



GCE AS

B480U20-1

MONDAY, 22 MAY 2023 – MORNING

**GEOLOGY – AS COMPONENT 2
FOUNDATION GEOLOGY**

1 hour 30 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 Mineral Data Sheet**
- **a calculator**
- **a ruler.**

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.

INFORMATION FOR CANDIDATES

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 6.

(Turn over)

Answer ALL questions.

- 1 The Earth is composed of a variety of different elements which can be classified using the Goldschmidt classification system.

TABLE 1

Lithophile	•
Siderophile	•
Atmophile	•

- (a) Complete TABLE 1 by matching THREE of the following Earth layers to their most likely corresponding Goldschmidt classifications.

[2 marks]

CORE

HYDROSPHERE

CRUST

MANTLE

ATMOSPHERE

(Turn over)

- 1 (b) (i) Using the following information, calculate the volume of the whole Earth assuming that it is a sphere. Show your working and write your answer in standard form. [3 marks]

$$r = \text{Earth radius} = 6371 \text{ km}$$

$$\pi = 3.14$$

$$\text{Volume of a sphere} = \frac{4}{3} \pi r^3$$

1 (b) (ii) Using your answer to question (b)(i) and the information below, calculate the mean density of the whole Earth. Show your working.

[2 marks]

Earth mass = 5.972×10^{24} kg

(Turn over)

- 1 (c) TABLE 2 shows the density of the Earth's crust and mantle.

TABLE 2

Earth layer	Density (g cm^{-3})
Continental crust	2.7
Oceanic crust	3.0
Mantle	4.5

The whole Earth has a density greater than 4.5gcm^{-3} .
With reference to the data in TABLE 2 only, explain how this can be used to support the theory that the Earth has an iron/nickel core. [3 marks]

10

(Turn over)

2 FIGURE 2a opposite is a graph showing a number of different rock forming conditions.

(a) State the rock type (igneous, sedimentary, metamorphic) forming at location G on FIGURE 2a.

[1 mark]

**2 (b) FIGURE 2b opposite shows sedimentary rock S.
In FIGURE 2c draw the texture of the rock that
would be formed if sedimentary rock S is exposed
to the conditions at location H on FIGURE 2a.**

[3 marks]

(Turn over)

2 (d) (i) James Hutton was the first to develop the principle of uniformitarianism.

State what is meant by uniformitarianism.

[1 mark]

(ii) James Hutton also developed the concept of the rock cycle which involves the transfer of energy. State the internal and external energy sources which drive the rock cycle. [2 marks]

Internal: _____

External: _____

(Turn over)

3 FIGURE 3a opposite shows different settings for the generation of magma. FIGURE 3b opposite shows the geotherm and melting point temperatures for peridotite, obtained by laboratory experiments.

(a) State the type of plate boundaries where volcano A and volcano B are formed on FIGURE 3a.

[2 marks]

Volcano A _____

Volcano B _____

(b) Location X is in the asthenosphere. Using FIGURE 3b state the physical state (solid, liquid, gas) of the asthenosphere at location X. [1 mark]

(Turn over)

3 (c) (i) Explain the process that enables magma to be generated beneath volcano A. [3 marks]

(ii) State the composition of lava most commonly erupted from volcano A and volcano B. [2 marks]

Volcano A _____

Volcano B _____

(Turn over)

3 (d) FIGURE 3c opposite shows a volcanic rock.

(i) Describe the texture of the rock shown in FIGURE 3c. [3 marks]

4 FIGURE 4a opposite shows fossil L and FIGURE 4b opposite shows fossil M (an ammonite).

Refer to FIGURE 4a and FIGURE 4b.

(a) (i) State the name of feature D in FIGURE 4a.

[1 mark]

(ii) State the type of fossil cephalopod shown in FIGURE 4a. Give a reason for your answer.

[2 marks]

(Turn over)

4 (a) (iii) Draw, in the box below, a diagram to show how feature D would appear between points X and Y in fossil M (an ammonite) in FIGURE 4b.

