



GCE A LEVEL

A480U10-1

MONDAY, 6 JUNE 2022 - AFTERNOON

GEOLOGY – A LEVEL COMPONENT 1
Geological INVESTIGATIONS

2 hours 15 minutes plus your additional time allowance

Surname

First name(s)

Centre Number

Candidate Number

2

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- **the Resource Sheet**
- **SPECIMENS E, T and X**
- **geological equipment for testing specimens**
- **the Mineral Data Sheet**
- **a calculator**
- **a ruler**
- **a protractor**

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball-point pen or your usual method.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces on the previous page.

Answer ALL questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

(Turn over)

INFORMATION FOR CANDIDATES

This paper is in 2 sections, A and B.

Section A: 30 marks. Answer BOTH questions. You are advised to spend about 35 minutes on this section.

Section B: 75 marks. Answer ALL questions. You are advised to spend about 1 hour 40 minutes on this section.

The geology is NOT designed to represent any particular area.

The Mineral Data Sheet and MAP 1 and PHOTOGRAPHS 1, 2, 3 and 4 are provided on separate resource sheets.

Three specimens, E, T and X, are provided for use. The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in questions 2 and 7.

(Turn over)

SECTION A

Answer ALL questions.

- 1 FIGURE 1a opposite shows a metalliferous ore body, shaded red, associated with igneous activity.**

(Turn over)

TABLE 1 opposite contains information about some of the ore minerals found in this ore body.

Refer to **FIGURE 1a** and **TABLE 1**.

1 (a) (i) Describe the size and shape of the gabbro intrusion. [2 marks]

(ii) Suggest why the ore body is found at the base of the gabbro intrusion. [2 marks]

(Turn over)

1 (b) State ONE geophysical prospecting technique that could be used to investigate the size of the ore body.

Explain why your chosen technique is useful for this ore body. [3 marks]

Technique _____

Explanation _____

- 1 (c) **FIGURE 1b opposite is a map showing copper concentrations in soil in parts per million (ppm) in Area A on FIGURE 1a.**

Refer to FIGURE 1b.

- (i) **State which sampling method was used to collect the geochemical data shown in FIGURE 1b.**
TICK (✓) only ONE box. [1 mark]

Cluster sampling

Stratified sampling

Random sampling

Systematic sampling

- (ii) **Complete FIGURE 1b to show the isolines representing:**

- **50 ppm copper concentration in the soil**
- **100 ppm copper concentration in the soil.**

[2 marks]

(Turn over)

1 (c) (iii) Refer to FIGURES 1a and 1b. Account for the distribution of copper concentrations in the soil in Area A. [3 marks]

(Turn over)

1 (c) (iv) Evaluate the effectiveness of geochemical surveys in locating ore bodies. [3 marks]

| |
|----|
| |
| 16 |

2 **FIGURE 2a and FIGURE 2b** opposite show photographs of structures found in a sedimentary sequence.

TABLE 2 contains details of the beds found in the same sedimentary sequence.

TABLE 2

| Bed | Description |
|-------------------|--|
| 5 (top) | 50 cm of black laminated shale containing graptolites |
| 4 | 80 cm of fine-grained sandstone |
| 3 | 70 cm of medium-grained sandstone (FIGURE 2a) |
| 2 | 150 cm of sandstone, grain size is very coarse sand at the base grading to medium sand at the top (FIGURE 2b) |
| 1 (bottom) | 50 cm of black laminated shale, mostly formed of clay minerals and containing graptolites |

(Turn over)

2 (a) (i) Identify the sedimentary structures present in FIGURES 2a and 2b. [2 marks]

FIGURE 2a _____

FIGURE 2b _____

- (ii) Draw an arrow in each box next to FIGURES 2a and 2b to show the current directions at the time the sedimentary structures formed. [2 marks]**
- (iii) Draw a graphic log on FIGURE 2c opposite to represent the sedimentary sequence shown in TABLE 2. [4 marks]**

(Turn over)

SECTION B

Answer ALL questions.

3 Study MAP 1 on the Resource Sheet.

(a) SPECIMEN T was collected from within the MAP 1 area.

(i) Describe how you would determine the streak of SPECIMEN T. [1 mark]

(ii) State the streak of SPECIMEN T. [1 mark]

(Turn over)

3 (b) TABLE 3 shows the results that a student obtained when investigating the density of a sample of SPECIMEN T.

