Geol 326-97 Lab Final

Class Ave = 101 / 150
s.d. = 24

This lab final exam is worth 150 points of your total grade. Each lettered question is worth 15 points. Read through it all first to find out what you need to do. List all of your answers on these pages and attach any constructions, tracing paper overlays, etc. Put your name on all pages.

1. One way to analyze brittle faults is to calculate and plot the infinitesimal shortening and extension directions on a lower hemisphere, stereographic projection. These principal axes lie in the "movement plane", which contains the pole to the fault plane and the slickensides, and are at 45° to the pole. The following questions apply to a single fault described in part (a), below:

   (a) A fault has a strike and dip of 250, 57 N and the slickensides have a rake of 63°, measured from the given strike azimuth. Plot the orientations of the fault plane and the slickensides on an equal area projection.

   (b) Bedding in the vicinity of the fault is oriented 37, 42 E. Assuming that the fault formed when the bedding was horizontal, determine and plot the original geometry of the fault and the slickensides.

   (c) Determine the original (pre-rotation)orientation of the infinitesimal shortening and extension axes for fault.

2. All of the following questions apply to the map shown on the next page. In all of the rocks with cleavage, you may assume that both cleavage and bedding strike 024°. [*Hint: This problem will be easier to do if you recall the relationships between cleavage and bedding in asymmetric folds*].

   (a) Determine the correct stratigraphic sequence and note where there are unconformities in the section (no need to determine thicknesses).

   (b) Determine the strike and dip of the fault which runs approximately north-south through the middle of the map ("fault A"). Is there any feature on the map which might allow you to determine the true slip on the fault?

   (c) Construct a pi-diagram for the cleaved rocks and use it to determine the general geometric style of the folds. [*Note: Because several of the points overlap completely, you will have to "offset" them slightly from one another to see the pi-diagram pattern.*] What is the vergence of the folds?

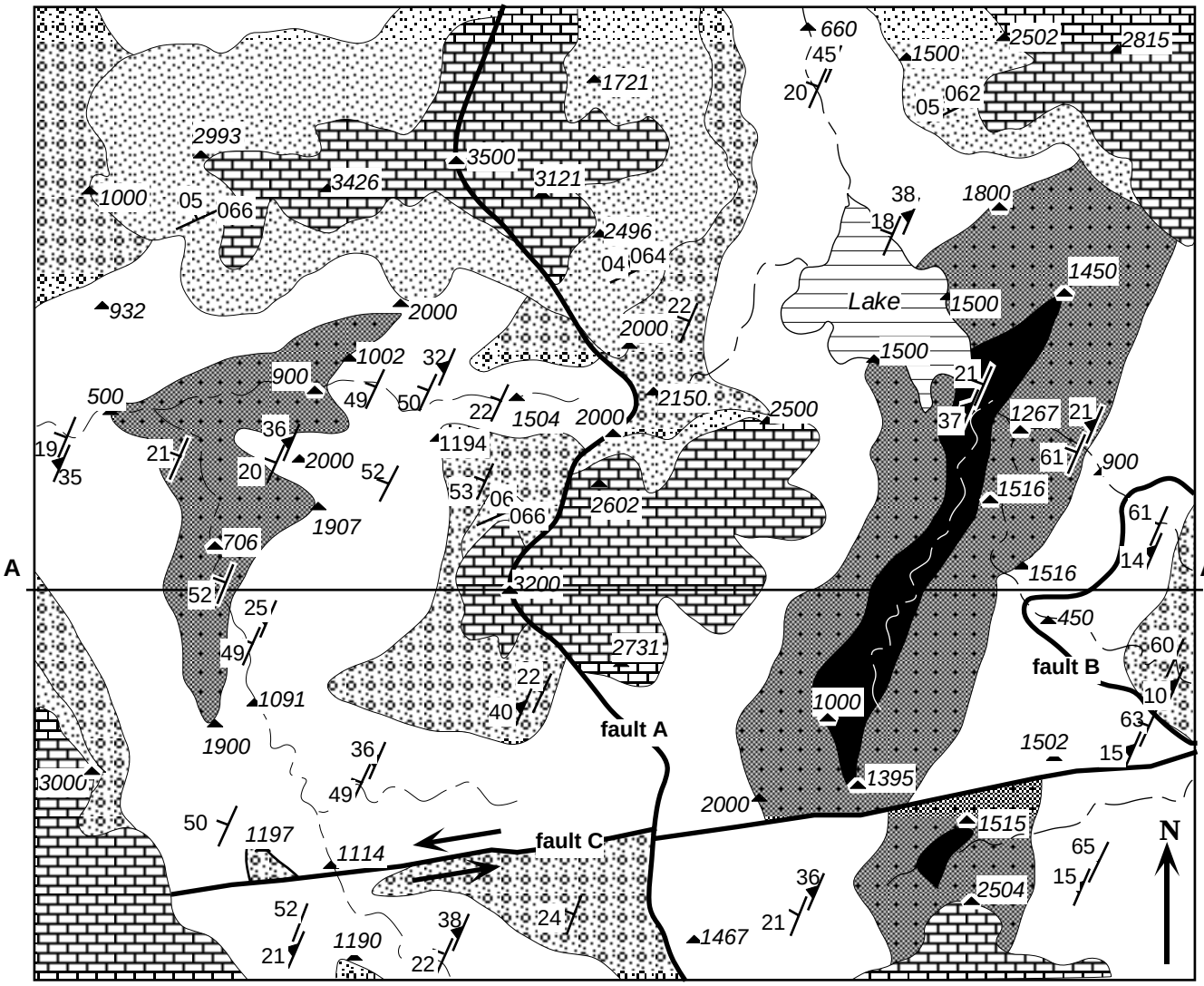
   (d) Is the boomerang shape of the outcrop of siltstone in the western part of the map due to multiple folding or topography? How can you tell?

