Name_____

SEISMICITY AND PLATE BOUNDARY TECTONICS

DEFINE YOUR STUDY AREA

Pick a study area that includes the three plate boundaries coming into your triple junction. Your study area should span 20-30 degrees in latitude and longitude. If there is a trench nearby, please include it in the area of your map, even if your triple junction does not involve any trenches.

PLOT THE DATA

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, we suggest that you copy the sample GMT script to your 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 are looking exclusively at ridge-transform 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 restrict the time interval or magnitude range 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.

INTERPRET THE DATA

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 few paragraphs discussing the focal mechanisms and touching upon the following aspects of the seismicity of the region:

For **each** plate boundary in your study area, specifically discuss the following:

- Is the boundary well-defined or poorly defined by epicenters in map view?
- Is the boundary seismicity narrow or diffuse 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.

For any subduction zone plate boundary in your study area, 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?

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 relative amounts of large earthquakes, and the type of boundary or the rate of motion along the boundary? (You can estimate the rate and direction of motion along the boundary, from your results on PS #3, or by 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 would expect?

If there are subducted slabs within this area, do the focal mechanisms constrain the orientations of P and T axes in the slabs? Do the stress regimes of these slabs resemble any that are mentioned in Cox and Hart? What is the depth limit of seismicity for each slab?

Are there any microplates? If you think there are, 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.