LAB Exercise #3 - Answers
Introduction to the Orientation of Structures in Space - Geologic Map, Cross section, and Geologic History

During LAB:
Working in groups of 4-5 people, make a cross section of the Blue Diamond SE Quadrangle. Make sure to put all of your names on the cross section. (15 pts)

LAB Exercise
A lawyer has contacted the UC Berkeley Geological Survey and asked you to prepare a concise geologic report explaining the geologic history observed in the Fault Mountain Quadrangle (map given on page 2).

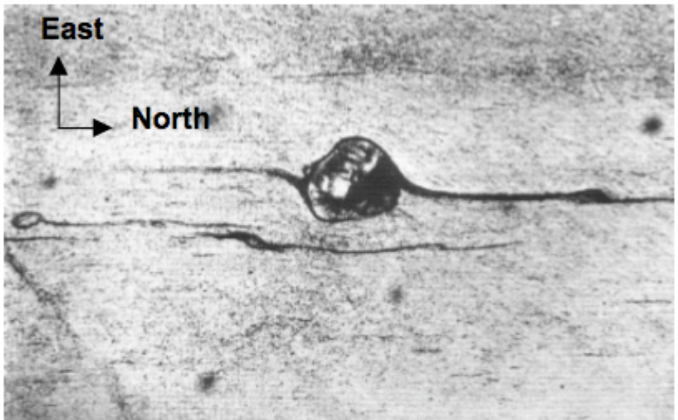
Your workplan also includes the following:

1. Give a brief geologic history of the region describing any deformation or age relationships that you can find. Include the order in which the lithologic units formed (youngest to oldest). (10 pts) *Oldest 4 3 2 1 5 6 7 8 Youngest*
2. Using the map and the well data (page 3), construct cross section A-A'. (15 pts).
   -1 for all the following that are missing or wrong: horizontal or vertical scale, orientation, lithologic units
   -2 if missing fault
   -1 if assumed bottom of borehole is bottom of unit 5
3. Using the map and the well data (page 3), construct cross section B-B' across all three faults. If you can, indicate the attitude (strike and dip) of each fault. (20 pts)
   -1 for all of the following that are missing or wrong: horizontal or vertical scale, orientation, lithologic units
   -1 if assumed bottom of borehole is bottom of unit 4
   -1 if didn't depict unit 5 west of fault #1
   -1 if used true eastern fault dip in cross section
   -1 for each unit 6 that is too thick (didn't take into account the offset between hinge line and B-B'
   West fault: N0°W, 53°E (atan (376m/280m) = 53.3°
   Middle fault: N0W, constrained between 85°E and 87°W, near vertical (atan(25m/2m) = 85° atan(39m/2m) = 87° - **4 pts: -2 if didn't constrain the fault properly with wells**
   East fault: N10E, 68.5° E (in cross section), 68.7° is true dip; 230m from unit 4 top edge to well, map view, 583 m: atan (583m/230m) = 68.5° - this is apparent dip, true dip = atan(tan68.5°/sin81°) = 68.7° - **3 pts**
4. If you can, tell whether each fault is a normal fault, reverse fault, or oblique fault. (10 pts)
   West fault: Normal - **3 pts**
   Middle fault: Oblique vertical, east side up - **4 pts**
   East fault: reverse - **3 pts**
5. Measure the total amount of relative offset along each fault. For faults whose attitudes are known, report the amount of movement along the fault plane. For faults whose attitudes are not known, report the amount of horizontal and vertical separation. (10 pts)