(i) Complete TABLE 3 by calculating the density of the sample. [1 mark]

TABLE 3

| Mass (g) | Volume (cm ³) | Density (g cm ⁻³) |
|----------|---------------------------|-------------------------------|
| 12.5 | 2.5 | • |

(Turn over)

- 3 (b)(ii) The results were obtained using a top pan balance that had a resolution of 0.1 g and a measuring cylinder that had a resolution of 0.25 cm³. Calculate the total percentage uncertainty created by using this equipment. Show your working. [2 marks]

Total percentage uncertainty = _____ %

(Turn over)

3 (c) **FIGURE 3** opposite is a mineral identification key.

State the name of SPECIMEN T using FIGURE 3. You should use some of the equipment provided. [1 mark]

SPECIMEN T _____

| |
|----------|
| |
| 6 |

4 SPECIMEN E was collected from ROCK UNIT E on MAP 1.

(a) Draw the texture of SPECIMEN E in FIGURE 4.

Add a scale. [4 marks]

(b) State, giving TWO reasons, the name of SPECIMEN E. [3 marks]

Name of SPECIMEN E

1. _____

2. _____

| |
|---|
| |
| 7 |

5 PHOTOGRAPH 1, on the Resource Sheet, shows a sample of ROCK UNIT F collected from LOCALITY I on MAP 1. SPECIMEN X was collected from ROCK UNIT F at LOCALITY II on MAP 1.

(a) Complete TABLE 4 opposite to show the characteristics of ROCK UNIT F and SPECIMEN X. You may wish to refer to the Mineral Data Sheet and use the equipment provided.

[6 marks]

- 5 (b) Complete TABLE 5 opposite to show the angle and direction of dip at LOCALITIES I and II on MAP 1. [2 marks]

- (c) Suggest why there is a difference in the dip of ROCK UNIT F at these two localities. [2 marks]

| |
|----|
| |
| 10 |

6 A student investigated a model of how the temperature of a pluton might affect the width of a metamorphic aureole around a pluton. **FIGURE 6** opposite is a diagram of the equipment used.

Refer to FIGURE 6.

(a) For the student's investigation state:

(i) The independent variable [1 mark]

(ii) TWO variables that need to be controlled (kept the same) [2 marks]

1.

2.

6 (b) State TWO steps that the student has taken to maximise the transfer of thermal energy from the hot water to the sand. [2 marks]

1. _____

2. _____

| |
|---|
| |
| 5 |

7 PHOTOGRAPH 2 on the Resource Sheet shows an exposure of ROCK UNIT H at LOCALITY III on MAP 1. PHOTOGRAPH 3 on the Resource Sheet shows a close-up of a bedding plane surface within ROCK UNIT H at LOCALITY III on MAP 1.

Plan a field investigation to determine the past geological processes that have happened at LOCALITY III in PHOTOGRAPHS 2 and 3.

For each of the observations you would make:

- state the observation**
- give reasons for the observation**
- describe the technique you would use to make the observation.**

You may wish to use an annotated diagram(s).

[9 QER]

(Turn over)

8 PHOTOGRAPH 4 on the Resource Sheet is a photomicrograph of ROCK UNIT B on MAP 1.

Refer to PHOTOGRAPH 4 and MAP 1.

(a) Describe the outcrop pattern of ROCK UNIT B on MAP 1. [2 marks]

(b) State the name of the rock forming ROCK UNIT B. [1 mark]

(Turn over)

8 (c) A student concluded that

“ROCK UNIT B is the product of a LAVA FLOW”.

Evaluate this statement using evidence from PHOTOGRAPH 4 and MAP 1. [3 marks]

| |
|---|
| |
| 6 |

- 9 MAP 2 opposite shows an area of MAP 1.
The key for the rock units is the same as for
MAP 1.
- (a) On MAP 2 clearly mark and label the position
of TWO fold axial plane traces using the
symbols in the key. [2 marks]

9 (b) **FAULT F2 dips at 75° to the North.
State the type of fault (normal, reverse, thrust or strike-slip) represented by FAULT F2.
Explain the evidence from MAP 1 that has enabled you to make this conclusion.**

[4 marks]

Fault type _____

Explanation _____

| |
|---|
| |
| 6 |

(Turn over)

10 (a) The topographic profile opposite was taken along the line Y–Z on MAP 1.

Complete the geological cross-section along this line using MAP 1.

