MAPS AND CROSS SECTIONS (I)

I   Main Topics
  A Three point problems
  B Rule of vees
  C Map interpretation and cross sections

II Three point problems (see handout)
  A Three points define a plane
  B The line of strike is given by the bearing of a horizontal line in a plane; a horizontal line connects points of equal elevation.
  C The angle of dip is given by looking parallel to strike in a cross section drawn perpendicular to the line of strike.
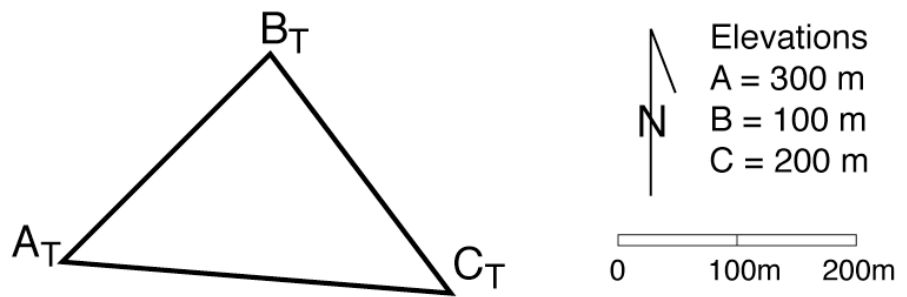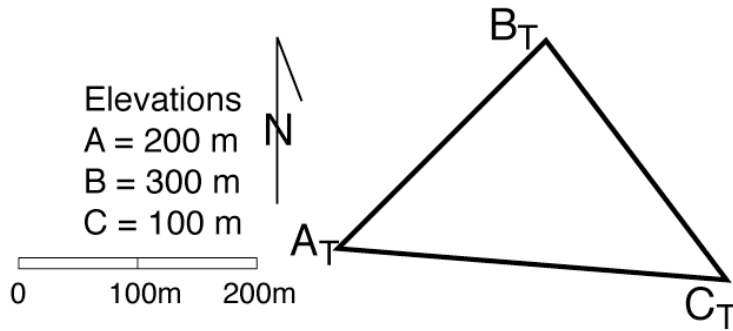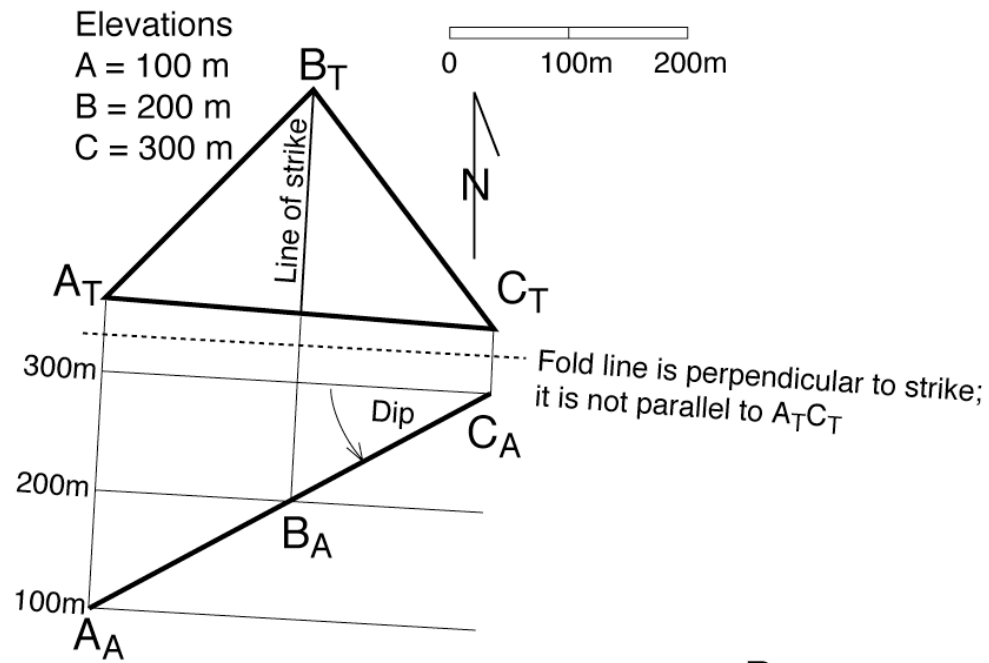
III Rule of vees
  Although not usually phrased this way, this is really a three-point problem. Find a line of strike for the feature of interest by finding two points on the feature at equal elevation (this follows from the definition of strike). Points on opposite sides of a stream, where the feature intersects a particular contour line, are a good choice of points. Note the elevation of this line of strike. Then find a third point at a known elevation on the feature that is off the line of strike (e.g., where the feature intersects the stream bed). The positions and elevations of these three points allow the direction and amount of dip to be determined.