   (e) Is the fault that runs approximately east-west through the southern part of the map ("fault C") a strike slip or a dip slip fault? How can you tell? Show the sense of offset on the map using appropriate symbols.

   (f) Construct a cross-section along **A - A'**. Be sure to use arrows that show the relative sense of slip on the faults crossed by the section.

   (g) List the geologic events, in order from oldest to youngest, which produced the present geometries observed in the map.

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Key (*units are not shown in stratigraphic sequence*)

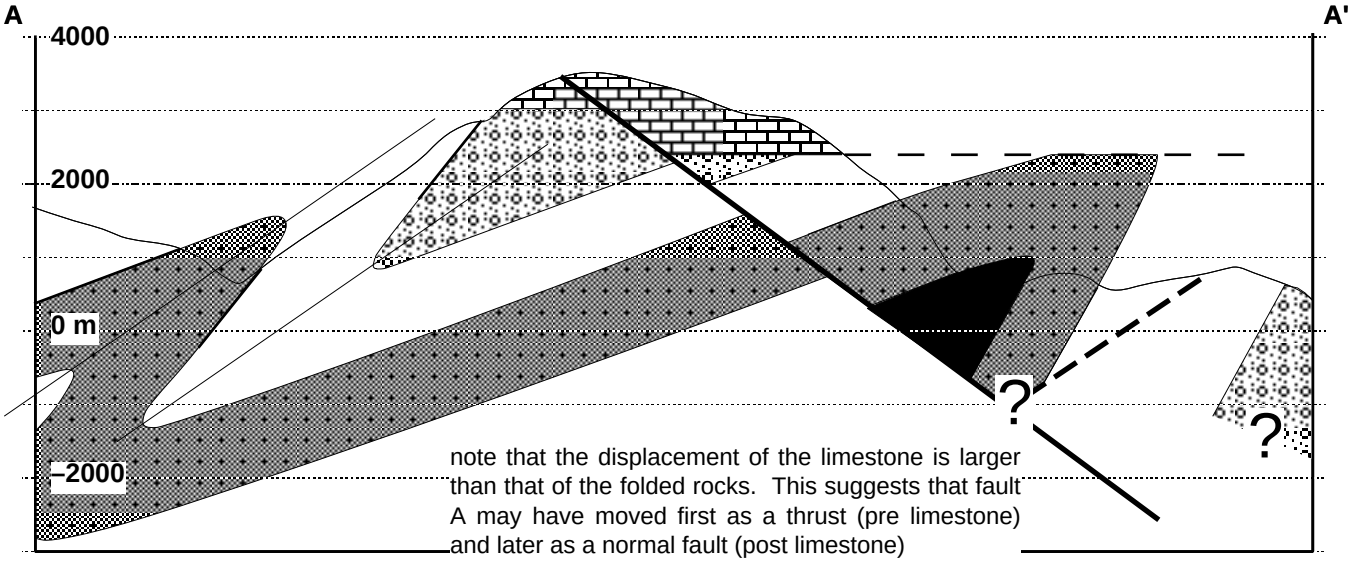
0 2 km

conglomerate | siltstone | gray slate

sandstone | limestone | black slate

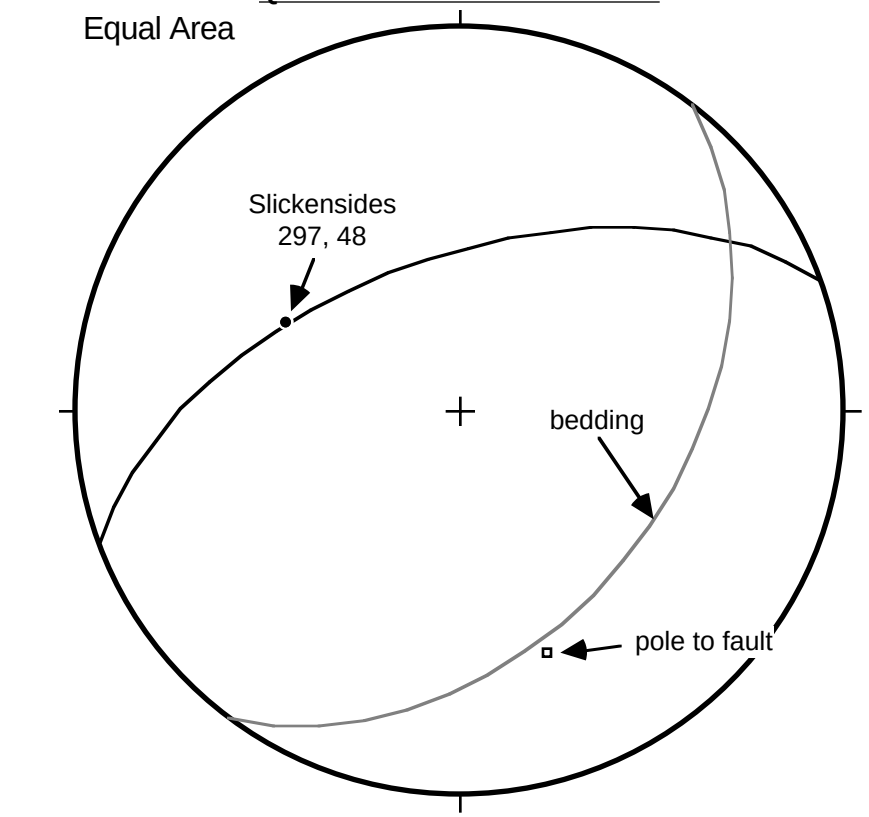
drainage

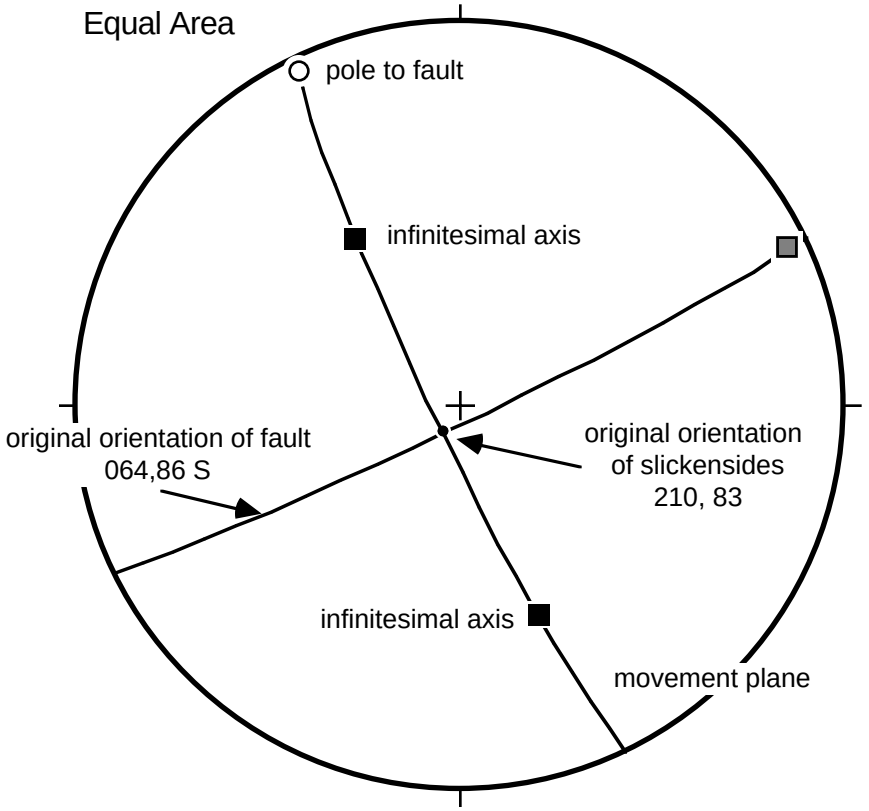
