419-421
*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

March 2: **Seafloor Spreading**
Look at videos
http://emvc.geol.ucsb.edu/downloads.php#GlobalTectonics
4 videos: Seafloor Spreading (cross-section), South Atlantic spreading, Seafloor spreading and magnetic reversals, and Tuzo's puzzle
Kearey et al. Chapter 4 (17 pages)

March 4: **Seafloor Spreading** (continued)
Keary et al. Ch 6. (31p)

March 9: **Midterm exam**

March 11: **Passive Continental Margins**
Wikipedia entries: "Passive Margin", "Volcanic Passive margin" and "Non-volcanic passive margin". These were created by UTD students
*Skogseid 2001. "Volcanic Margins: Geodynamic and Exploration Aspects" Marine and Petroleum Geology, 18: 457-461.
*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

March 16-18: **No class Spring Break**

March 23: : **The Texas Passive Continental Margins**

March 25: **Transform Faults and Triple Junctions**
Kearey et al. Ch. 8. (39p)
Go to < http://emvc.geol.ucsb.edu>;
then "Downloads", "Regional Plate Tectonics and Geologic 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

Mar. 30: **Back-Arc Basins**

April 1: **Subduction Initiation and Ophiolites**
* Stern, R.J. 2004. Subduction Initiation: Spontaneous and Induced. Earth Planet. Sci. Lett. 226, 275-292

April 6: **No class – RJS in Michigan; Work on Term Project**

April 8: **When Did Plate Tectonics begin?**
Kearey et al. Ch 13.
*Rollinson 2008. When did plate tectonics begin? Geology Today 23, 186-191.

April 13: **No class – RJS in Missouri; Work on Term Project**

April 15: **Collisions** Kearey et al. Ch 10. Orogenic belts
*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
Look at http://emvc.geol.ucsb.edu/downloads.php#GlobalTectonics "Himalayan Subduction"

April 20: **Collisions** (continued) & **Orogenic Plateaux**

April 22: **Student Presentations**

April 27: **Student Presentations**

April 29: **No class – RJS in S. Carolina**

May 4: **Student Presentations**

Friday May 8: **Final Exam (2pm)**

Some Useful links:

- http://topex.ucsd.edu/index.html Satellite geodesy website. Global topography (including bathymetry); satellite radar altimetry (including free-air gravity).
- http://mahi.ucsd.edu/Gabi/rem.html Reference Earth Model website. Comparison of seismic tomographic maps of the Earth's mantle.
- http://web.ig.utexas.edu/research//projects/plates Plate tectonic and geographic reconstructions
- http://www.scotese.com/default.htm Paleomap project. Detailed paleogeographic maps with commentary and animations. http://earthquake.usgs.gov US national earthquake information service. Earthquake Hazards Program, maps of seismicity, etc.
- http://www.seismo.ethz.ch/GSHAP/ Global Seismic Hazard Assessment Program website.
- http://www.iris.edu/hq/ Incorporated Research Institutes for Seismology (IRIS) website. Includes Global Seismograph Network data.
- www.seismology.harvard.edu
- www.volcano.si.edu/world/ Global Volcanism Program
- www.mantleplumes.org/ Website for discussion of the origin of hotspot volcanism.
- www.world-stress-map.org World Stress Map project website. Global database of present-day stress in the lithosphere from various types of stress indicator. Includes world and regional maps of stress measurements.
- www.marine-geo.org Marine Geoscience Data System Includes Ridge 2000 and MARGINS programs, relating to mid-ocean ridge crests and continental margins respectively.
- www.ngdc.noaa.gov National Geophysical Data Center of the U.S. National Oceanographic and Atmospheric Administration. Includes Marine Geology and Geophysics, Bathymetry and Global relief and Natural Hazards.