IV Map interpretation and cross sections
  A Project structural information on planes (e.g., location of bedding contacts) along lines of strike onto the plane of the cross section
  B The elevation of the structural information is plotted at the appropriate elevation
  C Strike view cross sections differ from arbitrarily chosen cross sections in that the lines of projection are straight in the strike view cross sections but are dog-legged (bent) in the arbitrarily chosen cross sections.
  D Cross sections of the geologic structure *only* will not show topography, just the geologic structure

Three Point Problems

Lab 3.1

Elevations
A = 100 m
B = 200 m
C = 300 m

B_T

Line of strike

A_T

C_T

N

0   100m   200m

300m

Fold line is perpendicular to strike;
it is not parallel to A_TC_T

Dip

C_A

200m

B_A

100m

A_A

Elevations
A = 200 m
B = 300 m
C = 100 m

N

0   100m   200m

B_T

A_T

C_T

B_T

A_T

C_T

Elevations
A = 300 m
B = 100 m
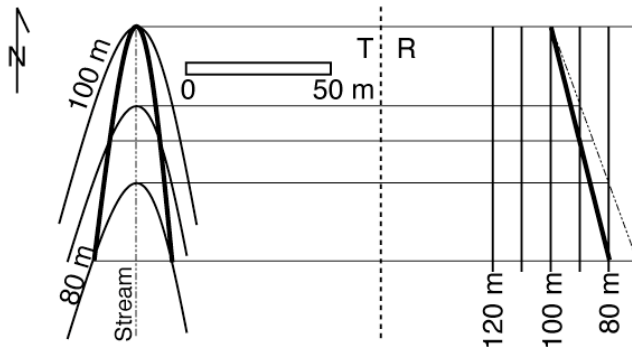C = 200 m

N

0   100m   200m
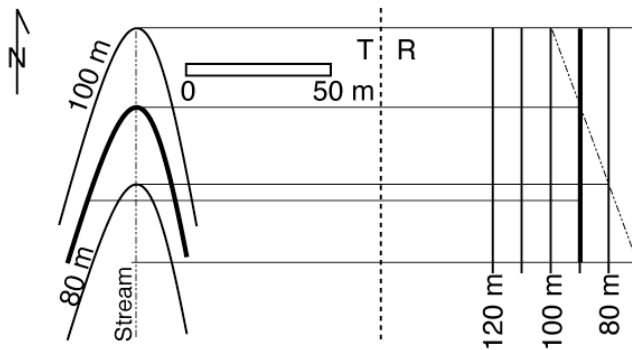
Rule of Vees

Lab 3.2

## Direction of vee depends on dip of plane relative to stream gradient
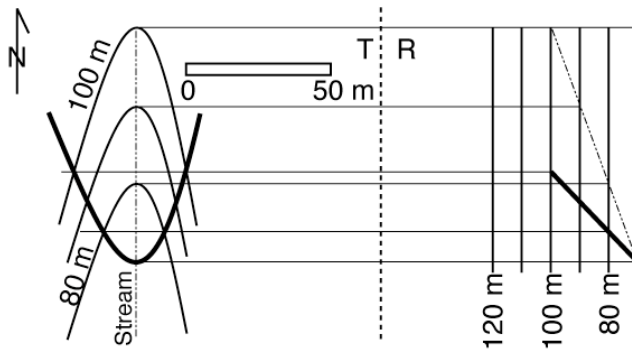
Plane dips downstream
at steeper angle than
stream gradient;
contact vees downstream.