- **Draw the rock units. Use similar ornament or letters for those used on MAP 1**
- **Draw and label any FOLD AXES**
- **Project the rock units and structures above the ground surface to illustrate any cross-cutting relationships. [14 marks]**

(Turn over)

- 11 A resources company is dredging gravel from LOCALITIES IV and V on MAP 1. TABLE 7 shows information about the clast lithology of a sample of 100 clasts collected from LOCALITIES IV and V. FIGURE 11 opposite shows two box and whisker plots to show the variation in clast size at LOCALITIES IV and V.

TABLE 7

| CLAST LITHOLOGY | LOCALITY IV | LOCALITY V |
|----------------------------------|--------------------|-------------------|
| igneous granitic | 35 | 5 |
| igneous basaltic | 5 | 27 |
| sedimentary carbonate | 33 | 9 |
| sedimentary non-carbonate | 21 | 54 |
| metamorphic | 6 | 5 |
| Total | 100 | 100 |

(Turn over)

11 (a) Refer to TABLE 7. The resources company intended to test the hypothesis that

“the clasts at the two localities were derived from different sources”.

Suggest the most suitable statistical test to use by ticking ONE of the boxes below. Give a reason for your answer. TICK (✓) only ONE box. [2 marks]

Spearman’s Rank

Chi-squared

Mann-Whitney U test

| Question number | ADDITIONAL PAGE, IF REQUIRED. WRITE THE QUESTION NUMBER(S) IN THE LEFT-HAND MARGIN. |
|------------------------|--|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

ACKNOWLEDGEMENTS

FIGURE 2a <https://www.flickr.com/photos/royluck/5203527666>

FIGURE 2b [https://www.researchgate.net/figure/](https://www.researchgate.net/figure/Origin-of-)
Origin-of-

| For Examiner's use only | | | |
|--------------------------------|-----------------|---------------------|---------------------|
| | Question | Maximum Mark | Mark Awarded |
| Section A | 1 | 16 | |
| | 2 | 14 | |
| Section B | 3 | 6 | |
| | 4 | 7 | |
| | 5 | 10 | |
| | 6 | 5 | |
| | 7 | 9 | |
| | 8 | 6 | |
| | 9 | 6 | |
| | 10 | 18 | |
| | 11 | 8 | |
| | | Total | 105 |

FIGURE 1a

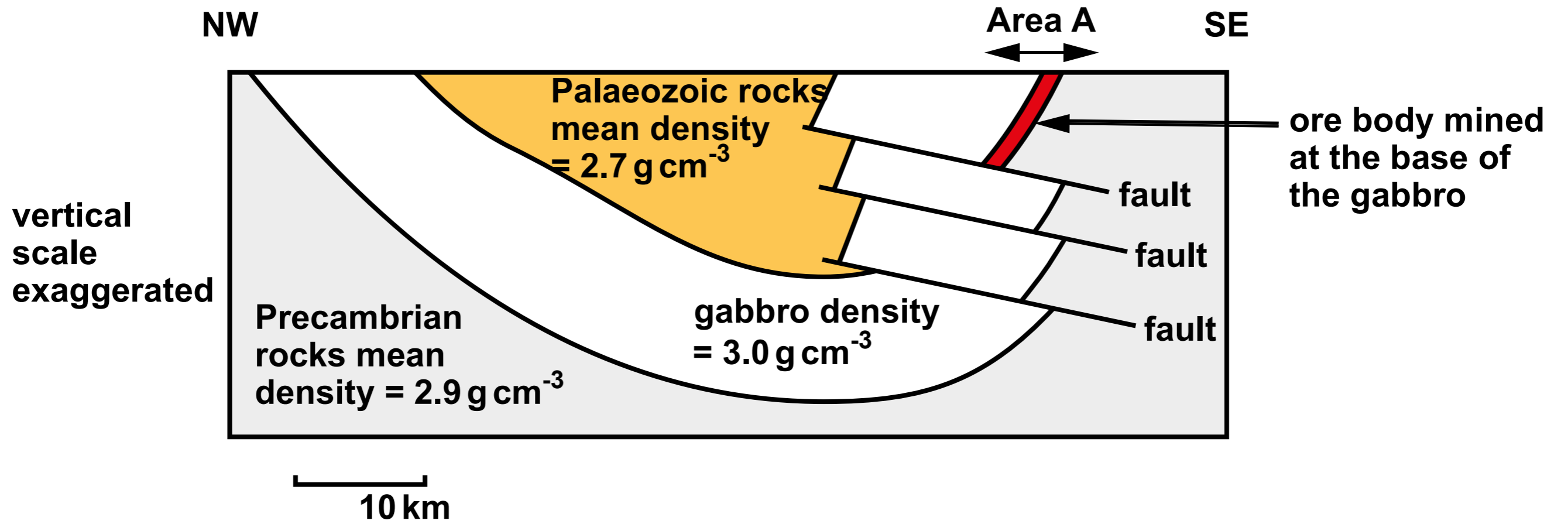


TABLE 1

| Mineral | Composition | Density (g cm⁻³) |
|---------------------|---|------------------------------------|
| pentlandite | (Fe,Ni)₉S₈ | 4.8 |
| chalcopyrite | CuFeS₂ | 4.2 |
| pyrrhotite | FeS | 4.6 |

