# Geology 207: Map Interpretation

## Final Exam Spring 97/98

**Time allowed: Three hours**
**Read the paper carefully before answering any of the questions**
**Exam rules apply**

**Section A (75 marks)**

Answer the multiple choice questions on the answer sheet provided.
Three marks will be given for each correct answer.
One mark will be deducted for each incorrect answer.

Figure 1:

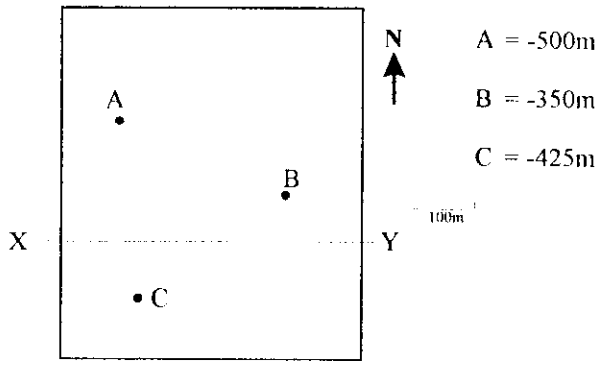



Figure 1 is a map of a coal mining area. The area is flat lying (300m above sea level) and is covered with 30m of horizontal glacial drift. Three boreholes were drilled and the top of a seventy-five metre (true thickness) coal seam was encountered at the elevations indicated on the map. Note that the elevations are given relative to sea level and not to the present day surface. Study the map carefully and then answer questions 1-4.

1) What are the dip and the strike of the coal seam in figure 1?
   a) 45.2°/030°
   b) 45.2°/210°
   c) 63°/190°
   d) 26.6°/205°
   e) 26.6°/025°

2) What is the apparent dip of the coal seam along the line of section X-Y in figure 1?
   a) 23.9°
   b) 29°
   c) 48.2°
   d) 32.7°
   e) 35°

3) The mining company would like to know at which point directly East (090°) of Borehole A in figure 1 is the coal closest to the surface. The answer is?
   a) 333m
   b) 560m
   c) 810m
   d) 900m
   e) 1125m



Name.....

4) When the mining company continued to drill the boreholes they discovered the top of another coal seam (50m true thickness) at -600m in Borehole A, at –450m in Borehole B and at –525m in Borehole C. How much barren ground lies between the two coal seams?
   a) 25m
   b) 20.4m
   c) 16.1m
   d) 83.9m
   e) 70m

Figure 2.

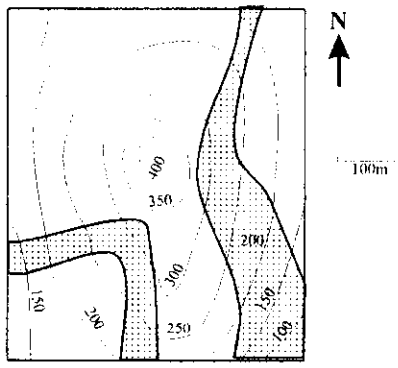



Figure 2 is a map showing the outcrop pattern of a sandstone horizon. Study the map carefully and then answer questions 5-7.

5) What is the nature of the fold shown in figure 2?
   a) Cylindrical, symmetrical antiform
   b) Cylindrical, symmetrical synform
   c) Asymmetrical plunging antiform
   d) Asymmetrical plunging synform
   e) Cylindrical, asymmetric antiform

6) What is the true thickness of the sandstone unit in figure 2?
   a) 50m
   b) 41.6m
   c) 30m
   d) 25m
   e) The true thickness is variable

7) A 50m (true thickness) conglomerate unit lies 50m above the top of the sandstone. What is the vertical thickness of this unit in the area shown in figure 2?
   a) 50m
   b) 60.1m
   c) 83.3m
   d) 75.4m
   e) The vertical thickness is variable

Name.....

Figure 3.