Plane dips downstream
at gentler angle than
stream gradient;
contact vees upstream.
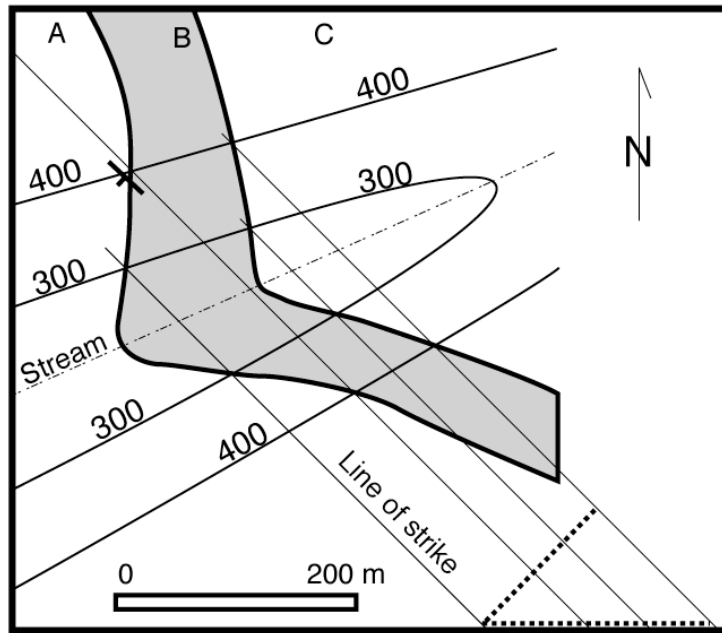Contact nested inside
topographic contours.

Plane is horizontal;
contact vees upstream.
Contact parallels
topographic contours.
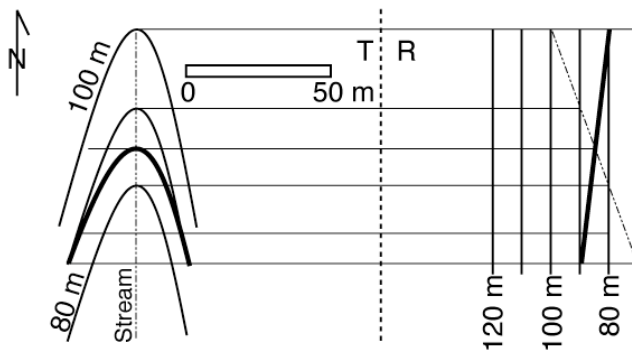
Plane dips upstream;
contact vees upstream.
Topographic contours
nested inside contact.

PROJECTION OF STRUCTURAL INFORMATION   Lab 3.3
ONTO CROSS SECTIONS

A   B   C
400
400   300
300
Stream
300
400
Line of strike
0   200 m

N

1) Determine the
direction of bed strike

2) Project structural
information from the
map along strike onto
the cross section plane.
The projection lines
are parallel to lines of
strike.

Strike View
Cross Section
400 m
300 m
200 m
True dip
A   B   C

Note that the arbitrary cross section
is "stretched out" and yields shallow
apparent dips. The strike view cross
section yields true dips.

Cross-Section
Along south edge
of map
400 m
A   Apparent dip
B
300 m
C
200 m
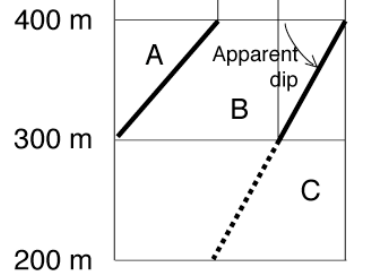
3) Plot structural
information
at the correct
elevation
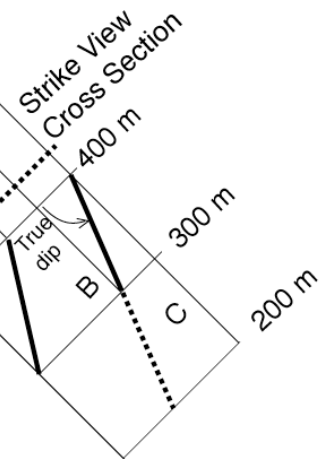
In a strike view cross section the cross section plane is like a
window that you look through and see along strike. In an arbitrary
cross section the view is generally not along strike.

Note that the horizontal scale on the map is the same as the
horizontal scale and vertical scale in the cross section.

