Mountain Belts (GE398) Syllabus

Spring, 2009

1. Instructor

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2. Prerequisite: GE231 Structural Geology

3. Texts

Since most of the course will deal with material from the primary literature and textbook chapters from a wide range of sources, there is no required textbook. However, you might want to consider purchasing the following:

Moores, E.M., and Twiss, R.J., 1995. Tectonics: W. H. Freeman & Company, New York, 415 p.

Passchier, C.W., and Trouw, R.A.J., 2005. Microtectonics: Springer-Verlag, Berlin, 366 p.

van der Pluijm, B.A., and Marshak, S., 2004. Earth Structure: W. W. Norton and Company, New York, 656 p.

These textbooks will be on reserve in the Science Library.

PDF's of papers covered in class not available through Colby's library will be on the course website (http://www.colby.edu/personal/w/wasulliv/ge398_index.htm). If PDF's are not available, photocopies will be handed out in class. *Power Point* presentations developed by your classmates will also be made available on the course website.

4. Course objectives

This is a primary literature synthesis course designed to guide you through the anatomy and analysis of mountain belts formed at collisional plate tectonic margins. By the end of the course you should be able to: (1) piece together a broad-scale interpretation of the evolution of an active or ancient collisional mountain belt using data and interpretations gleaned from the primary scientific literature, and (2) apply modern microstructual and macro-structural techniques to better understand the deformation history recorded in collisional orogenic belts. In addition to these geoscience-centric goals, this course is also designed to improve your verbal communication skills and provide you with experience in accessing, reading, and assimilating scientific literature.

5. Course structure

5.1. Regular class meetings

The lecture component of this course will be divided into two parts. The first part of the course will focus on deformation mechanisms and microstructural analyses. During this part of the course you will learn how to link deformation processes observed in laboratory experiments with deformed rocks found in nature. I will be the primary presenter for this part of the course, although, there will also be student presentations and discussions of some key papers.

The second part of the course is designed around student interpretation, presentation, and discussion of material from the primary scientific literature, and will focus on case studies of the northern Appalachian Mountains and the European Alps. It is up to you to read and interpret papers and book chapters on the various topics then present the material to the rest of the class as either a formal lecture or an in-class activity. Of course, I will be available to help you with this. For each topic, I will give you some over-arching questions that you should consider when thinking about each paper and book chapter. Each paper on a topic will be assigned to a student(s) who is/are responsible for presenting that material to the rest of the class. Note that everyone is responsible for reading all of the papers. During class, you are expected to take notes and ask questions. Once all of the papers on a given topic have been covered, we will devote a final class period to an instructor-mediated brainstorming discussion of how the theories and data from each of the papers relate to each other. The goal of these discussions is building a broad-scale picture of the topic by integrating all of the studies together.

5.2. Laboratory class meetings

The laboratory component of this course is designed to give you experience working with some of the data and techniques used in analyzing the internal geometry and deformation history of major collisional mountain belts. Topics will include, interpretation of collisional mountain belts from topography, cross-section construction and balancing, and microstructural and crystallographic fabric analyses.

5.3. Central Maine summary papers

Central Maine summary papers will provide an overview of the important deformational, metamorphic, and magmatic events in the central and mid-coast regions of Maine including cross-cutting relationships and overprinting relationships. This information should be incorporated into a broader regional context of the northern Appalachian Mountains from our in-class presentations. Papers should be ~3000-words long or shorter and use in-text citations of material covered in class with a reference list at the end. References and in-text citations will follow the standard Geological Society of America format used in *Geology* and the *Geological Society of America Bulletin*.

6. Assessment

Assessment is based on:

1. In-class oral presentations of papers–20%
2. Class participation (This may include reading quizzes!)–10%
3. Central Maine summary papers–20%
4. Laboratory exercises–35%
5. Take-home final exam–15%

7. Attendance and academic dishonesty policies

Attendance of all lectures, labs, and field trips is required. Unless other arrangements are made prior to the due date, all assignments are due by 4PM of the day given. After 4PM, I will deduct 10% of the total grade from your score for each 24-hour period the assignment is late. If I find you working on an assignment from a previous class meeting in class on the day the assignment is due, I will consider it to be late and deduct 10% of the total grade from your score. Don't cheat. I am really intolerant of academic dishonesty. I will follow College policies on attendance and academic dishonesty. These can be found in the College Catalogue and the Student Handbook.

8. Tentative course schedule

8.1. Lecture Schedule

1. Elements and geometry of collisional orogenic belts lecture

2. Deformation mechanisms, rheology, and tectonics
   - Brittle rupture and frictional sliding review lecture
   - Diffusive-mass-transfer processes and microstructures lecture
   - Dislocation creep, dynamic recrystallization, and LPO lecture

3. Microstructural and crystallographic-fabric analyses
   - Instantaneous vs. finite deformation and flow geometry lecture
   - Shear-sense indicators lecture

4. Case study of the high Himalayas, using microstructural analyses to understand channel flow student presentations—Reading list will be handed out in class
5. Case study of the northern Appalachian Mountains student presentations—Reading list will be handed out in class
6. Case study of the Alpine orogeny student presentations—Reading list will be handed out in class

8.2. Laboratory schedule

All labs due the following Monday unless otherwise noted.

Feb. 9: Digital mapping tools and recognizing elements of collisional mountain belts

Feb. 16: Optical microscopy and mineral identification review—Read Olympus polarizing microscopy review

Feb. 23: Cross-section construction review

March 2: Recognizing deformation mechanisms in thin section

March 9: Shear-sense analyses

March 16: Shear-sense analyses: Quantifying shear-sense indicators

March 23: No lab, Spring Break

March 30: Crystallographic fabric analyses

April 6: Kinematic-vorticity analyses

April 13: Cross-section construction: Transport-parallel and transport-perpendicular sections (week one)

April 20: Cross-section construction: Transport-parallel and transport-perpendicular sections (week two)

April 27: Cross-section balancing and shortening estimates—Read McClay (1991)

May 2–3: Field trip

8.3. Due dates

May 1: Central Maine summary papers due at 4PM.

May 2–3: Field trip

May 8: Take-home final to be passed out in class.

May 15: Take-home final due at the end of the scheduled final-exam period.