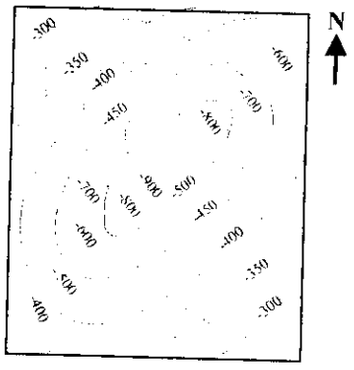



Figure 3 is a map showing structural contours for the upper and lower boundaries of an igneous body. Study the map carefully before answering questions 8-9.

8) The maximum thickness of the igneous body shown in figure 3 is?
   a) <200m
   b) 250m
   c) 300m
   d) 350m
   e) > 400m

9) The shape of the igneous body most resembles which of the following structures?
   a) Dyke
   b) Sill
   c) Laccolith
   d) Lopolith
   e) Cone sheet

Figure 4.

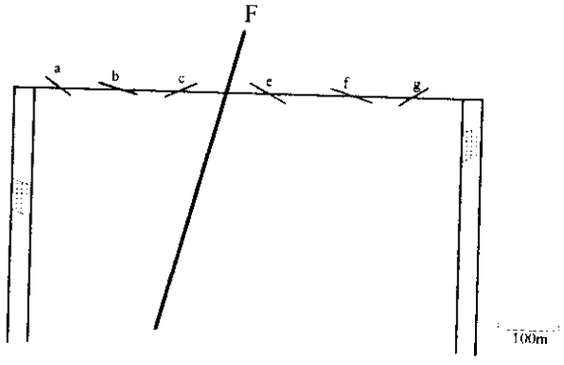



Figure 4 is a cross-section though an area of variably dipping strata. Two boreholes in the area indicate the depths of a sandstone horizon. Use the busk construction to answer question 10.

10) The throw on the fault as shown by the sandstone horizon in figure 4 is?
   a) 110m
   b) 187.5m
   c) 237.5m
   d) 270m
   e) 325.5m

Name.....

11) Two apparent dips taken on a single bedding plane were 20°→ 040° and 50° → 130°. What is the dip and strike of the bed?
   a) 160°/30°
   b) 340°/30°
   c) 024°/51°
   d) 204°/51°
   e) 010°/45°

12) Two beds A and B have strikes and dips of 330°/40° and 220°/50° respectively. The apparent dip of the beds towards 020° in each case would be?
   a) A=32°, B=22°
   b) A=22°, B=12°
   c) A=12°, B=02°
   d) A=36°, B=28°
   e) A=25°, B=24°

Table1:

| Locality | Bedding | Cleavage |
|---|---|---|
| 1 | 080°/60° | |
| 2 | 090/52° | |
| 3 | 120°/39° | |
| 4* | 220°/70° | 170°/39° |
| 5* | 210°/60° | |
| 6* | 200°/52° | |
| 7 | 010°/50° | |

Table 1 shows structural data for an area of folded Palaeozoic rocks. Use this data to answer questions 13-16. Note that at localities denoted with an asterisk (*) the beds are inverted.

13) The pitch of the fold hinge in the cleavage plane is?
   a) 60°S
   b) 70°S
   c) 80°S
   d) 70°N
   e) 60°N

14) The acute inter-limb angle between beds 2 and 4 is?
   a) 87°
   b) 81°
   c) 75°
   d) 68°
   e) 59°

15) A lineation has a pitch of 50°N on bed 6. What was the orientation of the lineation prior to folding?
   a) 130°
   b) 310°
   c) 230°
   d) 330°
   e) 250°

Name.....

16) Bed 7 is not folded but forms an angular unconformity above beds 1-6. What was the plunge of the fold axis prior to the deposition of bed 7?
   a) 35°→188°
   b) 49°→270°
   c) 15°→260°
   d) 28°→235°
   e) 52°→192°

Figure 5.

