

## **Geol 4315 / Geop 5361 Plate Tectonics**

Classes: TTh 3:00-4:20, Geology Building 302

### **Contact Information**

Instructor: Dr. Marianne Karplus

Office: Geology Building 317

Office hours: to be decided and by appointment

Email: [mkarplus@utep.edu](mailto:mkarplus@utep.edu)

Overview: The application of geological and geophysical data to the description and evolution of motion between the lithospheric plates. Topics include: relative velocities between plates, triple junctions, plate rotations, seismicity and plate boundaries, marine magnetic anomalies, paleomagnetism, plate driving mechanisms, relationship of plate tectonic processes to the geologic evolution of the western United States.

Class Objectives: Develop a thorough background in the basic geophysical and geologic characteristics of plate boundaries. Emphasis is on tectonic processes and implication of plate boundary processes to development of geologic systems. By the end of this class students should be able to:

- Understand and apply the concepts of relative plate motion on planes and spheres
- Use seismicity and focal mechanisms to analyze active fault kinematics and their relationships to plate boundary processes
- Understand how different data sets are used to analyze both present day and past plate motions
- Recognize the different definitions of lithosphere vs asthenosphere and the importance of variations in these characterizations of the system
- Understand the distinctive rock and structural associations that characterize different plate boundaries
- Be able to use lithologic and structural associations to synthesize geologic and geophysical data into a coherent tectonic history of ancient plate margins
- Analyze diverse geologic and geophysical data sets to solve large-scale problems, recognizing inconsistencies and ambiguities in interpretations of data

Activities: This class is a lecture class but a large amount of your learning comes from assignments. These assignments tend to be a lot of work, but a practical application that will help you learn the material. DO NOT get behind on these assignments, they are key part of your learning in the class. You can think of these assignments as lab assignments that aren't done in a specific lab setting, but are time consuming, problem solving assignments.

Prerequisite: graduate standing OR approval. That means class members are expected to have course work in geology equivalent to an undergraduate senior geology major. Class members should also be comfortable with basic sophomore level physics and with math equivalent to at least the first semester of calculus.

**ALL undergraduates registering to take this course must have approval by the instructor. Talk to the instructor if you aren't sure you have the background.**

**Text:**

Kearney, P., Klepeis, K., and Vine, F.J., 2008, *Global Tectonics*, 3<sup>rd</sup> Ed., Wiley-Blackwell, 282p.  
Supplementary: Cox and Hart, 1986, *Plate Tectonics, How it works* + supplements

We'll also be doing readings from Cox and Hart (pdfs) and the scientific literature. Speed reading is important in this class!

**Grading:**

25% midterm

25% final

10% class quizzes (some may be unannounced)

40% assignments (~8 total assignments, drop lowest grade)

*Undergraduate vs Graduate Student Assessment:* I will have higher expectations for homework assignments submitted by graduate students compared to undergraduates due to the difference in experience and available time. Homework assignments will be assessed with a different scale for undergraduates vs. graduate students. Exams will be set up differently as well. All students will be given the same exam, except graduate students will get extra question(s) which may include a take home question on exams.

*Late assignments:* You have one "2-day-late assignment pass". That means that you can choose one assignment to turn in no more than 48 hours late for no penalty. After you have used the pass, assignments are 5% off per day that they are late.

Attendance Policy and Exam Makeup Policy: This is a graduate level class. I assume this is a nonissue at this level. However, no makeup exams without prior approval, except in emergency situations.

Academic Integrity and Civility: Refer to <http://sa.utep.edu/osccr/academic-integrity/> for the universities academic integrity policy; Plagiarism will not be tolerated on any assignments, and any assignment containing clear plagiarism given an automatic F.

Disability Statement: If you have a disability and need accommodation, you should contact the Disabled Student Services office at 747-5148 or go to Rm 106 Union East. You are responsible for obtaining accommodation letters and instructions.

Military Service: If you are in the military and service or training may take you out of town, please advise the instructor and we'll work out an accommodation if at all possible, but you'll need to let the instructor know well in advance.

**Outline: (schedule is approximate, and may be updated)**

*Weeks 1 and 2*

- I. Overview of the major tectonic features of the earth
    - A. Fundamental concepts of Plate Tectonics, origins of the theory
    - B. Basic earth structure, plate boundary types, etc.
- Chpt. 1,5, 6 C&H, chpt. 1-4, Kearney et al.

*Weeks 3-5*

- II. Plate motion
    - A. Relative vs Absolute velocity, description of motion on a plane and three-plate interactions, motion on a sphere--Euler poles and angular velocity
    - B. Finite Motions
    - C. Driving mechanisms of plate tectonics
- Chpts. 2, 3, 4, part of 7, and 10 C&H, chpt. 5, 12 Kearney et al.

*Weeks 6-7*

- III. Thermal models and the definition of the lithosphere
  - 1) Oceanic lithosphere models
  - 2) Continental lithospheric models
  - 3) Mechanical lithospheric models

supplemental readings,

**Midterm exam—scheduled when we have better idea of progress**

*Week 8-9*

- IV. Divergent plate boundaries
    - A. ophiolites and sea-floor spreading
    - B. Rifted continental margins
- Chpts 6-7, Kearney et al. + reading supplements

*Weeks 10-14*

- V. Geology of convergent and conservative plate boundaries
    - A. Transform and transcurrent fault systems
      - 1) continental vs oceanic transforms
      - 2) tectonic associations of transcurrent faults--plate boundary transforms vs microplate boundaries
- chpts 8, Kearney et al. + Reading supplements
- B. Convergent margins
    - 1) Arc-trench systems
      - a) overview of major observations
      - b) forearc systems
      - c) triple junction interactions and forearc development
      - d) forearc “backstop”
      - e) volcanic arc and its basement
      - f) backarc systems
- chpts 9, Kearney et al. + Reading supplements

- 2) Collisional systems
  - a) terminal vs nonterminal sutures
  - b) 3-D complications
  - c) erosional effects on tectonic systems

Chpt. 10, Kearney et al. + Reading supplements

**Final Exam (emphasizes last half of class—last day of scheduled class or finals week? (negotiable) )**

**Note on Homework assignments:**

This class is a lot of work. You will be doing both a lot of reading and take home assignments. You will get a series of homework assignments that are exercises meant to give you feedback on things we are discussing in class and all of them have real world applications. We could have scheduled this as a separate lab, because these assignments can be time consuming, but it is more efficient if you work on them on your own time. Nonetheless, I will always make a point of being available for a couple hours after every class to discuss these assignments.

Most of these exercises will emphasize the geophysical aspects of PT--plate motion problems, lithospheric cooling problems, magnetic stripes, seismology, etc. The last two or three exercises, however, will emphasize geologic applications. This final problem will require synthesis of diverse data; the details will depend on our progress through the semester and class interest.