fault | 50 bedding dip | 38 cleavage dip | 1467 spot elevation (m)



note that the displacement of the limestone is larger than that of the folded rocks. This suggests that fault A may have moved first as a thrust (pre limestone) and later as a normal fault (post limestone)

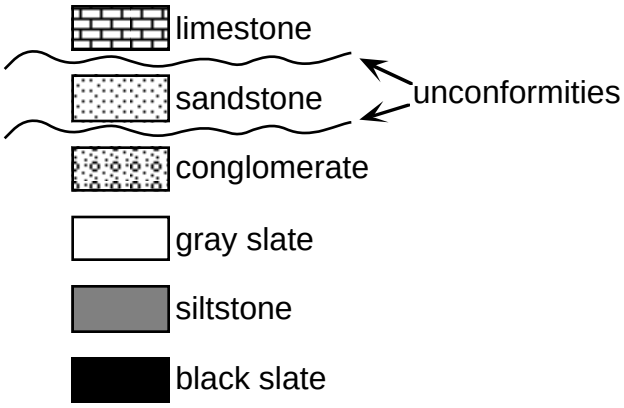
QUESTION #1 — ANSWERS





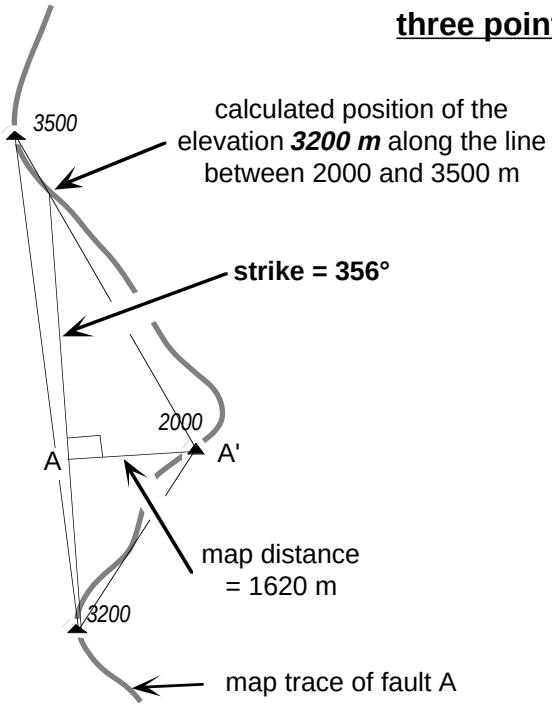
QUESTION #2 — ANSWERS

(a)

