

Marine Tectonics – Spring 2011

- Instructors:** Nathan Bangs (nathan@ig.utexas.edu, 471-0424)
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- Text Book:** Global Tectonics, 3rd Edition, Kearey, Klepeis and Vine. ISBN: 978-1-4051-0777-8, Wiley-Blackwell Publishers, 2008.
- Meetings:** GEO 3.222 at 2-3:30 on Tuesdays and Thursdays (lectures)
- Office hours:** 1:00-2:00 Tuesdays, 2:00-4:00 Wednesdays, EPS 4.102 (UTIG Office located in Schoch Building adjacent to main Geology Building on main campus)

Assignments:

- There will be six exercises. Each will be assigned on a Thursday and due two weeks later at the start of class. These exercises will probably require some assistance from the instructors during office hours. Arrangements for turning in a late assignment may be possible for some exceptional circumstances, but must be made in advance of the due date via e-mail to all 4 instructors. Unexcused late exercises will receive a maximum of half credit.
- There will be numerous discussion periods during the semester as listed in the schedule. All students are expected to read the assigned discussion journal article, and in addition each student will be required to present one paper and be the discussion leader for one paper during the semester.
- The final project will consist of both an oral presentation and a written report. The written report will be due 7 May, with an oral presentation 28 April, 3 May or 5 May.
- Graduate students will prepare a report presenting original analysis of data (e.g., seismicity, potential fields, GPS, bathymetry) along a plate margin of their choice. The data are likely to derive from publications; however, analysis and synthesis of data should represent the student's work.
- Undergraduates will synthesize three or more journal articles about a plate margin of the student's choice, based on multiple techniques to understand the tectonics of the area. The written report should be 3-5 pages of text and include figures from and references to the journal articles.

Grading:

- Exercises and problems sets total to 50% of grade; leading and participating in class discussion total to 20%; final project is 30%.
- There are NO in-class exams or final exam.

Schedule

Week 1

18 January (Tu) – Course introduction, History of Plate Tectonics (Christeson)

20 January (Th) – Plate kinematics (Bangs)

[Assignment #1: Triple junction evolution]

Week 2

25 January (Tu) – Driving forces of plate tectonics and isostasy (Bangs)

[Discussion: Mueller, Steve and Phillips, Roger J. (1991), *On The Initiation of Subduction*, J. Geophys. Res., Vol. 96, pp. 651–665]

27 January (Th) – Composition, rheology, deformation mechanisms (Hayman)

[Discussion: Van Dover et al., (2002), *Evolution and Biogeography of deep-sea vent and seep invertebrates*, Science, 15, 1253-1257]

Week 3

1 February (Tu) – Geophysical Techniques: GPS, paleoseismology, gravity, focal mechanisms (Gulick)

[Discussion: Molnar, P. (1988) *Continental tectonics in the aftermath of plate tectonics*, Nature, v. 335, 131-137]

3 February (Th) – Geophysical Techniques: Seismic reflection and refraction (Bangs)

[Assignment #1 Due]

[Assignment #2: Velocity Models]

Week 4

8 February (Tu) – Geophysical Techniques: Multibeam, sidescan sonar, magnetics, drilling (Hayman)

[Discussion: Minshull et al., (1998), *Is the oceanic Moho a serpentinization front?*, Geological Society of London, Special Publications, v. 148, pp. 71-80.]

10 February (Th) – Pure Shear vs. Simple Shear Rifting (Hayman)

[Discussion: Reston, T., et al. (2007), *Extension discrepancy at North Atlantic nonvolcanic rifted margins: Depth-dependent stretching or unrecognized faulting?*, Geology, v. 35, pp 367-370.]

Week 5

15 February (Tu) – Passive vs. Active Rifting (Hayman)

[Discussion: Whitmarsh et al. (2001), *Evolution of magma-poor continental margins from rifting to seafloor spreading*, Nature, v. 413, pp. 150-154.]

17 February (Th) – Back-arc Rifts (Hayman)

[Assignment #2 Due]

[Assignment #3: Isostasy and Rifting]

Week 6

22 February (Tu) – Structure of oceanic crust (Christeson)

[Discussion: Francheteau et al. (1992), *Dyke complex of the East Pacific Rise exposed in the walls of Hess Deep and the structure of the upper oceanic crust*, Earth Planet. Sci., v. 111, pp. 109-121.]

