

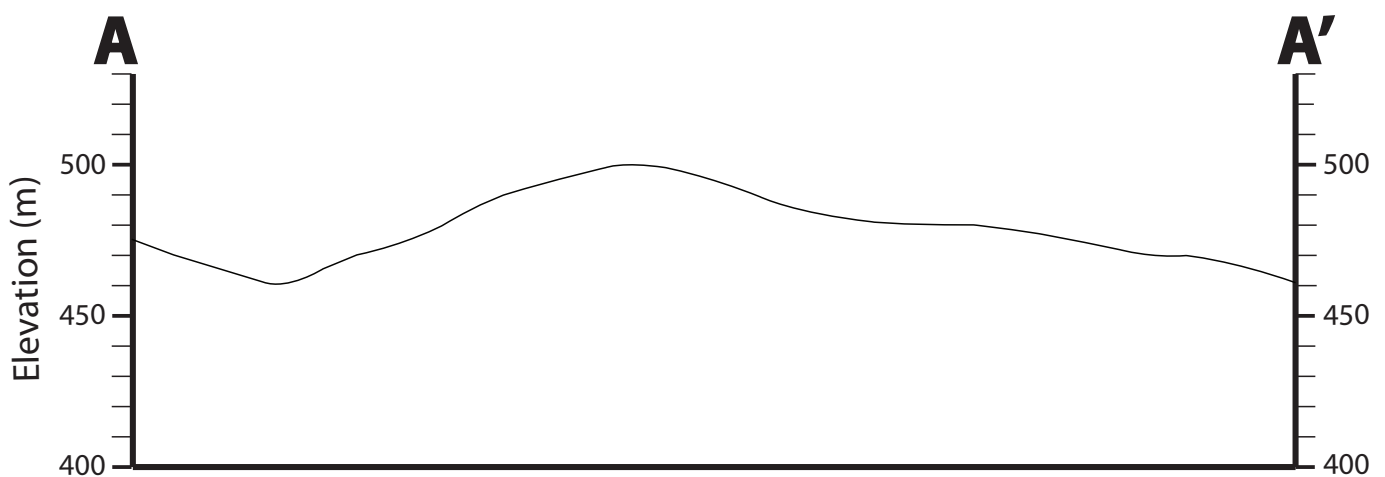