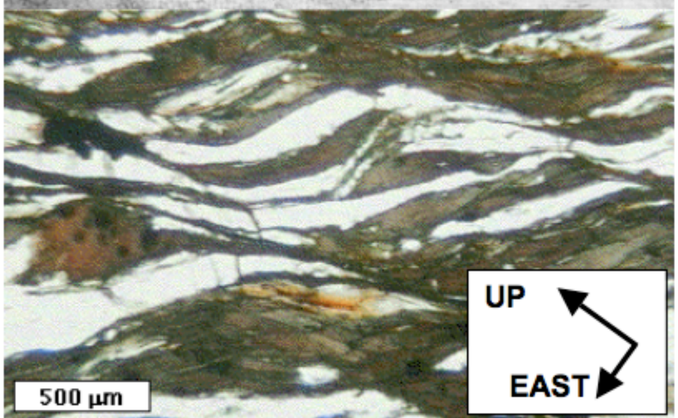
West fault: ~120m measured from cross section - **3 pts**
Middle fault: ~60-65m vertical measured, ~50-55 m horizontal from offset hinge - **4 pts**
East fault: at least ~600 m along dip (measured from cross section and also known from unit 5 thickness in western section and accounting for unit 6 thickness in middle section and the fault dip) with almost no horizontal by aligning fold axis of unit 6 and 5 - **3 pts: - 2 if measured from top of unit 5, -1 if gave vertical offset instead of along dip, -1 if only used unit 5 thickness in middle section, -1 if didn't consider offset of unit 6**

6. From the above information, determine the trend and plunge of slickenlines that you would expect to see along each of the faults. For faults whose attitude is not known, give the trend and plunge that connects two piercing points. (10 pts)
West fault: 53°, 90° - **3 pts**
Middle Fault: approximately 50°, approximately 180° - **3 pts: -1 if trend = 0°, -2 if trend = 90°, -1 if gave complement of plunge**
East Fault: 69° or -69°, 110° - **4 pts: - 2 if gave apparent plunge**

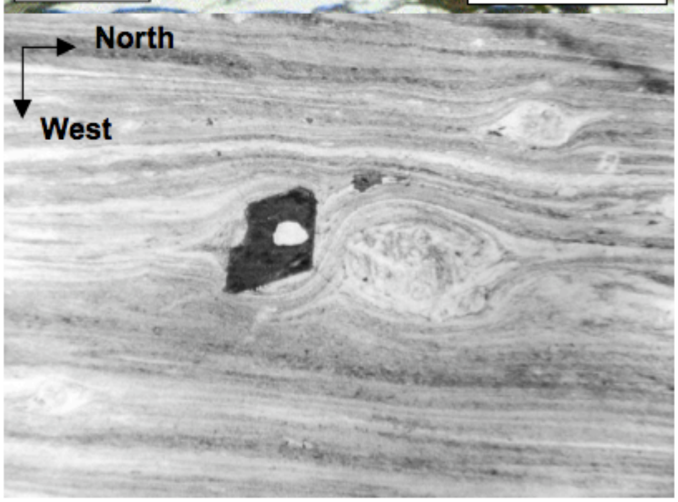
7. You recently trained your field assistant to take oriented field samples (see Prior et al., 1987). Your assistant told you that she collected oriented samples at surface exposures of the three faults. She cut vertical and horizontal slices from each of the oriented samples. There's only one problem -- your thin sections got mixed up with someone else's and none of them have sample labels! Using only the sense of shear as an indicator, can you figure out if these thin sections came from the Fault Mountain Quadrangle? If so, which faults are they from? (10 pts)



This one is reversed. Look at the compass directions and its not the way a normal compass would be. It's left-lateral as shown, but converting to a geographic coordinate, you get a east side-north right-lateral (no fault).
3 pts
-1 if wrong fault
-2 if didn't convert coordinates



This is an S-C mylonite with the C-axis parallel to the Up-arrow. The S axis indicates right-lateral in the plane being shown. Therefore we get West side down (closest to Eastern fault, but wrong dip direction).
4 pts if attempted



This is a sigma-type porphyroclast and is right-lateral, as shown. Here we get east-north, or left lateral. This one probably comes from the middle fault that has a significant left-lateral component (Central Fault).
3 pts
-1 if wrong fault
-2 if didn't convert coordinates