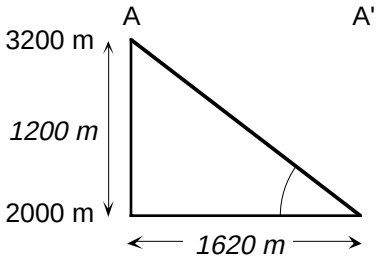


(b)

three point problem



vertical section on AA'

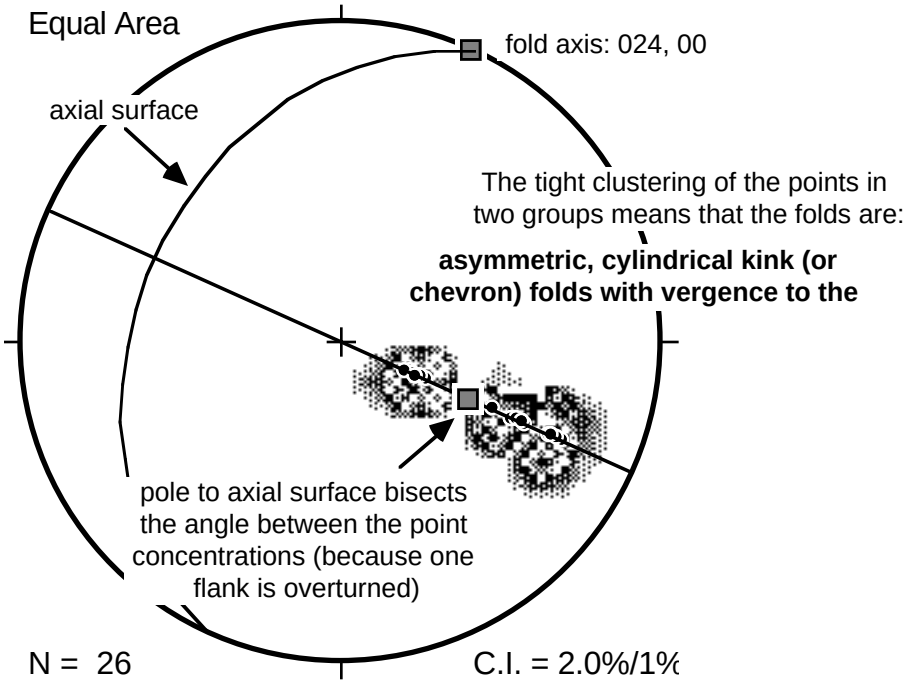


tan (dip) = 1200 m / 1620 m = 0.7407

dip = 36.5°

The truncation of the base of the sandstone beneath the limestone defines lines on either side of the fault which can be used to get the necessary piercing points.

(c)



(d) The boomerang shape is due to topography. The π-diagram from part (c) shows a single set of perfect cylindrical folds. The might be possible with type 0 superposed folds but boomerangs are typical of type 2 superposed folds and would show up. Likewise, there is only one generation of cleavage (which is axial planar to the one generation of folds). Additionally, the elevations within the boomerang are all lower than surrounding elevations.

(e) Fault C is mostly a **strike-slip** fault. The trick is to find piercing points on either side of the fault so that one can define the slip (offset planar markers just give you the separation). For fault C the best bet is to use the fold axis on a particular stratigraphic horizon. The axis at the siltstone/slate contact in the eastern side of the map has been offset vertically by ~100 m but horizontally by ~1500 m so the fault is primarily a strike-slip fault. Note that fault C is nearly vertical (because it has a straight trace across topography).

(f) See map and cross-section page.

(g) Geologic events from oldest to youngest:

1. Deposition of mudstone to conglomerate
2. Folding with ESE vergence and cleavage formation; metamorphism to slate
3. Left Lateral movement of fault C
4. Thrust or oblique slip motion on fault A
5. Uplift and erosion
6. Deposition of sandstone
7. Tilting, uplift, and erosion
8. Deposition of limestone
9. Normal movement on fault A; probably movement of fault B.