Comments on Cross Section Construction   Lab 3.4

1 Cross sections
All cross sections should be neat. If they are sloppy they can not be relied upon.
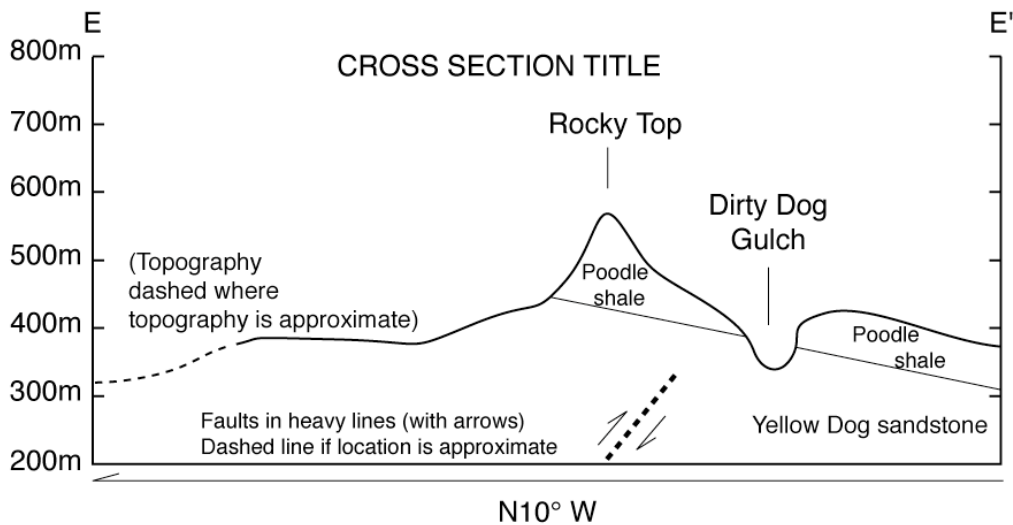All cross sections should have a title
The elevation bars at the ends of the cross section should extend to the same height and
  go to the top of the cross section
The direction of the cross section should be indicated somehow.
On structural cross sections the vertical scale should NOT be exaggerated; the horizontal
  and vertical scales should be the same. If they aren't, include a horizontal and vertical scale.
Label key geologic, geographic, or cultural features on all cross sections
The northernmost end of the cross section is usually to the left (this is not a hard rule)

The line of cross section (shown on the corresponding map) should have little end bars:

2 Calculations
Show the calculations (or the spreadsheet) for any calculations you do. If no calculations
are shown and there is any error, there will be no credit.

3 Strike and dip
The strike of a horizontal bed is not uniquely defined, but it is not undefined. There is a difference.
Any value will work for the strike of a horizontal bed.

The following description of strike and dip is complete:
The bed strikes N31°W and dips 18° to the NE.   Give the approximate dip direction.
Do not say the dip of the bed is N18°E. That notation is reserved for the strike (or trend).
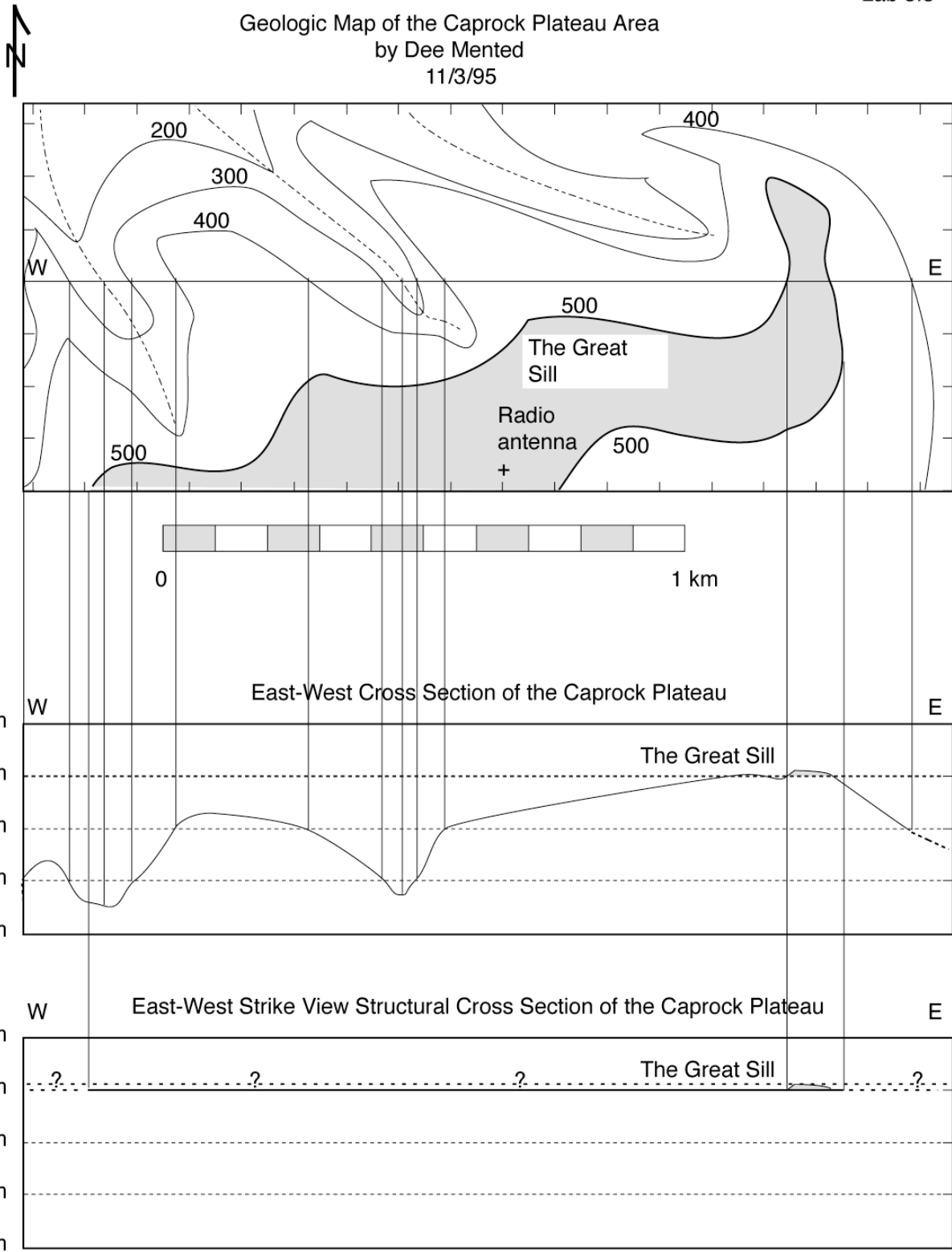
The symbol for horizontal bedding goes on the horizontal bed, not beneath the horizontal bed.