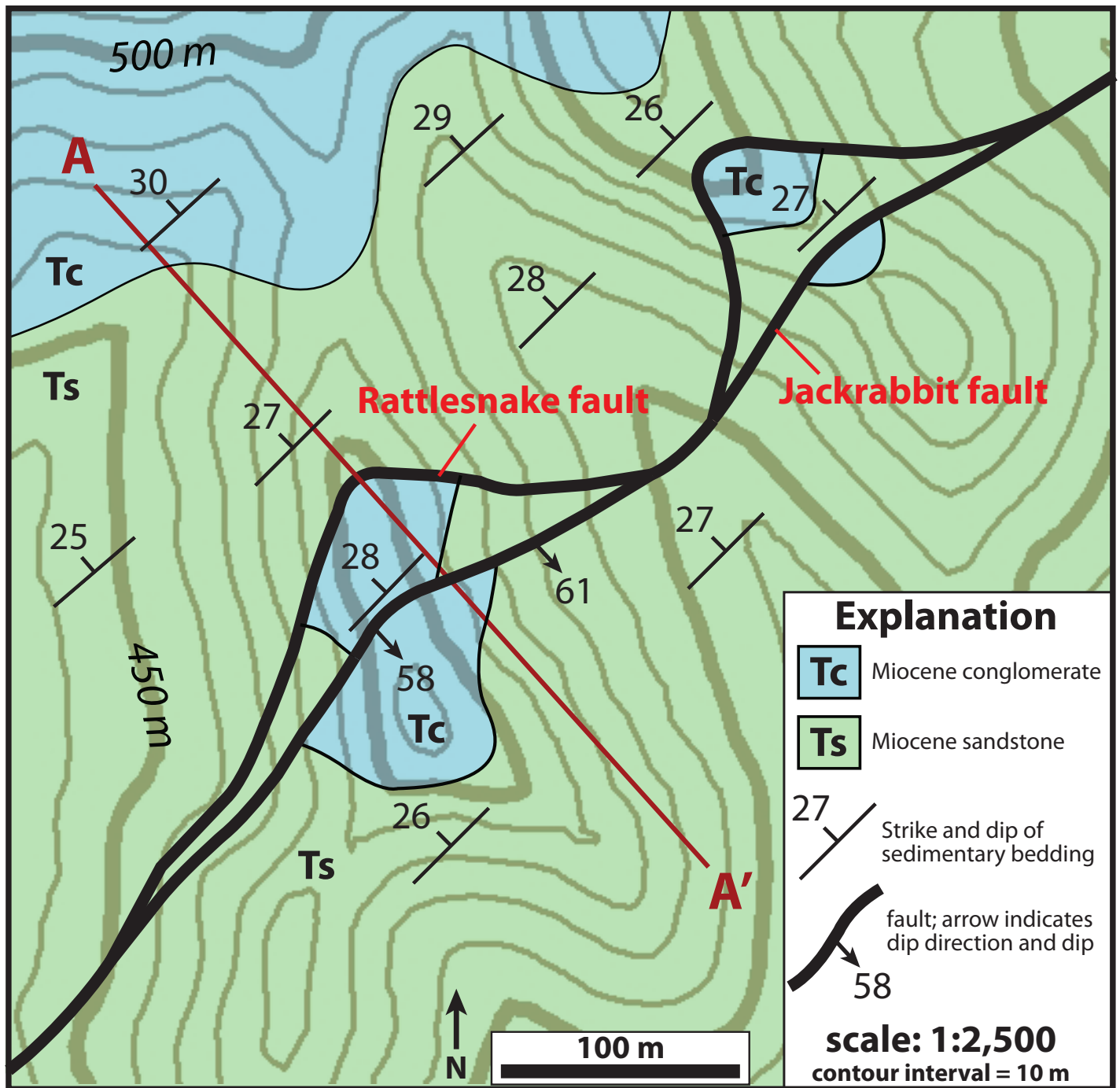
PROBLEM SET #X