FIGURE 1b

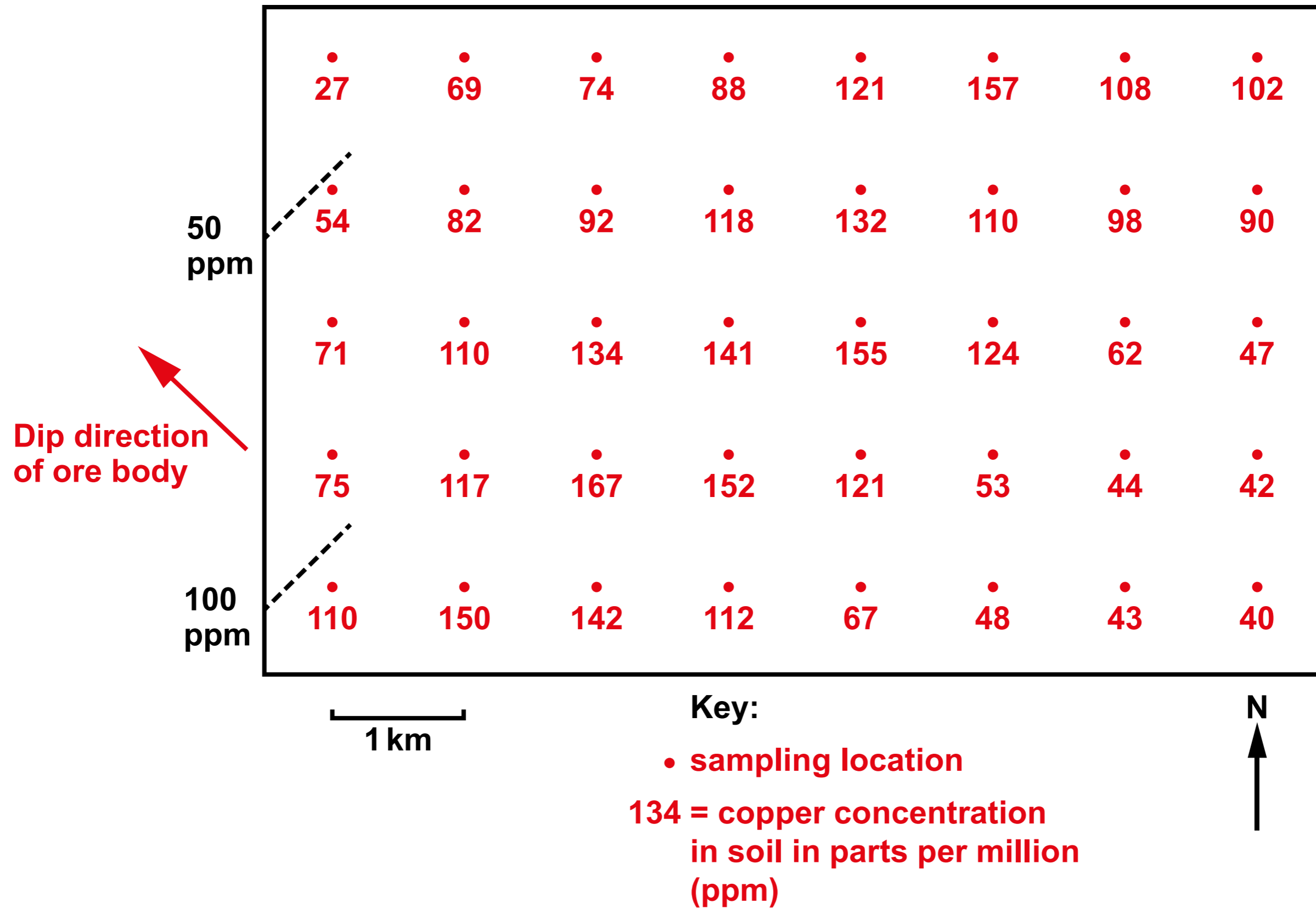


FIGURE 2c

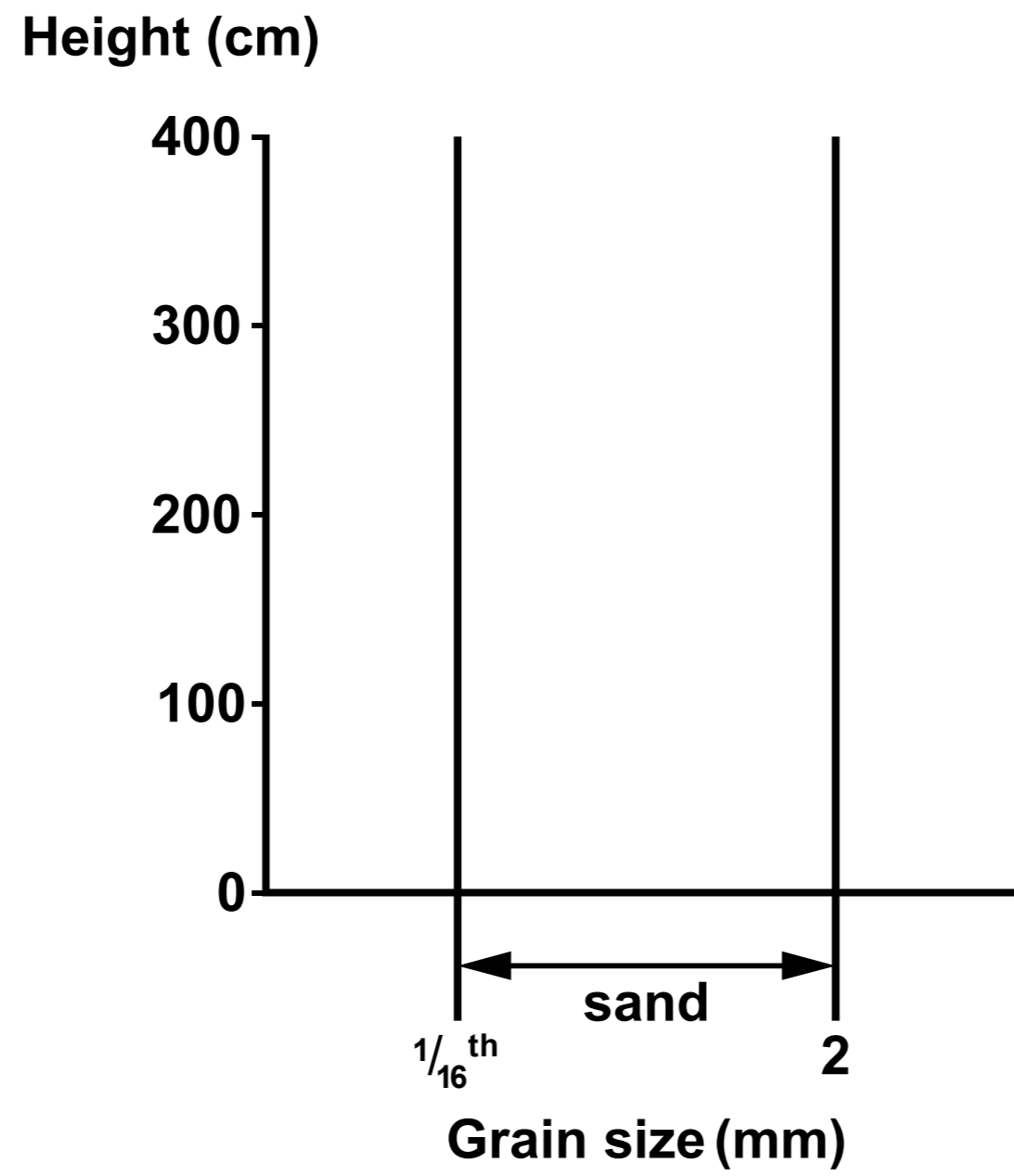


FIGURE 2a

Photograph of part of bed 3



5 cm



FIGURE 2b

Photograph of part of bed 2



30 cm