The little tick mark should point in the direction of dip. For the attitude mentioned above:
the proper symbol is:

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Cross Section of Geologic Structure With and Without Topography

Lab 3.5

Geologic Map of the Caprock Plateau Area
by Dee Mented
11/3/95

N

200

400

300

400

W

E

500

The Great Sill

Radio antenna +

500

500

500

0   1 km

East-West Cross Section of the Caprock Plateau

W   E

600m

500m — — — — — — — — — — — — — — The Great Sill — — — —

400m

300m

200m

East-West Strike View Structural Cross Section of the Caprock Plateau

W   E

600m

500m — ? — — — — — — ? — — — — — — ? — — — The Great Sill — — — ? —

400m — — — — — — — — — — — — — — — — — —

300m — — — — — — — — — — — — — — — — — —

200m

Exercise 1 (**27 points total**)

Three points with the following coordinates lie on a planar bed:

A: 0m N, 400m E, 400m elev;   B: 0m N, 0m E, 300m elev;

C: 300m N, 0m E, 500m elev. You are asked to find the orientation of the plane as in the example of 3.1.

1a   Plot and label the points on the attached map; the axes cross at the coordinate origin. **(3)**

1b   Draw and label a line of strike through point A for the bed on the map **(2)**

1c   Determine to the nearest 45° (i.e., N, NE, E, SE, S, SW, W, or NW) the direction of dip and write it here: direction of dip = _____.**(1)**

1d   Measure the strike of the bed (**use the right-hand rule**) and write it here:

       strike = _____**(2)**

1e   Draw a dashed cross section line (fold line) through point E that is perpendicular to strike and that divides the top view of the map from auxiliary view A. Label the elevation of this line "600m" in auxiliary view A. **(2)**

1f   Project points A, B, and C onto the auxiliary cross section view, then measure and label the dip of the plane and write it here (include the dip direction):

       dip = _____**(4)**

1g   Measure the horizontal component of the shortest distance (H) on the map between the line of strike and point B (<u>use the map scale</u>) and write it here: distance =

       _____**(2)**

1h   Label on the cross section (A) view the vertical distance (V) and horizontal distance (H) between your line of strike and point B, and label on the top view the horizontal distance (H); this is a total of three labels **(3)**

1 i   Write the mathematical expression relating the dip of the plane to H and V here:

       dip = _____**(2)**

1 j   Based on the mathematical expression relating the dip of the plane to H and V, calculate the dip of the plane and write it here: dip = _____**(2)**