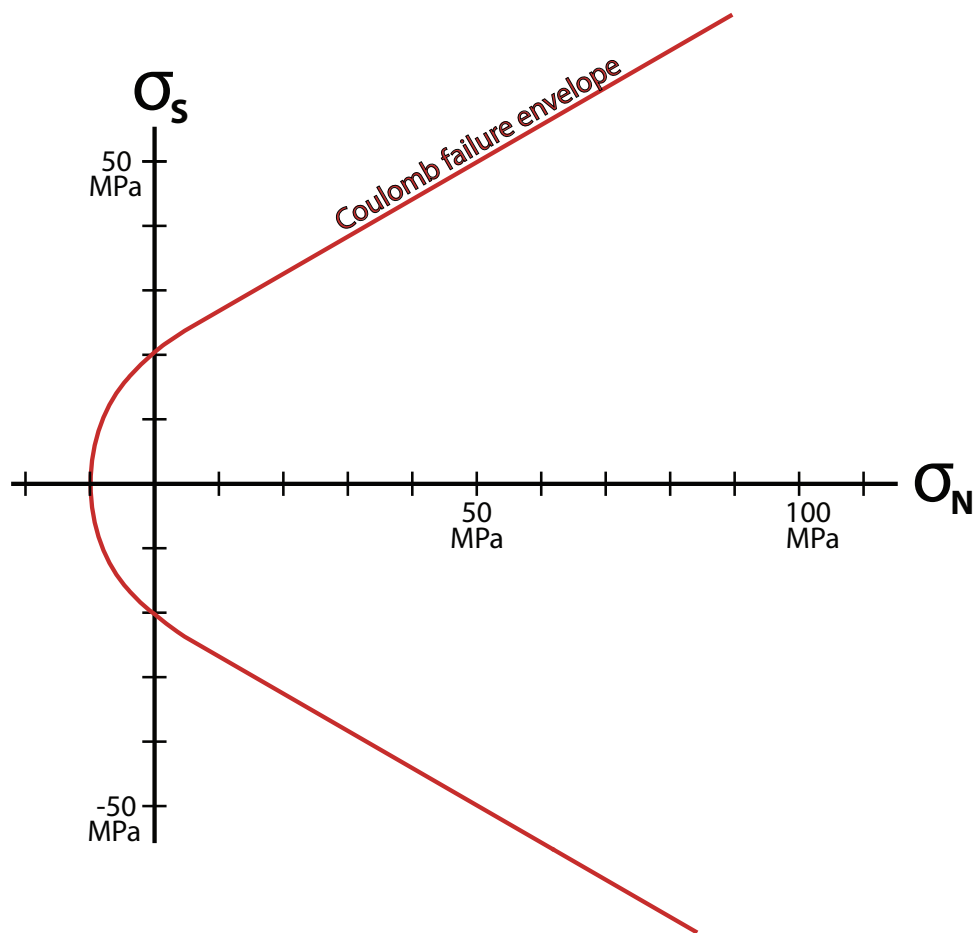
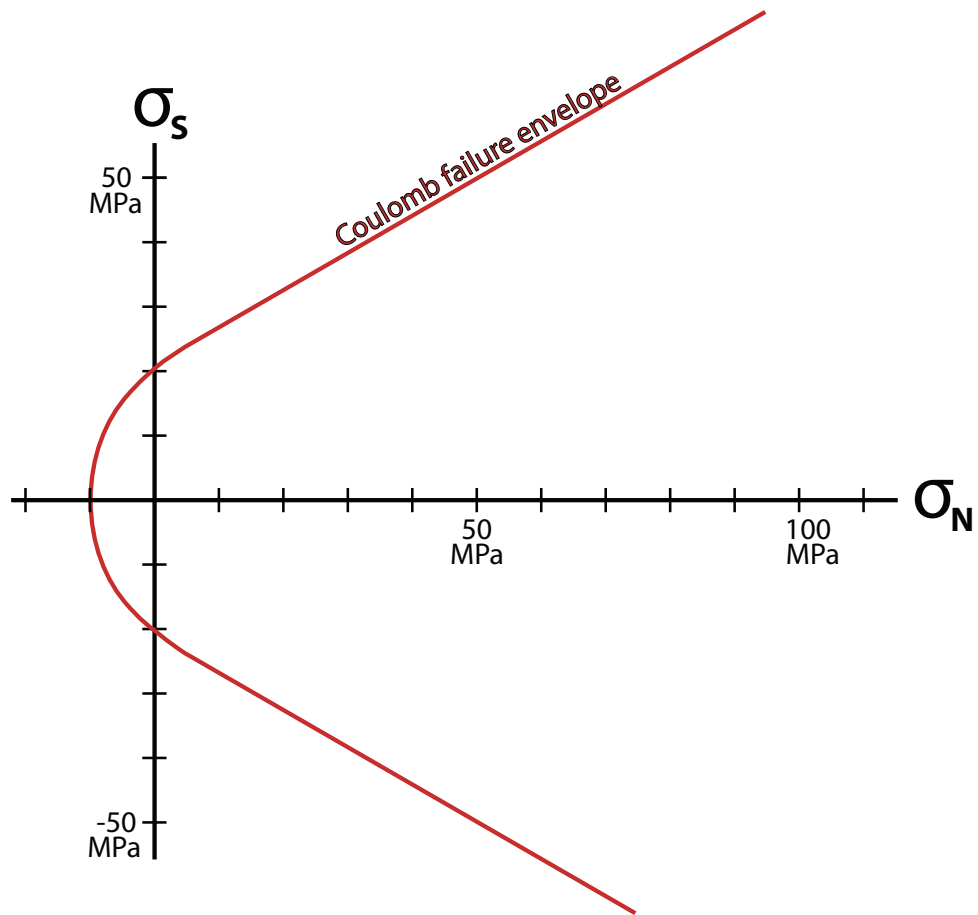
PART A:

The geologic map on page 3 is from an area consisting of faulted Miocene sedimentary rocks. There are two major faults exposed here: the Rattlesnake fault and the Jackrabbit fault. Based on the map view pattern and field observations, it is clear that the Jackrabbit fault cuts the Rattlesnake fault. Using this map and your knowledge of fault mechanics, answer the following questions.

- 1) What is the orientation (strike and dip) of the Rattlesnake fault?
- 2) Draw a cross section from A-A' using the topographic profile provided on page 3.
- 3) What types of faults are the Rattlesnake fault and Jackrabbit fault?
- 4) Based on your cross section, how much apparent displacement is there on the Rattlesnake fault? On the Jackrabbit fault?
- 5) Assuming that these strata were horizontal at the inception of faulting in this area, what was the initial dip of the Rattlesnake fault?
- 6) As the Rattlesnake fault rotated to its current orientation, friction along the fault increased. The Jackrabbit fault cut through these beds at ~4 km depth after slip on the Rattlesnake fault ceased due to frictional lockup. Assuming an Andersonian stress field, what was the direction and magnitude (in MPa) of σ_1 when the Jackrabbit fault formed? (note: the average density of these strata is ~2,500 kg/m³).

- 7) Assuming there was no pore fluid pressure, determine the magnitude and direction of σ_3 when the Jackrabbit fault formed (via Mohr-Coloumb failure). Use the Mohr space diagram on page 4 to draw a Mohr circle that illustrates this stress state during formation of the Jackrabbit fault.
- 8) Now assume that pore fluid pressure was hydrostatic when the Jackrabbit fault formed. What was the magnitude of σ_3 ? Again, illustrate with a Mohr circle.
- 9) On the Mohr diagram, draw a frictional sliding envelope that accounts for frictional lockup on the Rattlesnake fault at its current orientation, assuming hydrostatic pore fluid pressure. Based on the slope of this envelope, what is the coefficient of friction for the Rattlesnake fault? How does this value compare to Byerlee's experimental values? If the Rattlesnake fault obeyed Byerlee's law ($\sigma_s = 0.85 * \sigma_n$), what would have been the dip of the fault when it locked up?





PART B:

Now onto some more complicated (real) geology. The map and cross section on the following pages are from a classic study by John Proffett on the Yerington mining district in Nevada. This area exposes at least three generations of faulting. Based on the map and cross section A-A', answer the following questions:

- 10) What kind of faulting has occurred here?
- 11) Based on cross-cutting relationships, give the name and orientation of one of the oldest faults exposed near A-A'. Give the name and orientation of one of the youngest faults.
- 12) Which generation of faults have the most displacement? What is the largest amount of displacement on any individual fault?
- 13) Assuming the oldest faults formed when the Tertiary volcanic and sedimentary rocks in the area were horizontal, what was the approximate initial dip of the oldest faults? (hint: determine the average bedding orientation in the fault hanging wall and footwall and restore to horizontal). Is this initial dip consistent with Andersonian theory?
- 14) Assuming the second generation of faults (e.g. near Singatse Peak) obeyed Andersonian mechanics (and have rotated to its current orientation), at what angle did the oldest generation of faults cease to slip? At what angle did the second generation of faults cease to slip? Are these angles roughly consistent with Byerlee's law (where $\sigma_s = 0.85 \cdot \sigma_n$)? (e.g. see your answer to question 9 in Part A)

15) In his 1977 paper published on this area, Proffett indicates that clay gouge is present along faults in this area. In addition, based on structural reconstructions, the Singatse fault in this area must have been >10 km deep where it was cut by younger faults. Given this information, why may the fault lockup angles you inferred in question 14 differ from those predicted by the relationship $\sigma_s = 0.85 \sigma_n$? Take a look at Byerlee's experimental data below.