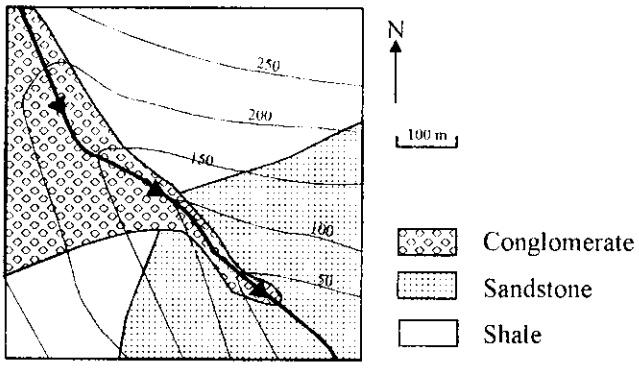



Figure 5 is a map depicting three different stratigraphic units. Examine the map carefully before answering questions 17-18.

17) Assuming that there has been no inversion of any strata, the order from oldest to youngest of the units shown in figure 5 is:
   a) Conglomerate, sandstone, shale
   b) Conglomerate, shale, sandstone
   c) Shale, sandstone, conglomerate
   d) Sandstone, conglomerate, shale
   e) Sandstone, shale, conglomerate

18) Two boundaries are shown on the map one between the sandstone and shale, the other between the conglomerate and the other two units. The intersection of these two boundaries is a line that plunges:
   a) 14.9°→206°
   b) 14.9°→026°
   c) 22.1°→210°
   d) 22.1°→030°
   e) 28.7°→015°

Name.....

Figure 6

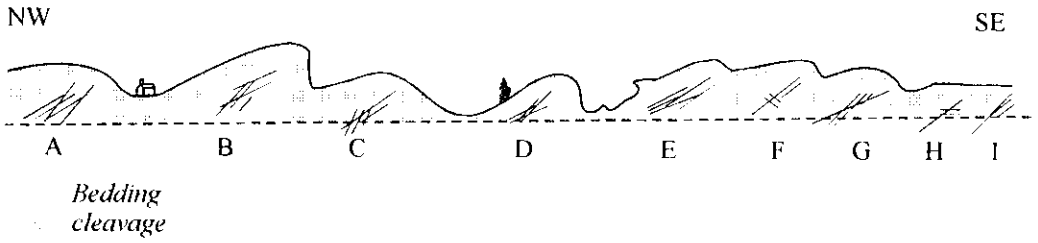
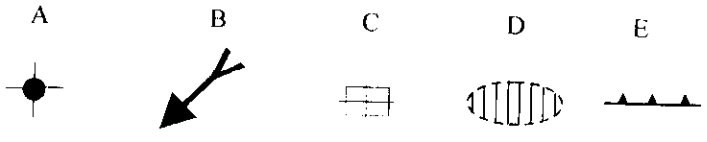



Figure 6 is a diagram of a road section showing the relationship between bedding and cleavages at outcrop in a sandstone unit. Study the section carefully before answering questions 19-20.

19) In which of the outcrops (A-I) shown in figure 6 are the beds inverted?
   a) A, B, C & E
   b) B, C, G & I
   c) B, C & G
   d) A, D, E, & F
   e) B, E, F, G & H

20) The folds that can be drawn from the bedding and cleavage data shown in figure 6 are best described as:
   a) Symmetrical, open synforms and antiforms
   b) Aymmetrical, tight synforms and antiforms
   c) Asymmetrical synforms and antiforms with a SE facing and parasitic folds
   d) Asymmetrical synforms and antiforms with a NW facing and parasitic folds
   e) Asymmetrical box folds

Figure 7




21) The map symbols shown in figure 7 are
   a) A= Horizontal bedding, B= Minor fold, C= Horizontal joint, D= Made ground, E= Normal fault
   b) A= Horizontal joints, B= Regional dip, C= Horizontal cleavage, D= Opencast area, E= Normal fault
   c) A= Horizontal cleavage, B= Younging direction, C= Horizontal joint, D= Landslip, E= Reverse fault
   d) A= Horizontal bedding, B= Minor fold, C= Horizontal cleavage, D= Opencast area, E= Lava flow
   e) A= Horizontal cleavage, B= Regional dip, C= Horizontal joint, D= Made ground, E= Reverse fault

Name.....