1 k   The trend of the pole to the bed is: _____**(2)**

1 l   The plunge of the pole to the bed is: _____**(2)**

Exercise 1A

N

0 250m

E
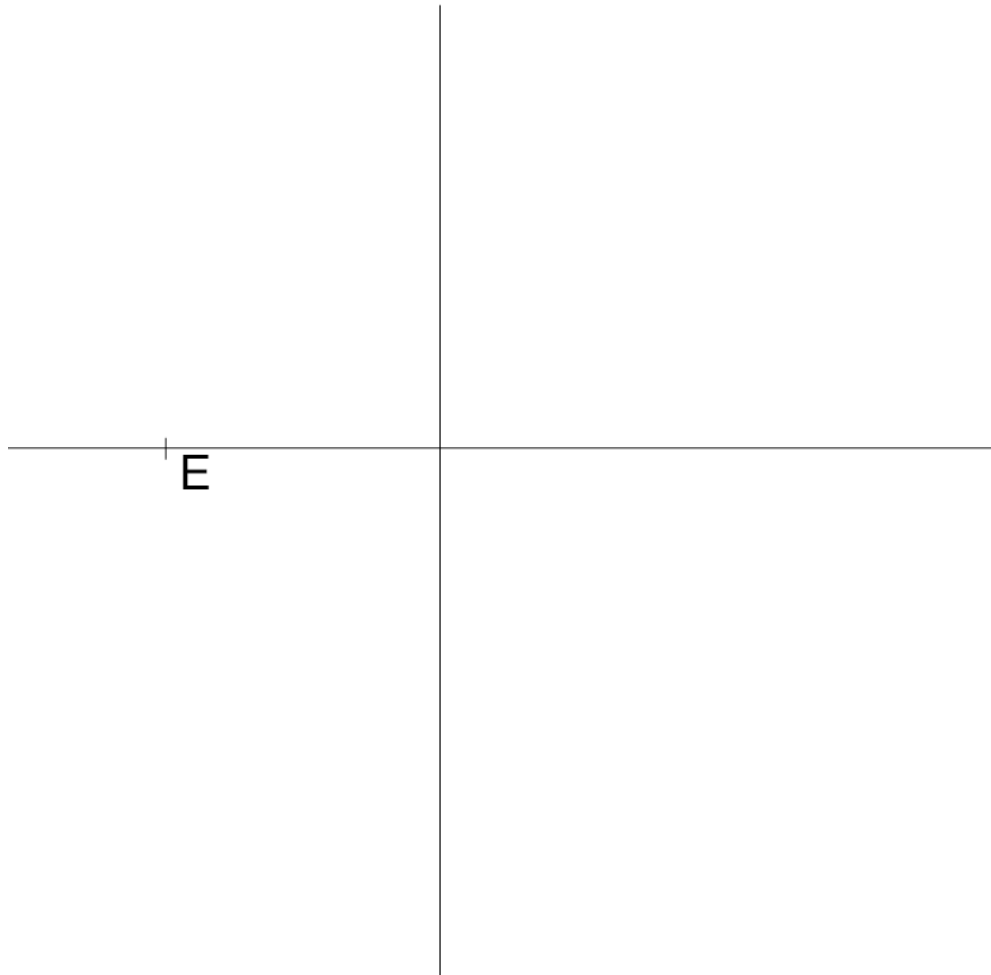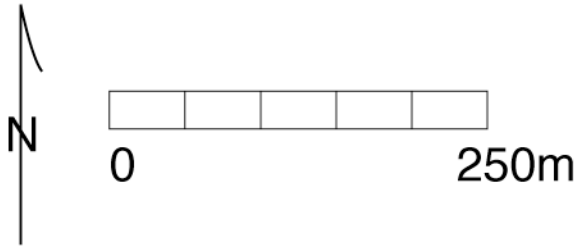
Exercise 2 (26 points total)

The points on the map of Exercise 2 lie on a planar bed, and the labeled elevations for the points are in meters.

