SEDIMENTARY BASINS: TECTONICS AND MECHANICS

SYLLABUS -- Fall 2004

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Office Hours: Tuesday 10:00 AM-11:00 AM
Other times: please drop me an email a day in advance asking to reserve a time (or call my assistant, Lynda Swafford, at 4-8737)

text(s):
recommended: P.A. Allen & J.R. Allen, 1990, Basin Analysis: Principles and Applications: Blackwell Scientific Publishing (we will use parts of several chapters of this, but you can probably get by without buying it -- share one with a couple friends, or look for a used one)
other readings: From time to time, other readings will be assigned. Photocopies of those papers will be available in Snee reading room.

SCHEDULE (Approximate, some drift expected)

August 27

1. introduction (philosophy, scope, work expectations); overview of basin classification; independent variables in basin system (subsidence, supply, surface processes, eustatic sea level)

week of August 30

Part 1: Mechanical Principles

2. mechanical introduction (isostasy/uplift/subsidence -- scales and rates)

3. heat flow and cooling of the lithosphere

4. rheologies; intro to bending of elastic plates

HOMEWORK 1: Isostasy (due Friday Sept. 3)
week of September 6

5. flexure (continued): examples for oceanic lithosphere and continental lithosphere; comparison of Airy compensation and regional (flexurally supported) compensation; equations for flexure of distributed loads

HOMEWORK 2: Flexure (due Monday, Sept. 13)

Part 2: Application of the mechanical principles to the real earth: uncertainties and complexities

6. in-plane stress; relaxation of elastic strength

Sept. 10: I will be traveling

week of September 13

7. Temporal and spatial variations of flexural rigidity on continents

8. Orogenic loads, depositional loads, erosional unloading

9. "Dynamic" loads of subducting plates

week of September 20

10. McKenzie's pure-shear quantitative model of extensional basins

HOMEWORK 3: McKenzie calculations of stretching (due Friday, September 24)

11. simple-shear extension; more complex quantitative models; introduction to backstripping
12. backstripping rock thicknesses to determine tectonic subsidence; decompaction

week of September 27

HOMEWORK 4: Geohistory Analysis: Calculation of Tectonic Subsidence from Stratigraphic Data (due Friday, October 1)

13. picking your basin; organization into teams

14. & 15. sequence stratigraphy in relation to geometry of subsidence and sediment supply in a basin and Wheeler Diagrams

HOMEWORK 5: Sequence Stratigraphic Interpretation (due Wednesday October 6)

week of October 4

Part 3: Survey of basins in the context of plate tectonic activity

16. overview of plate tectonic basin classifications

PROJECT ASSIGNMENT: identify basin that will be used in project and hand in reference list for that basin (due Friday October 8)

17. rift basins -- graben systems (East African rifts) (structural styles; lithosphere profile; basin characteristics)

18. rift basins -- low-angle extensional systems (Basin & Range; Mojave)

HOMEWORK 6: Chronostratigraphic Plots (Wheeler diagrams) corresponding to last week’s stratigraphic work (due Wednesday October 13)
week of October 11: Fall Break, no class Monday

19. incipient ocean basins & aulacogens; early passive margins 

20. late passive margins & flexural effects

PROJECT PIECE #1: General tectonic and stratigraphic setting of your basin; "global" environment (e.g., paleolatitude, general sea level influences, major bi-evolutionary trends) (due Friday, October 15)

week of October 18

21. sediment-starved vs filled passive margins

22. trench systems

23. midterm (class can request a take-home exam if that format is preferred)

week of October 25

PROJECT PIECE #2: chronologic constraints available for your basin; columnar sections describing strata (due Wednesday, October 27)

24. forearc basins

25. foreland basins -- general structural and stratigraphic characteristics

26. thrust-sheet-top basins (piggyback) and foreland basins
week of November 1

PROJECT PIECE #3: sequence stratigraphic data and interpretation for your basin; AND Wheeler diagram (due Monday, November 1)

27. retroarc foreland basins
28. intermontane block basins
29. peripheral foreland basin

week of November 8

PROJECT PIECE #4: isopach maps of time slices in your basin (due Monday, November 8)

30. advancing vs retreating convergent boundaries; "Mediterranean-type basins"
31. life cycle of peripheral foreland basin
32. remnant ocean basins

PROJECT PIECE #5: subsidence analysis and backstripping (due Monday, November 15)

week of November 15

PROJECT PIECE #6: facies descriptions and paleogeographic reconstruction of your basin (due Friday, November 19)

33. extensional backarc and interarc basins
34. intra-arc basins -- likely driving mechanisms
35. intra-arc basins - examples
week of November 22

PROJECT PIECE #7: plate tectonic classification and tectonic history of your basin (due November 29)

36. strike-slip related basins -- structural framework

THANKSGIVING WEEK, NO CLASS ON FRIDAY

week of November 29

PROJECT PIECE #8: mechanical interpretation of your basin, with quantified fit to data (due December 3)

37. strike-slip related basins -- characteristics of basin fill

38. intracratonic basins #1

39. intracratonic basins #2

FINAL PROJECT PIECE: An abstract, suitable for submission to a Geological Society of America meeting, summarizing the key facets of your basin’s history and cause(s), condensed into 300 words, PLUS ~5 illustrations that you would use to illustrate your major points to an audience. This must be written by each individual member of the class, not by the teams (due December 7)

COURSE GRADING

ALL GRADED ASSIGNMENTS DUE ON DAY POSTED OR NO GRADE CREDIT WILL BE GIVEN (UNLESS LATE SUBMISSION OF ASSIGNMENT HAD INSTRUCTOR’S APPROVAL IN ADVANCE)

GRADED ASSIGNMENTS (24% of grade)
6 general homework assignments (4 points each) -- practice with techniques needed for use in term projects
TERM TEAM PROJECT ON BASIN (48% of grade)
1. very important to pick a good basin (ie, good age constraints, good data in at least some spatial dimension)
2. pieces of basin analysis are assigned and due ~1/week through middle and latter parts of course (8 individual project pieces, for 6 points/piece)

INDIVIDUAL ABSTRACT BASED ON TERM PROJECT (5%)

EXAMS -- midterm and final (10% each = 20% total)

(other 3% of grade is discretionary -- class participation, evidence of having kept up in the readings)

ACADEMIC INTEGRITY:

All students in this class are expected to strictly uphold Cornell University's Code of Academic Integrity. In the case that these standards of academic integrity are not met, I will penalize the involved students appropriately (such as grades of zero on assignments or exams, or failure of the course, depending on the violation(s)). Within the scope of EAS 476, the principal academic integrity issues involve properly crediting the work of others (avoidance of plagiarism and acknowledging the role of teammates) and independent completion of examinations. The rules of conduct concerning take-home exams will be specifically described at the times the exams are administered. The term project is to be completed by a team and nearly all parts of the project may be submitted by the project team rather than by the individual student. However, all students are responsible for shouldering an equal load of the project work. Failure of a student to contribute their fair share to the effort will be considered to be an example of inappropriately presenting the work of others (their teammates) as their own work, which is a violation of academic integrity.