24 February (Th) – Mid-ocean ridges and spreading rates (Christeson)

[Discussion: Scheirer, D. S., and K. C. Macdonald (1993), *Variation in cross-sectional area of the axial ridge along the East Pacific Rise: Evidence for the magmatic budget of a fast spreading center*, J. Geophys. Res., 98, 7871-7885.]

Week 7

1 March (Tu) – Numerical Models of Rifts (Hayman)

[Discussion: Martinez and Taylor (2002), *Mantle wedge control on back-arc crustal accretion*, Nature, 416, 417-420]

3 March (Th) – Hot spots and plumes (Bangs)

[Assignment #3 Due]

[Assignment #4: Google Earth]

Week 8

8 March (Tu) – Upwelling beneath ridges and accretion of oceanic crust (Christeson)

[Discussion: Toomey, D.R. et al. (2007), *Skew of mantle upwelling beneath the East Pacific Rise governs segmentation*, Nature, vol. 446, pp. 409-414.]

10 March (Th) – Discussion of term projects, scientific writing and speaking (Bangs)

SPRING BREAK- No Class

Week 9

22 March (Tu) – Introduction to convergent margins (Gulick)

[Discussion: Mourgues, R., and P. R. Cobbold (2006), *Thrust wedges and fluid overpressures: Sandbox models involving pore fluids*, J. Geophys. Res., 111, B05404, doi:10.1029/2004JB003441.]

24 March (Th) – Structure of convergent margins (Bangs)

[Assignment #4 due]

[Assignment #5: Accretionary Prism]

Week 10

29 March (Tu) – Fluids in accretionary prisms (Bangs)

[Discussion: Screatton, E., Saffer, D., Henry, P., Hunze, S., and Leg 190 Shipboard Scientific Party (2002), *Porosity loss within the underthrust sediments of the Nankai accretionary complex: Implications for overpressures*, Geology, v. 30, p. 19-22.]

31 March (Th) – Seismogenic zone (Gulick)

[Discussion: ?????]

[Term Project Topic due via email to all 4 instructors]

Week 11

- 5 April (Tu) – Drilling convergent margins (Gulick)
[Discussion: Moore et. al. (2007), *Three-dimensional splay fault geometry and implications for tsunami generation*, Science, v. 318, p. 1128-1131.]
- 7 April (Th) – Microplates and triple junctions (Gulick)
[Assignment #5 Due]
[Assignment #6: Caribbean Tectonics]

Week 12

- 12 April (Tu) – Transform faults and fracture zones (Christeson)
[Discussion: Gregg, P. M. et al. (2007), *Spreading rate dependence of gravity anomalies along oceanic transform faults*, Nature, vol. 448, pp. 183-187.]
- 14 April (Th) – Transform plate boundaries (Christeson)
[Discussion: Atwater, T. (1970), *Implications of Plate Tectonics for the Cenozoic Tectonic Evolution of Western North America*, Geol. Soc. Am. Bull., 81, 3513-3536.]

Week 13

- 19 April (Tu) – Plate boundaries in transition I (Gulick)
[Discussion: Kreemer, C., and Hammond, W. C. (2007), *Geodetic constraints on areal changes in the Pacific-North America plate boundary zone: What controls Basin and Range extension?*, Geology, v. 35, p. 943-947.
&
Research Focus discussion: Flesch, L. M. (2007), *A possible “window of escape” in the southern Cascadia subduction zone*, Geology, v. 35, p. 959-960.]
- 21 April (Th) – Plate boundaries in transition II (Hayman)
[Discussion: Gulick, S. P. S., et al. (2007), *Geophysical insights into the Transition fault debate: Propagating strike slip in response to stalling Yakutat block subduction in the Gulf of Alaska*, Geology, v. 35, p. 763-766.]
[Assignment #6 due]

Week 14

- 26 April (Tu) – Class Discussion: the right tool for the job (Gulick)
- 28 April (Th) – Project presentations

Week 15

- 3 May (Tu) – Project presentations
- 5 May (Th) – Project presentations
[Written portion of class project due]