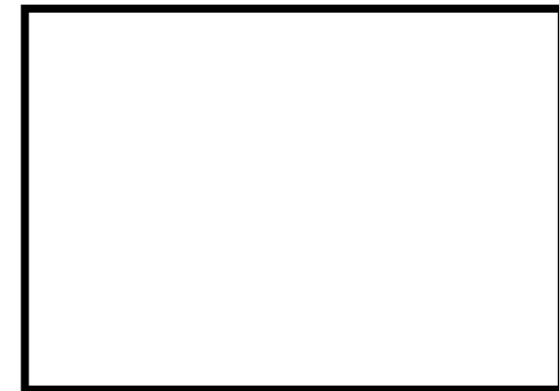


FIGURE 3

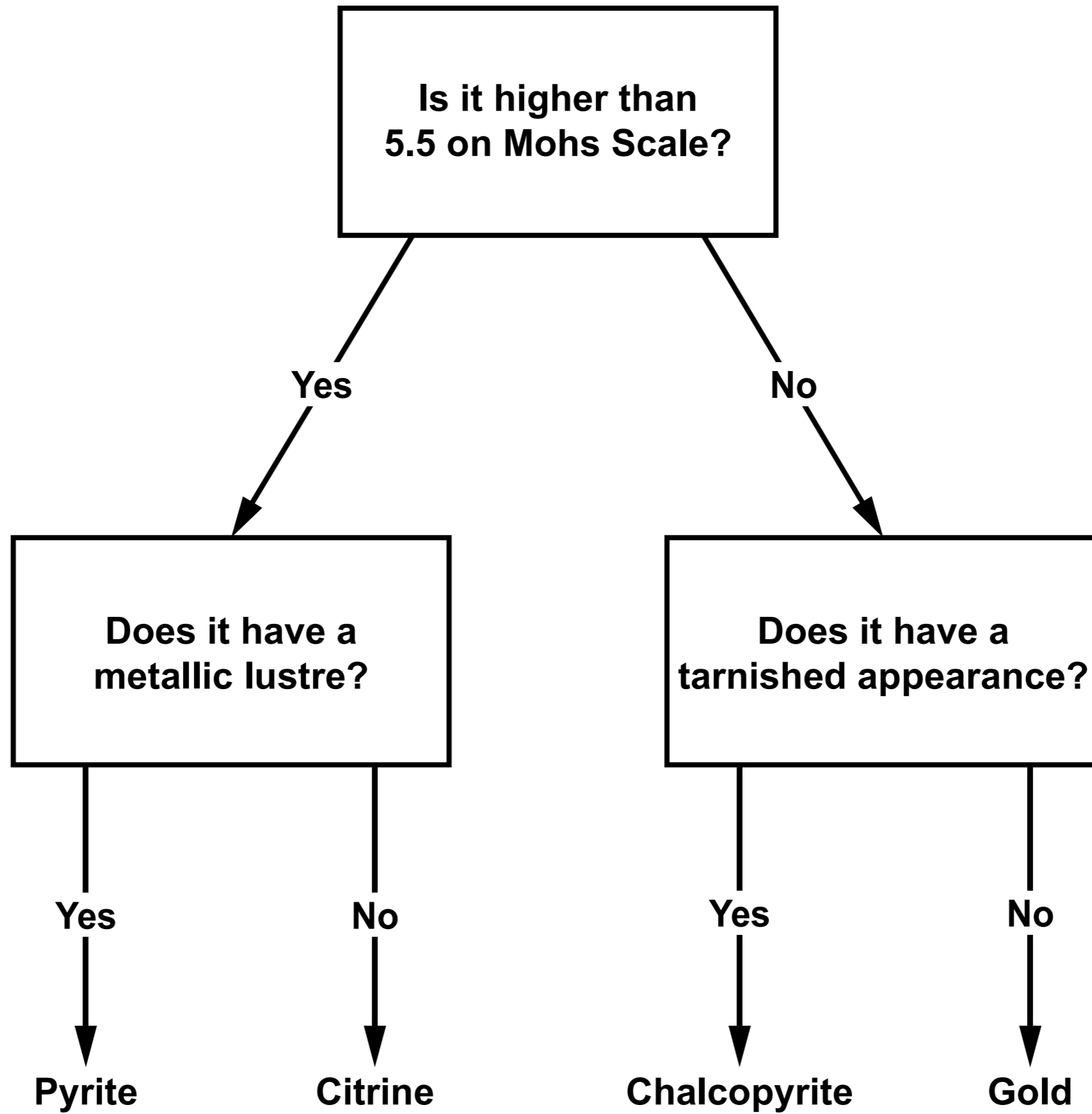


FIGURE 4

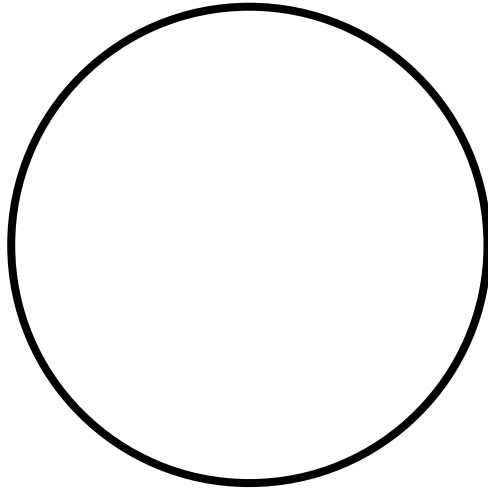


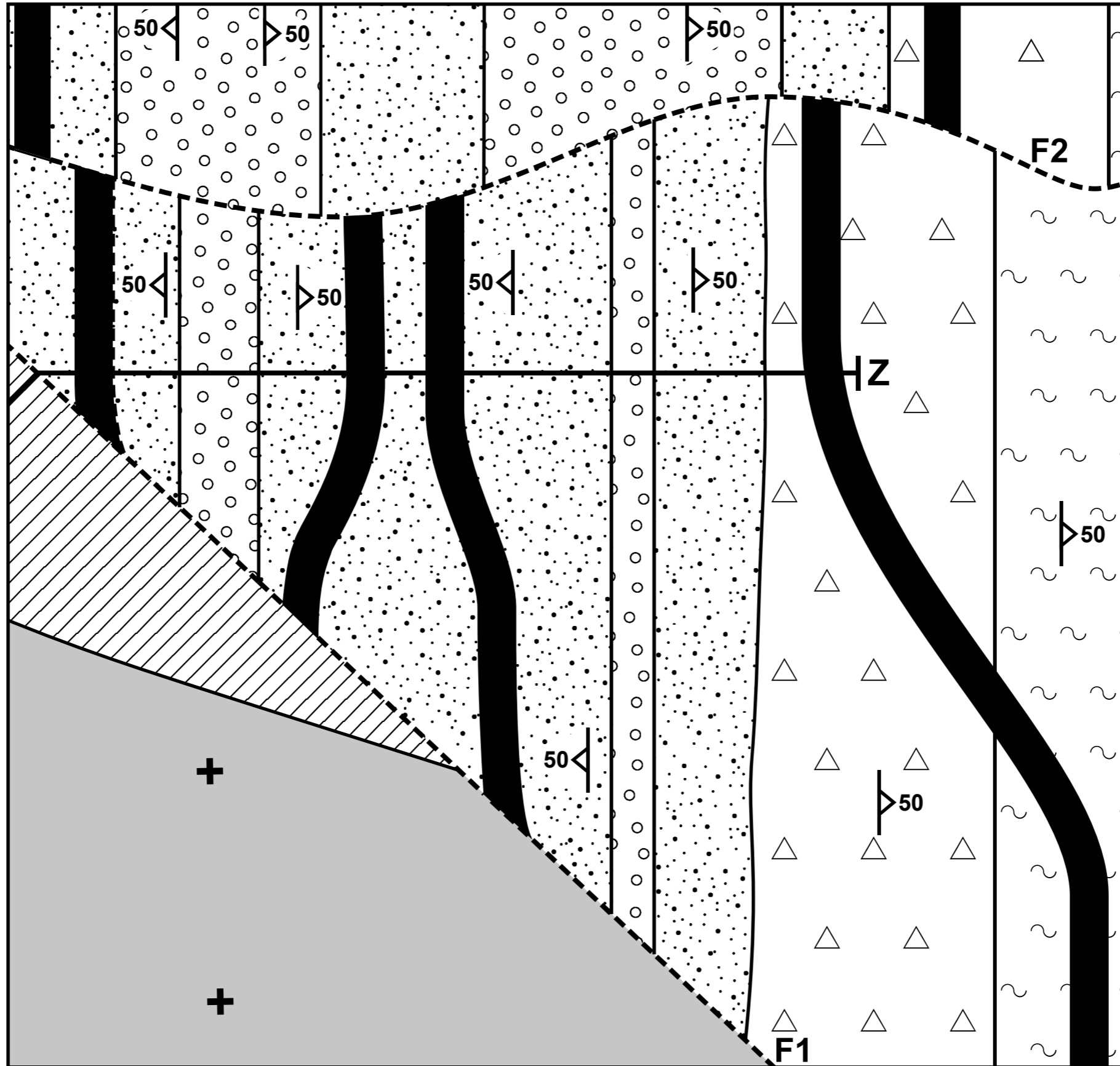
TABLE 4

| | PHOTOGRAPH 1 | SPECIMEN X |
|---|---|--|
| Crystalline Texture (yes / no) | <ul style="list-style-type: none">• | <ul style="list-style-type: none">• |
| Mean size of crystals/grains (mm) | <ul style="list-style-type: none">• | 0.5 |
| Composition | Calcite | Diagnostic test and result <ul style="list-style-type: none">• Conclusion/composition <ul style="list-style-type: none">• |
| Name of Rock | <ul style="list-style-type: none">• | <ul style="list-style-type: none">• |