[2 marks]



(iv) Explain how fossil M has been preserved. Give a reason for your answer. You may wish to refer to the Mineral Data Sheet. [3 marks]

(Turn over)

4 (b) Fossils L and M were observed at two of three locations shown on the geological map in FIGURE 4c opposite.

(i) Fossils L and M can be used as zone fossils. Explain what is meant by the term zone fossil. [1 mark]

5 FIGURE 5 opposite is a partially completed diagram showing variations of magnetic inclination at different latitudes around the Earth.

- (a) Complete FIGURE 5 by drawing an arrow in FOUR circles to show the variation in magnetic inclination from the North Pole to the South Pole. [3 marks]
- (b) TABLE 3 shows magnetic inclination data of lavas erupted during the 2016 Cotopaxi volcanic eruption in Ecuador and of lavas erupted in India over time.

TABLE 3

Sample Number	Cotopaxi magnetic inclination (°)	India magnetic inclination (°)
1	1	-20
2	2	-30
3	1	10
4	-1	20
5	1.5	15
6	-0.5	12
7	1.5	1.5
8	2	2
9	-0.5	1
10	1.5	-15
11	1	19
12	2.5	0.5
MEAN	•	1.3

(Turn over)

5 (b) (i) Complete TABLE 3 on the previous page by calculating the mean magnetic inclination for the Cotopaxi volcano. Show your working.

[2 marks]

(ii) Explain how the lavas erupted during the Cotopaxi eruption have preserved magnetic inclination data.

[3 marks]

(Turn over)

5 (b) (iii) The formula below can be used to calculate the latitude of the Cotopaxi volcano.

$$\tan \lambda = \frac{\tan L}{2}$$

λ = latitude of Cotopaxi

L = mean magnetic inclination

Calculate the latitude of the Cotopaxi volcano.
Show your working. [3 marks]

o

(Turn over)

- 5 (c) TABLE 4 shows the magnetic inclination data of lavas erupted in India over time and calculations required to determine standard deviation.

TABLE 4

Sample number	Magnetic inclination ($^{\circ}$)	$x-\bar{x}$	$(x-\bar{x})^2$
1	-20	-21.3	453.7
2	-30	-31.3	•
3	10	•	75.7
4	20	18.7	349.7
5	15	13.7	187.7
6	12	10.7	114.5
7	1.5	0.2	•
8	2	0.7	0.49
9	1	-0.3	0.09
10	-15	•	265.7
11	19	17.7	•
12	0.5	-0.8	0.64
	MEAN INCLINATION		$\Sigma(x-\bar{x})^2$
	1.3		2741.26

Positive magnetic inclination formed in the northern hemisphere, negative magnetic inclination formed in the southern hemisphere.

- (i) Complete TABLE 4 by inserting the FIVE missing values. [3 marks]

(Turn over)

5 (c) (ii) Using the formula, complete TABLE 5 by calculating the standard deviation for the data in TABLE 4. Show your working. [2 marks]

SD = standard deviation

n = sample size

$$\sum (x-\bar{x})^2 = 2741.26 \quad \text{SD} = \sqrt{\frac{\sum (x-\bar{x})^2}{n}}$$

TABLE 5

	Cotopaxi	India
Standard deviation	1.11	•

(Turn over)

5 (c) (iii) The palaeomagnetic data sets in TABLE 3 have similar means. Explain why the standard deviation of the palaeomagnetic data for India is so different to Cotopaxi. [3 marks]

19

6 **FIGURE 6** opposite is a geological map.

Refer to FIGURE 6.

(a) **Draw on FIGURE 6 the axial plane trace of a fold using the correct symbol. [1 mark]**

(b) **A student stated that structure A is a dyke. Give TWO reasons to support this statement.**

[2 marks]

1 _____

2 _____

6 (c) Fault F crops out in an area of varying topography. Using the evidence from FIGURE 6, tick (✓) ONE box which BEST identifies the type of fault shown by Fault F. Give reasons for your answer.

