FUNDAMENTALS OF PLATE TECTONICS
Fall Semester 2012-13

Geological Sciences G454/G554
Section 32565/32566
3 Credits
Website: http://www.indiana.edu/~tecton

CLASS MEETINGS:
Tuesday – Thursday 11:15-12:30
Room 416, Geology Building

INSTRUCTOR:
Michael Hamburger
Office Hours:
415 Geology Building
Thursday 1:30-2:30 PM
Telephone: 855-2934 or by appointment

DESCRIPTION:
The first portion of this course emphasizes the new synthesis of observations from marine
geology and geophysics, paleontology, seismology, paleomagnetism, petrology, and
structural geology that led to the development of plate tectonic theory. The second portion
will focus on the theory's application to fundamental problems of continental and marine
geology. The prerequisites for the class are G323 (Structural Geology) and G334
(Stratigraphy) and graduate standing. No previous geophysics coursework is required.

COURSE GRADES:
The course grade will be based on written exercises (30%), in-class contributions (10%), a
mid-term exam (25%), a final paper (25%). and a class presentation (10%). The final
grade will be based on a curve of the numerical sum. Course curves will be computed
separately for graduate and undergraduate participants.

CLASS MEETINGS
Participation in class meetings is required, and will include lectures, discussion, review of
problem sets, and seminar-type discussion of current readings in the scientific literature.
Students will be expected to contribute to an ongoing bibliography of current tectonic
literature.

FINAL PAPER:
In lieu of a final examination, each student will prepare a paper on some aspect or applica-
tion of plate tectonic theory. The paper should be a well-written, thoroughly researched
summary of a current problem in plate tectonics, using primary scientific papers (not
textbooks) as sources. The paper should incorporate materials from a variety of disciplines.
Topics must be approved by the instructor on or before 30 October (11th week). A one-two
paragraph "Statement of the Problem," an outline of the paper, and a list of key references
are due on 15 November (13th week). The completed, typed report is due on 10 December
(first day of exams). Credit will be deducted for late submission of papers.
PRESENTATION:

The final paper will be accompanied by a brief (15-20 minute) presentation of your work. The presentation should be a clear, concise, and well presented summary of your findings, using powerpoint slides and blackboard where necessary. The form should be that of a review paper given at a scientific meeting.

TEXTBOOKS:

The readings for the class are from two main sources. Both are considered required texts, and should be available at the local bookstores. They are both on reserve in the Geology library.

The first is a new textbook that is an excellent review of geological and geophysical observations associated with global tectonic processes:

Kearey, Philip, Keith A. Klepeis, and Frederick J. Vine
*Global Tectonics, 3rd ed.*
Hoboken, Wiley-Blackwell, 2009

The second is a useful "how to" manual for solving plate tectonics problems:

Cox, Allan, and Hart, Robert B.
*Plate Tectonics: How it Works*
Palo Alto, Blackwell Scientific, 1986

READING LIST & FIGURES:

An extensive bibliography of papers related to each study topic and a set of key figures used in the lectures will be provided.

COURSE SCHEDULE:

The tentative course schedule is attached.

BIBLIOGRAPHY:

A general bibliography of books on plate tectonics and continental drift is also attached. The final section of the list includes several "popular" books that are useful in providing a general overview of the subject. Those marked [R] should be on reserve in the Geology Library.
**SYLLABUS**

*Reading assignments refer to KKV (Kearey, Klepeis & Vine) and C/H (Cox & Hart) texts*

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<th>Week</th>
<th>Date</th>
<th>Subject</th>
<th>Reading</th>
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| 1    | August 21-23 | Introduction: Historical Perspective  
Internal Structure of the Earth  
*Reading: KKV Chap. 1, Chap. 2.2-2.3, 2.8-2.12* |                                               |
| 2    | August 28-30 | Continental Drift: Evidence from Paleontology, Climatology,  
and Stratigraphy  
Paleomagnetism and Magnetic Field Reversals  
*Reading: KKV Chap. 3; C/H Chap. 8* |                                               |
| 3    | September 4-6 | Polar Wander Curves  
Marine Magnetic Anomalies  
*Reading: KKV Chap. 4.1; C/H Chap. 9* |                                               |
| 4    | Sept. 11-13 | Sea Floor Morphology and Structure: Observations from  
Marine Geology and Geophysics  
*Reading: KKV Chap. 2.4 - 2.6, Chap. 6* |                                               |
| 5    | Sept. 18-20 | Oceanic Heat Flow and Topography of the Sea Floor  
Transform Faulting  
*Reading: KKV Chap. 2.13, 4.1, Chap. 6* |                                               |
| 6    | Sept. 25-27 | Earthquakes and Focal Mechanisms along the Mid-ocean Ridge/Transform Fault System  
Earthquake Distribution and Focal Mechanisms  
*Reading: KKV Chap. 2.1; C/H Chap. 6* |                                               |
| 7    | October 2-4 | Plate Subduction and Convergent Plate Tectonics  
Geological Processes in Subduction Zones  
*Reading: KKV Chap. 9* |                                               |
| 8    | October 9-11 | Tectonics of Forearc and Backarc Environments  
Hotspots and Absolute Plate Motion  
*Reading: KKV Chap. 5.5-5.7, Chap. 9.7-9.10* |                                               |
| 9    | October 16-18 | Geometric Constraints on Plate Motions  
Euler Poles and Instantaneous Plate Velocities; Finite Plate Motions  
*Reading: KKV Chap. 5.1-5.4; 5.9-5.11; C/H Chap. 2-4* |                                               |
| 10   | October 23-24 | Direct Measurements of Plate Motion  
Driving Forces of Plate Tectonics: Mantle Convection  
*Reading: KKV Chap. 5.8, Chap. 12; C/H Chap. 7, 10* |                                               |
<p>|      | October 26-28 | Mid-term Examination (take-home) |                                               |</p>
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<th>October 30 - November 1</th>
<th>November 6-8</th>
<th>November 13-15</th>
<th>November 20-22</th>
<th>November 27-29</th>
<th>December 4-6</th>
<th>December 10</th>
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| 11| Plate Tectonics and Magmatism: Mid-ocean Ridges, Oceanic Islands, Hotspots, Island Arcs  
   | Reading: Condie, Chap. 7 | Final Paper Topics Due | Continental Rifting & Evolution of Passive Continental Margins  
   Plate Tectonics and Orogenesis: Stratigraphy/Structure of Mountain Belts  
   Reading: KKV Chap. 7, 10.1-10.2 | Subduction-related orogens: island arcs and cordilleran tectonics  
   Final Paper Outlines Due | Collisional Orogens  
   Complex Plate Boundaries: "Microplate Tectonics"  
   Tectonostratigraphic Terranes  
   Reading: KKV Chap. 10.3-10.6 | Student Presentations | Exam Week: Final Papers Due |