2a   Determine the elevations of five structure contours for the bed, with the highest and lowest contours passing through the points with the highest and lowest elevations, respectively; the contour interval should be uniform. The elevations of the points are given in meters. List the contour elevations below. **(5)**

Contour 1 _____   Contour 2 _____

Contour 3 _____   Contour 4 _____

Contour 5 _____

2b   The strike of the bed is (**use the right-hand rule**):   strike = _____**(2)**

2c   On the map, draw and label five structure contours for the bed, with the highest and lowest contours passing through the points with the highest and lowest elevations, respectively; the contour interval should be uniform. **(5)**

2d   Determine to the nearest 45° (i.e., N, NE, E, SE, S, SW, W, or NW) the direction of dip and write it here: direction of dip = _____.**(1)**

2e   Draw a cross section perpendicular to the lines of strike, and by projecting at least 4 points onto the cross section, determine the dip of the plane and general dip direction, and write them here: dip = _____**(5)**

2f   Measure the shortest horizontal distance (on the map) between the high and low structure contours and write it here: distance = _____**(2)**

2g   Based on the vertical and horizontal distances between your high and low structure contours, calculate the dip of the plane and write it here: dip = _____**(2)**

2h   The trend of the pole to the bed is: _____**(2)**

2 i   The plunge of the pole to the bed is: _____**(2)**

Structure contour map, Lab 3
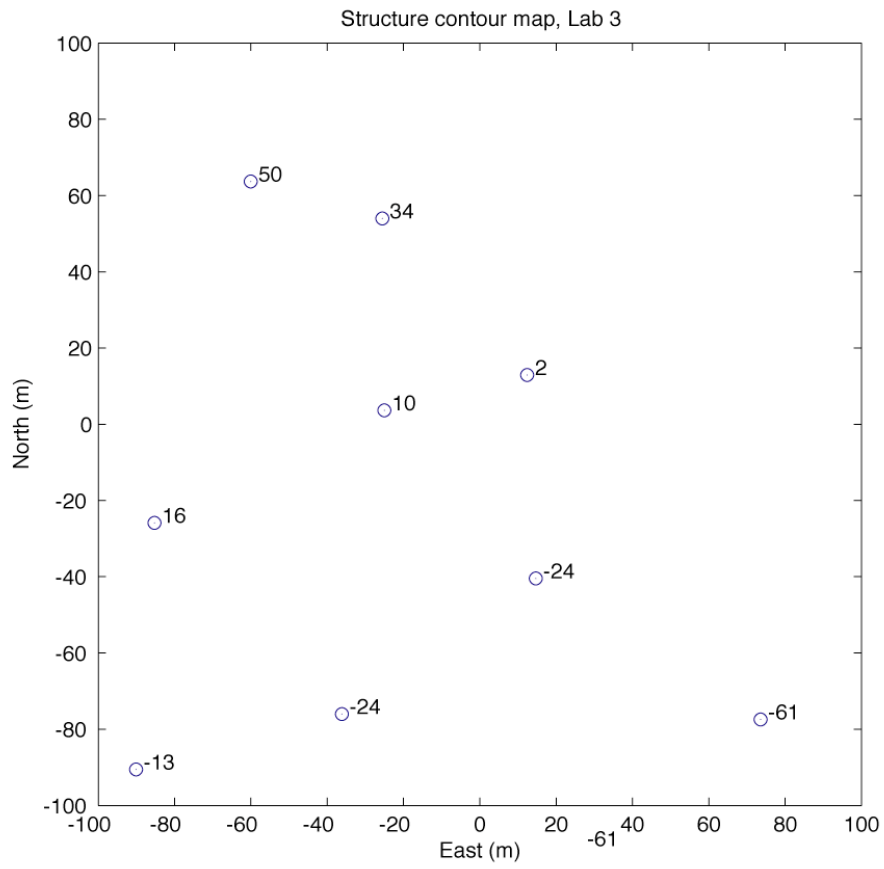
Exercise 3 (See attached geologic map of the Caprock Plateau; elevations are in meters) **(59 points total)**
Three planar dikes labeled A, B, and C cut the Paleocene Puddingstone and the Cretaceous Chalk.

3a   Determine the strike and dip (and dip direction) of these dikes as well as the attitude of the contact between the Paleocene Puddingstone and the Cretaceous chalk (this contact is labeled D).