[4 marks]

THRUST

NORMAL

STRIKE-SLIP

REVERSE

DIP-SLIP

(Turn over)

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

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

ACKNOWLEDGEMENTS

FIGURE 2e – https://www.sandatlas.org/wp-content/uploads/1709-09.08.15_4-https://www.geologysuperstore.com/media/catalog/product/cache/1/image/9df78eab33525d08d6e5fb8d27136e95/c/h/https://i.pinimg.com/originals/71/a6/19/71a61976c518a0779708434faeab8fd2.jpg

FIGURE 3c – <https://geology.com/rocks/tuff.shtml>

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	10	
2	17	
3	15	
4	13	
5	19	
6	16	
Total	90	

FIGURE 2a

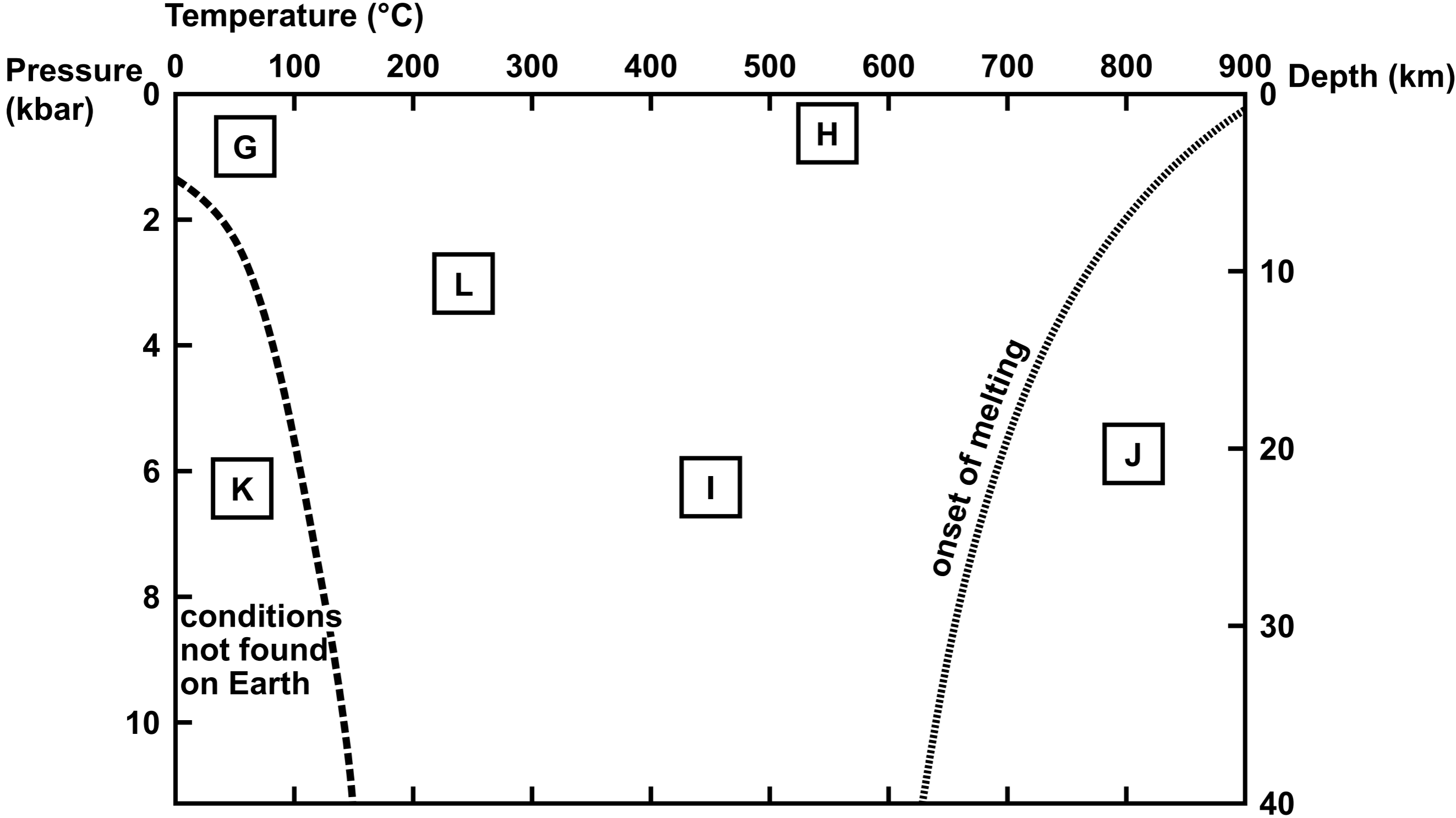
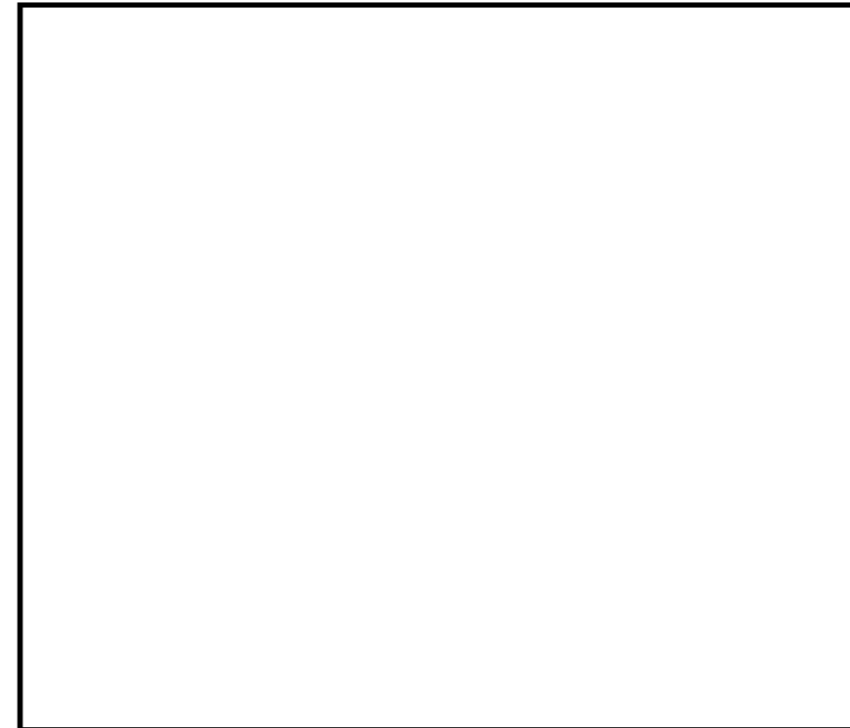