TABLE 5

| | LOCALITY I | LOCALITY II |
|-------------------------|-------------------|--------------------|
| Angle of dip | • ◦ | • ◦ |
| Direction of dip | | • ◦ |

MAP 2



Key:

- ◆ antiform
- ▼ synform

Question 10 (a)

Metres above sea-level

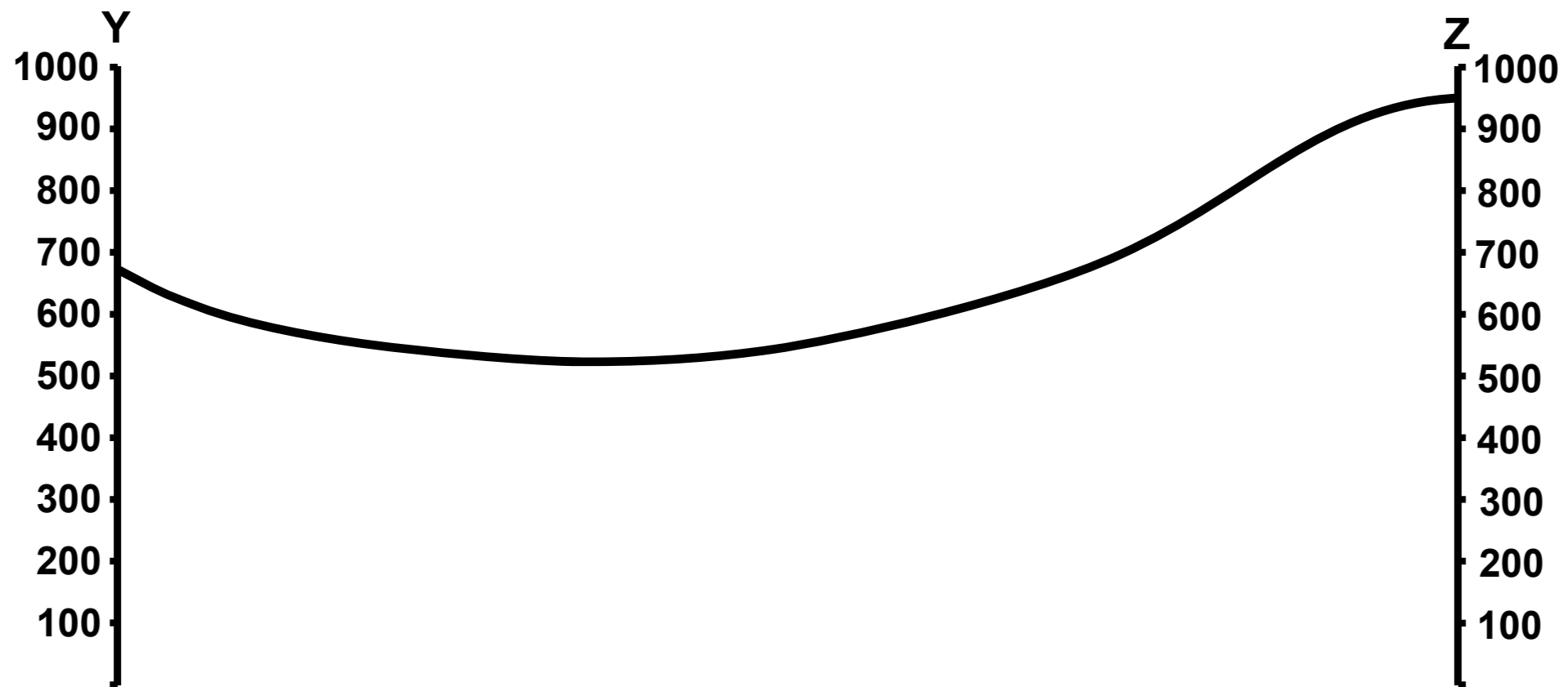


FIGURE 11

