Structural Geology Lab 5
Part I. More on Geologic Maps and Cross-Sections

I. The Nature of Geologic Contacts

A. Depositional Geologic Contacts

1. sedimentary or volcanic rocks deposited in stratigraphic succession according to the laws of layer-cake geology

a. Conformable Contact:

(1) no evidence of erosion or break in stratigraphic succession (i.e. each successive layer becomes sequentially younger in age)

(2) Geologic contact mapped as solid line showing break between rock formation or rock type

b. Unconformities

(1) Successive layers show evidence for significant erosion or non-deposition (i.e. there is a significant break in the stratigraphic record = "missing time")

(2) Types of Unconformities

(a) Nonconformities = sedimentary rocks deposited on crystalline rocks (e.g. igneous, metamorphic)

(b) Angular Unconformities = sedimentary layers deposited on deformed and eroded older sedimentary layers

i) erosional surface cross-cuts bedding planes of older sedimentary layers

(c) Disconformities = sedimentary layers deposited on undeformed, but eroded older sedimentary layers

B. Structural contacts

1. Fault Contacts

a. structural discontinuity between rock and/or bedding planes

(1) fault gouge, slickenlines, offset beds, etc.

b. Can result in angular discontinuities, or stratigraphic discontinuities just like an unconformity

C. Igneous Intrusive Contacts

1. Intrusive Contacts

a. intrusive, hypabyssal igneous rocks cross-cut younger sedimentary beds

(1) dikes = transverse to bedding planes at some angle
(2) sills = parallel to bedding planes at some angle
(3) stocks, batholiths

(a) erosional surface is parallel to bedding planes of older sedimentary layers

D. Field Identification

1. Conformable stratigraphic contacts:

a. no evidence for break in stratigraphic record
b. no evidence for erosional truncation, scour or lag conglomerates
c. no evidence for break in fossil record

2. Unconformable stratigraphic contacts

a. obvious erosion or scour surfaces
b. scour or lage conglomerates above erosional surface
c. signigicant gap in fossil or time record
d. angular discontinuity between bedding dip separated by erosional break or scour

3. Faults

a. angular / stratigraphic discontinuity
b. fault gouge, fault breccia, drag folds, slickensides, sympathetic secondary structures, fractures, etc.

II. The Stratigraphic Column

A. What is it??

1. a generalized column showing rock units in stratigaphic order from oldest on bottom to youngest on top

a. "structure" is removed
b. drawn to vertical scale showing bed thickness
c. essentially a generalized "layer cake" profile of the rock units and their stratigraphic relations

2. Essentially a scaled legend for rock types on a geologic map and cross-section

B. Graphical Display
   1. Color-coded or patterned legend on map
   2. Age and Formation Name of Rock Unit
      a. Map unit abbreviation
         (1) Age Unit at Period Level in Capital letters
            (a) e.g. Devonian = D, Mississippian = M, etc.
         (2) Formation name in lower case
            (a) e.g. g = Greenberg Sandstone, s = Swauk Formation
         (3) Total abbreviation = time + formation
            (a) e.g. Dg = Devonian Greenberg Sandstone
   3. Thickness of units drawn at an appropriate vertical scale
      a. Graphical depiction of rock unit using standard symbol designations for rock type (see previous hand out with standard graphical symbolds)
   4. Age of unit
   5. Rock unit name and description

III. The Arc Method for Drawing Concentric, Parallel Folds

A. Assumption: folds are parallel, i.e. beds maintain constant thickness throughout structure
B. Technique: drawing folds using a compass (i.e. drawing compass)
   1. Establish line of cross-section on geologic map
      a. draw line of cross-section perpendicular to strike if possible
      b. Begin by constructing a topographic profile
   2. Project strike-dip data points to line of cross-section
   3. Make tick marks on topo. profile showing proper dip angle of beds
   4. draw construction lines perpendicular to adjacent tick marks until they mutually intersect ("intersection points")
   5. Use the drawing compass to draw, parallel concentric lines of constant arc between the rays of each mutual intersection point
      a. see e.g. on p. 53, and read description on p. 50 of lab manual
   6. Continue drawing concentric arcs at each intersection point until structure section in complete
      a. draw solid lines to depict bedding contacts below topographic grade
      b. draw dashed lines to depict "projected" bedding contacts above topographic grade (i.e. to show contacts of beds that have been eroded away)

Lab Exercise Instructions

1. Complete Problem 3.4 on p. 40 of lab manual

2. Examine Figure 3.13 on p. 41. Color code the map (a), stratigraphic column (c), and structural cross-section (b). Make each geologic unit the same color. Truly examine the map and cross-section in detail; make sure you understand how they correlate with one another.

    a. What type of geologic contact exists between unit Mw and Ta?

    b. What type of geologic contact exists between unit pCj and Dg on the eastern side of the map?

    c. What type of geologic contact exists between pCt and pCj?

    d. What type of geologic contact exists between Dg and Mw?

3. Read over the "arc method" described on p. 50 of lab manual. This is a method for drawing concentric, parallel folds in which the bed thickness remains constant throughout the structure. The technique description is very straight forward and is illustrated on p. 53.

    a. Complete problem 4.2 on p. 50

4. Complete Problem 4.3 on p. 54

5. Read over "structure section format" on p. 54 of lab manual. Try your hand at problem 4.4. Since the "Bree Creek" problem builds on itself, you will likely have to do more work on the map to determine thicknesses, contacts, structure, etc., before completing the cross-sections.

    a. Use 1x10 graph paper to construct your cross-section / topographic profile

    b. Use "no vertical exaggeration", ie. vertical scale of cross-section should be same has horizontal scale of map (also keep the horizontal scales of map and cross-section the same).

    c. neatly scale and label your profile according to format instructions

        i. color code the cross-section the same as your map pattern