FIGURE 2b



FIGURE 2c



0 1
mm

FIGURE 2d

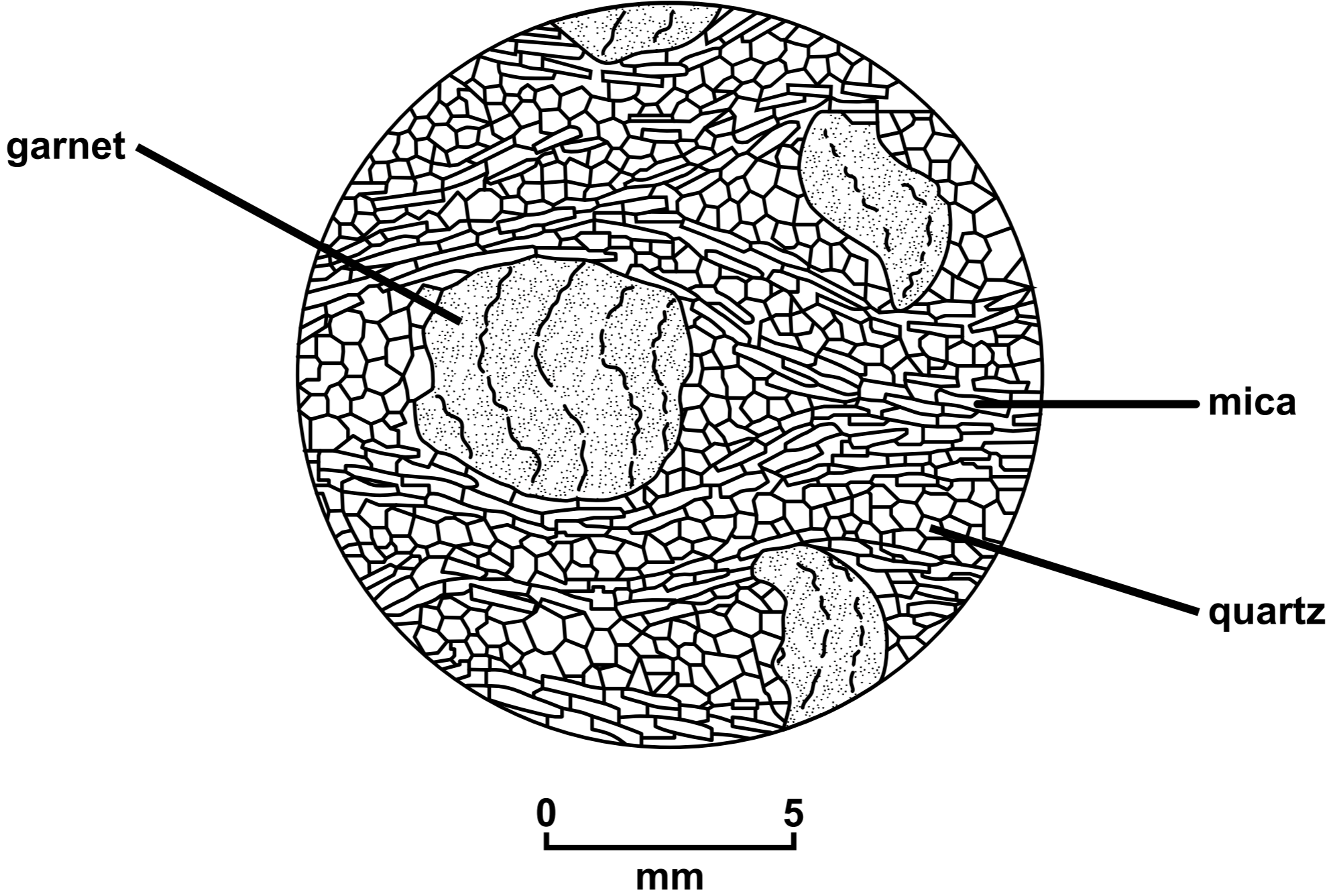


FIGURE 2e