Figure 8

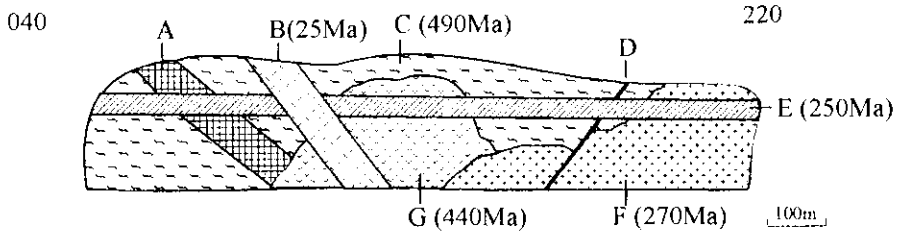
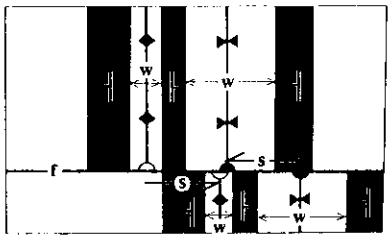



Figure 8 is a cross-section showing various units. The dates, in brackets, of certain units have been determined by radiometric dating methods. Study the diagram carefully before answering questions 22-23.

22) In what period was dyke A intruded?
   a) Cambrian
   b) Ordovician
   c) Silurian
   d) Devonian
   e) Carboniferous

23) In what period did the fault D move?
   a) Silurian
   b) Devonian
   c) Carboniferous
   d) Permian
   e) Triassic

Figure 9




24) Figure 9 is a map view of an area of folded stratum that has been cut by a fault and eroded. The displacement of the fault is:
   a) Sinistral strike-slip
   b) Dextral strike-slip
   c) Dip-slip, the northern section has been down-thrown
   d) Dip-slip, the southern section has been down-thrown
   e) Oblique slip

25) An outcrop at an elevation of 500m relative to sea level shows a fold hinge that plunges 30°→050°. The position of the fold hinge when plotted on a profile section 200m away from the outcrop towards 050° would be?
   a) 600m
   b) 500m
   c) 400m
   d) 300m
   e) 200m

Name.....

**Section B (25 marks)**

The map in this section depicts a mining area. The limestone found in this area, is host to sulphide minerals, many of which are economically viable. Study the map carefully before answering the following questions.

1) Give the dips and strikes of the following units
   a) Conglomerate
   b) Limestone/Shale
   c) F1
   d) F2
   e) F3

2) What type of fault is F1?

