

PLATE TECTONICS
AND ITS GEOLOGICAL CONSEQUENCES

GEOS 613 (3 Credits), Fall, 2006

Lecture: Tuesday and Thursday, 9:45-11:15

Natural Sciences 233

Professor: Wesley K. Wallace

Natural Sciences 330

Phone: 474-5386

E-mail: wallace@gi.alaska.edu

Office hours: After class, Tuesday/Thursday 2:00-3:00, or by appointment

Textbook: Tectonics, Eldridge M. Moores and Robert J. Twiss, W.H. Freeman & Co., New York, 415 p., 1995

The concept that rigid lithospheric plates move relative to one another and interact at their boundaries has revolutionized how we think about geological processes and the evolution of the earth, and has led to many new insights about the earth. The concept of plate tectonics has implications for virtually every aspect of geology and geophysics, so a single course can provide only an introduction to its basic elements and implications. The beginning of the semester will be devoted to the basic principles that underlie and led to the concept of plate tectonics. This will provide a foundation for the remainder of the semester, during which we will explore the geological consequences of plate tectonics, in other words, the tectonic character of the various types of plate boundaries and examples of each.

A preliminary outline of the course is shown on the next page, with a schedule of dates and readings. The class probably will depart somewhat from the schedule, depending on student interests and the actual time required to cover various topics.

The text includes the same essential elements as the class, but is organized a bit differently. The chapters that most closely fit the content of the lectures are assigned for reading on the course outline. The lectures and readings will complement one another because some topics that will be emphasized in class are covered only lightly or not at all in the text, and vice versa. Other optional chapters address topics that will not be covered in class.

Grades will be based on preparation and presentation of cross sections across examples of three different tectonic settings:

1. Rift/passive continental margin
2. Subduction zone to magmatic arc
3. Mountain belt

You will choose a modern or ancient example of each of these settings, find references, compile a cross section and evolutionary model, and present your results to the class. More detailed instructions will be provided soon on these projects. Projects will be due after each setting is covered in class.

CLASS SCHEDULE

<u>Date</u>	<u>Subject</u>	<u>Reading</u>
	<u>1. Principles of Plate Tectonics</u>	
August 31	A. Global patterns leading to the plate-tectonic concept	1, 3
September 5	B. Structure of the crust and upper mantle	
7	C. Geomagnetic reversals and oceanic anomalies	
	D. Patterns of seismicity	
	E. Hot spots and their traces	
12	F. Geometry of plate motion	4
14	G. Plate motion reconstructions and the supercontinent cycle	
19		
21	I. Driving mechanisms	
	<u>2. Plate Boundaries</u>	
	A. Divergent	5
26	1. Oceanic spreading centers	
28	2. Continental rifts and passive continental margins	
October 3		
	B. Convergent	7
5	1. Types, controls, and geological elements	
10	*Presentation of cross sections (rift/passive margin)	
12	1. Types, controls, and geological elements (continued)	
	2. Elements of convergent plate boundaries	
17	a. Trenches, subduction complexes, forearc basins	
19		
24	b. Arcs: Oceanic vs. continental, evolution, and magmatism	
26		
31	c. Back-arc basins	
November 2	a. Anatomy of mountain belts	
7	*Presentation of cross sections (subduction zone to arc)	
9		
14	b. Obduction, ophiolites, and terrane accretion	
16		
21	c. Continent-continent collisions	9
23	<i>No class: Thanksgiving holiday</i>	
28		
30	C. Transform	6
December 5		
7	*Presentation of cross sections (mountain belts)	
15	Exam period: 8-10 AM Synthesis of class (or date and time to be arranged)	

SOME USEFUL REFERENCE BOOKS ON PLATE TECTONICS

Listed by year of publication

Plate Tectonics and Geomagnetic Reversals, Allan Cox, editor, W.H. Freeman, San Francisco, 702 p., 1973 (out of print). (Collection of landmark papers)

The New View of the Earth, Seiya Uyeda, W.H. Freeman, San Francisco, 217 p., 1978.
(Basic-level overview)

Plate Tectonics, John M. Bird and Bryan Isacks, editors, American Geophysical Union, Washington, D.C., 1021 p., 1980. (Collection of papers from AGU journals)

The interior of the Earth: Its structure, constitution, and evolution, Second Edition, Martin H.P. Bott, Elsevier, New York, 403 p., 1982. (Geophysics text that provides a good summary of some of the geophysical observations and methods upon which the plate tectonics concept is based)

Plate Tectonics - How it Works, Allan Cox and Robert Hart, Blackwell Scientific Publications, Palo Alto, 392 p., 1986. (Basic introduction to plate tectonics, with emphasis on geometry and geophysical observations)

Geological Structures and Moving Plates, R.G. Park, Chapman and Hall, New York, 337 p., 1988.
(Emphasis on structural consequences of plate tectonics)

Plate Tectonics & Crustal Evolution, Third Edition, Kent C. Condie, Pergamon Press, Oxford, 476 p., 1989. (Emphasis on earth structure and evolution)

Tectonics, Eldridge M. Moores and Robert J. Twiss, W.H. Freeman & Co., New York, 415 p., 1995

Global Tectonics, Second Edition, Philip Kearey and Frederick J. Vine, Blackwell Scientific Publications, Oxford, 302 p., 1996. (Intermediate-level overview)

Whole Earth Geophysics, Robert J. Lillie, Prentice Hall, Upper Saddle River, New Jersey, 361 p., 1998.
(Practical treatment of the methods that provide geophysical data relevant to plate tectonics)

Plate Tectonics, Arthur N. Strahler, GeoBooks Publishing, Cambridge, MA, 554 p., 1998. (Lots of information and figures not in other books, but a bit less polished and with a more personal perspective from the author)

The Rejection of Continental Drift: Theory and Method in American Earth Science, Naomi Oreskes, Oxford University Press, New York, 420 p., 1999. (An exploration of why American approaches to science led to initial rejection of the idea of continental drift)

Plate Tectonics: An Insider's History of the Modern Theory of the Earth, Naomi Oreskes, editor, Westview Press, Boulder, CO, 424 p., 2001. (A history of the evolution of plate tectonics in the form of essays by major contributors to the plate tectonic concept)