Homework Set 4: Focal Mechanism Solutions

1. The figure below shows focal mechanism solutions for two earthquakes. The shaded areas represent the compressional regions in first arrivals at seismograph stations. The letters P and T refer to the compressional and extensional strain axis orientations, respectively.

A.    

B.    

a) Draw the lines onto the diagrams to show the orientations of the four fault planes. (4)

b) If there is any strike-slip motion on any of the faults, indicate this using arrows along the fault lines (i.e., indicate whether left-lateral or right-lateral). (4)

c) Use a table to document the following information for EACH of the four faults. Be sure to use the right-hand rule when determining the fault strike. (16)

   I. fault strike (in degrees)  
   II. fault dip (in degrees)  
   III. dip direction (compass direction)  
   IV. fault type (if a strike-slip component exists, mention whether left-lateral or right-lateral)

d) One of the focal mechanism solutions above represents a major earthquake that happened along the San Andreas fault system in California. Determine which of the two solutions (A or B) is most likely to represent the California earthquake. EXPLAIN YOUR REASONING!! Then, decide which of the two faults in the solution you selected is the most likely fault that actually produced the earthquake. Again, EXPLAIN YOUR REASONING! Hint: the earthquake occurred along the San Andreas fault itself. (6)
2. (a) Use the focal mechanism (aka moment tensor) data below to construct a focal mechanism diagram for the 1999 Izmit earthquake in Turkey. For both potential fault solutions, the strike direction is given using the right-hand rule. FP = fault plane. The orientations of the principal strain axes will help you identify the shaded and unshaded quadrants of the focal mechanism solution.

99/08/17 00:01:38.56 TURKEY  M<sub>b</sub> 6.3  M<sub>s</sub> 7.8  M<sub>w</sub> 7.4

**MOMENT TENSOR SOLUTION**

- Best Double Couple: FP1: Strike=092  Dip=75 S  T Azimuth= 049
- FP2: Strike=183  Dip=88 W  P Azimuth= 317

(b) What are the two types of faults that potentially produced the earthquake?  
(c) Which fault plane solution is more likely to be the correct one, and why?  
(d) Why are there three different magnitudes listed for the same earthquake, and why are they so very different to each other?  

3. On the attached figure, seismograph locations are plotted on a lower hemisphere stereographic projections with respect to an earthquake epicenter at the center of the projection. Stations with compressive first arrival P-waves are shaded squares; dilatational first arrivals are open circles.

(a) Use this information to construct a possible focal mechanism solution using the double-couple assumption (i.e., fault planes are 90° apart in 3-D space). Remember, faults intersect the edges of the circle at mutually opposite points, 180° apart.  

(b) Describe your two fault solutions (strike, dip, dip direction) and the types of faults potentially responsible for the earthquake.
Question 3:

**Lower Hemisphere Stereographic Projection**

First P wave arrival:

- **compressional**
- **dilatational**