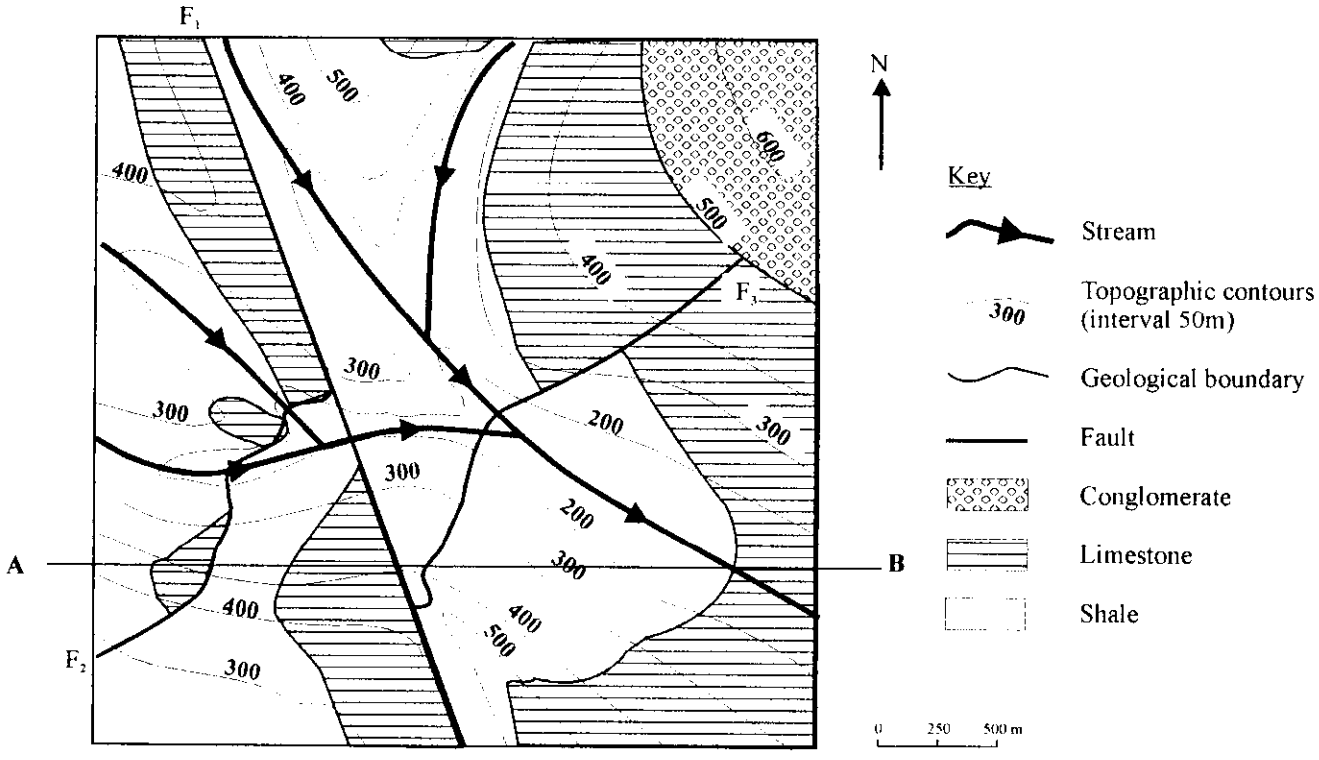
3) What types of fault are F2 and F3 (give the displacement in each case). What does this indicate about the relationship between F2 and F3?

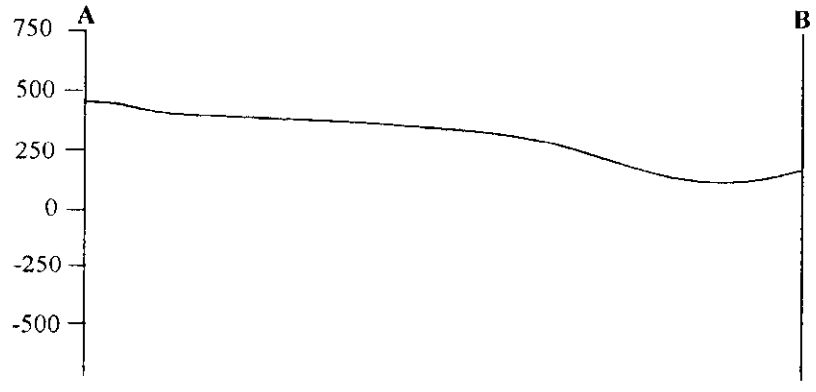
4) Draw an accurate cross-section from A-B using the topographic profile provided.

5) Environmentalists have run a successful campaign to prohibit mining in most of the area. The only area left to the miners is the area covered with the conglomerate. Indicate areas where they would find the limestone.

Name.....

Section B


F1
F2
F3
N
A
B
400
500
600
300
200
Key
Stream
Topographic contours (interval 50m)
Geological boundary
Fault
Conglomerate
Limestone
Shale
0
250
500 m


A
B
750
500
250
0
-250
-500