

Name _____

SEISMICITY AND PLATE BOUNDARY TECTONICS

I. MAKE THE MAPS

Your study area includes your triple junction, the region around it for at least a few hundred km, and the trench that was assigned to you, closest to your triple junction. It should be a big area (at least 30 degrees across on the earth).

Use the computer programs (instructions on the class web site) to make maps of focal mechanisms and earthquake epicenters for your study area from the seismic catalogs. For the epicenters you can make maps on the internet (see directions). For the focal mechanisms, please copy the sample GMT script to your Unix/Linux directory, and modify it as needed so that you can plot your data.

Make FOUR separate plots all at the same map scale if you can (to be able to overlay them):

- epicenters of shallow (<70 km) earthquakes
- epicenters of intermediate (70-300 km) earthquakes
- epicenters of deep (300-700 km) earthquakes
- focal mechanisms of earthquakes with body wave and surface wave magnitude 6.0 or larger (note that if you don't get many events you may have to choose a lower magnitude limit, like maybe 5.0)

If there are too many earthquakes overlapping one another in your plots, please shorten the time interval or use only the larger magnitude earthquakes, to get fewer events.

If your study area crosses 0 degrees or 180 degrees longitude, make sure you plot the events on both sides of this boundary. In some cases you may have to search the catalog twice with different longitude ranges to get all the events. In this case you will have to modify the plot file to plot two datasets – or you can try to concatenate the two resulting data files into one file so that you don't have to modify the plotting script.

Note that your longitude limits have to agree with the longitude limits of the data set (i.e. the western hemisphere could be either -180 to 0 longitude, or it could be 180 to 360 longitude), or else you have to modify the plotting scripts to include -N in some of the GMT command lines. (If one of your datasets does not plot, and you think it might be due to this problem, add a -N to the relevant command line.) Also note that you may want to change the scales of the CMT circles (beach balls). See the directions about the software.

II. INTERPRET THE MAPS

Use your accumulated plate tectonic knowledge, as well as class handouts, the textbooks, previous problem sets, and any other information you want to use, to finish this homework.

1. On the focal mechanism plot, sketch in (use a visible color, e.g. not black) the types of all of the plate boundaries. Use the symbols from problem set 1 for ridges, trenches, and strike-slip faults. Label the plates. Label the P and T axes of the focal mechanisms and indicate which nodal plane is likely to have been the fault plane for each event. (If you can't tell, indicate this.)

2. Write a paragraph about the seismicity and the focal mechanisms for EACH of the plate boundaries on your map. Please specifically discuss the following:

- Is the boundary well-defined or poorly defined by epicenters in map view?
- Is the boundary seismicity narrow or broad in map view?
- Is strain partitioning occurring along this boundary (if so, what data support this)?
- What is the depth distribution of the earthquakes at the boundary?
- What is the sense of motion along the boundary (right lateral, convergence, divergence, etc)?
- Are all of the focal mechanisms consistent with the expected sense of motion? If not, comment on which ones are discrepant and speculate on why they might be discrepant.

3. For any subduction zone boundary, also answer the following questions:

- Are there intermediate or deep events?
- Is there a well-defined Wadati-Benioff zone (inclined seismic zone within a slab)?
- If so, what direction does it dip?
- What are the limits on the angle of dip of the Wadati-Benioff zone?
- What are the orientations of the P and T axes in the slab?

4. Compare the seismicity and focal mechanisms along the various boundaries (and along different parts of the same boundary, if there is some major change along it, for instance if one area is influenced by a hotspot and another is not).

- What are the relative amounts of seismicity along the various boundaries?
- Do some boundaries have more earthquakes, or bigger earthquakes than other boundaries?
- Can you draw any conclusions regarding numbers of large earthquakes, and the type of boundary or the rate of motion along the boundary? (You already should have estimated the rate and direction of motion along the boundary, from your results on PS #3; you can also do it using the program "rotate" from PS #4.)
- Are the P and T axes consistent for each plate boundary, or do they vary? Are there regions with relatively consistent P or T axes? Are these consistent with the tectonics you expect?
- Are there any microplates? If so, explain how you identified them.

Please write the essay in complete sentences. Don't worry if English is not your native language. You will be graded on your scientific ideas; you won't lose points for English mistakes.