	A	B	C	D
Strike (4x4)				
Dip (4x4)				

3b   Draw four attitude symbols on the map that show the strike and dip of each feature (draw one for each feature). Locate the symbols where you collected information to determine the strike and dip of the features. **(4x3)**
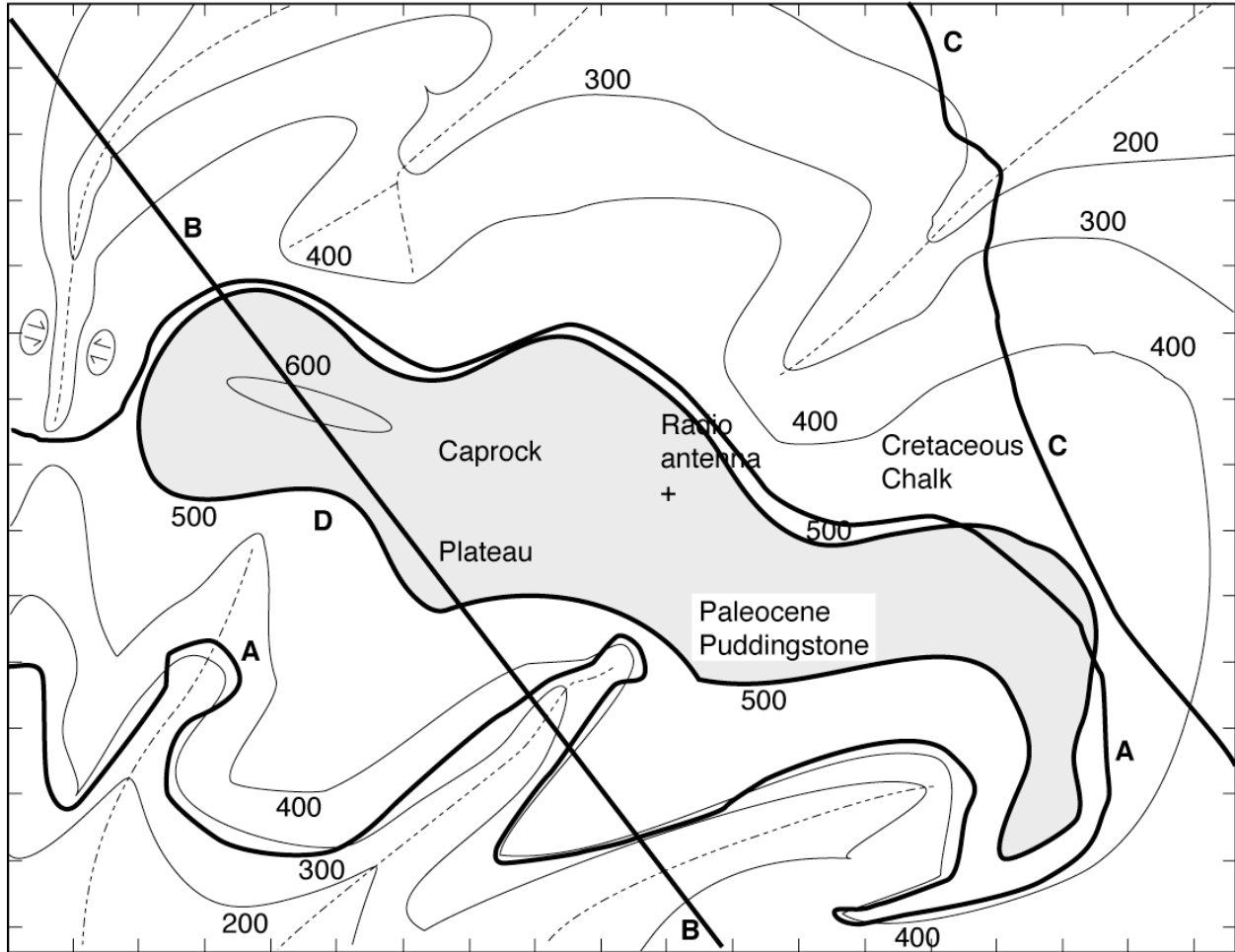
3c   Draw a line through the radio tower showing the orientation of a vertical cross section plane that is perpendicular to the strike of dike A. Label the end points E and E' **(3)**

3d   Draw cross section E-E' showing the topography and dike A **(10)**

3e   Does this cross section plane allow you to see the true dip of dike A? Explain briefly.

_____

_____

_____(2)

Geologic Map of the Caprock Plateau Area
by Dee Mented
11/3/95

N

C

300

200

B

300

400

400

600

Radio
antenna
+

Caprock

400

Cretaceous
Chalk

C

500

500

D

Plateau

Paleocene
Puddingstone

A

500

400

A

400

300

200

B

400

0   1 km

Explanation

Landslide

Cretaceous dike