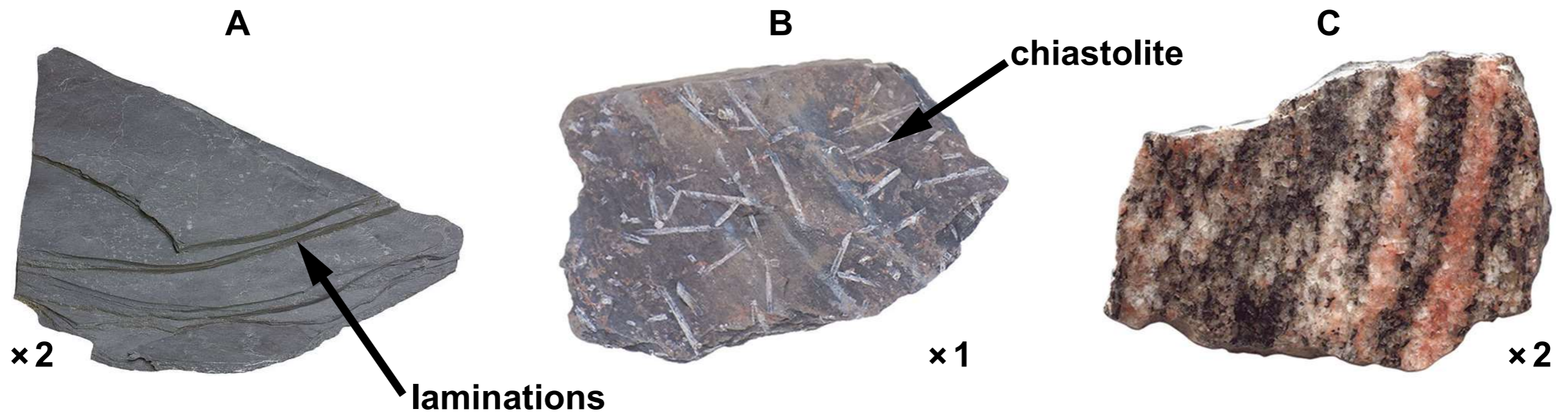


FIGURE 3a

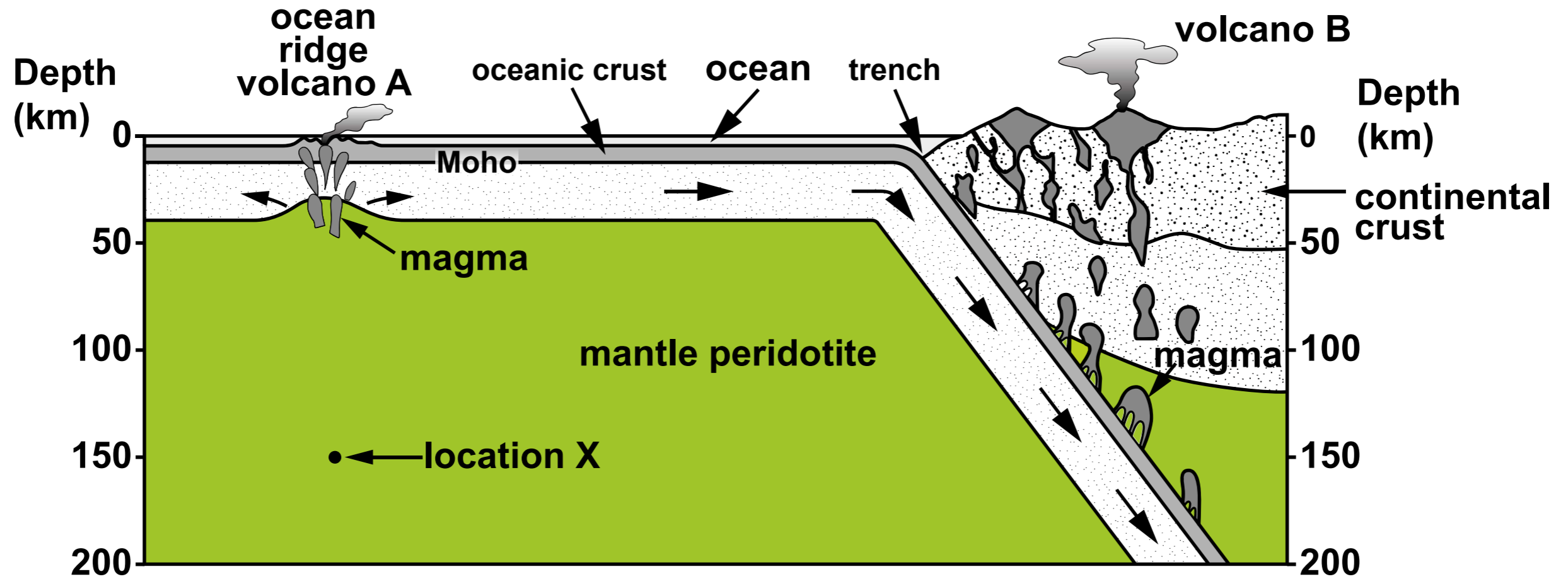


Figure 3b

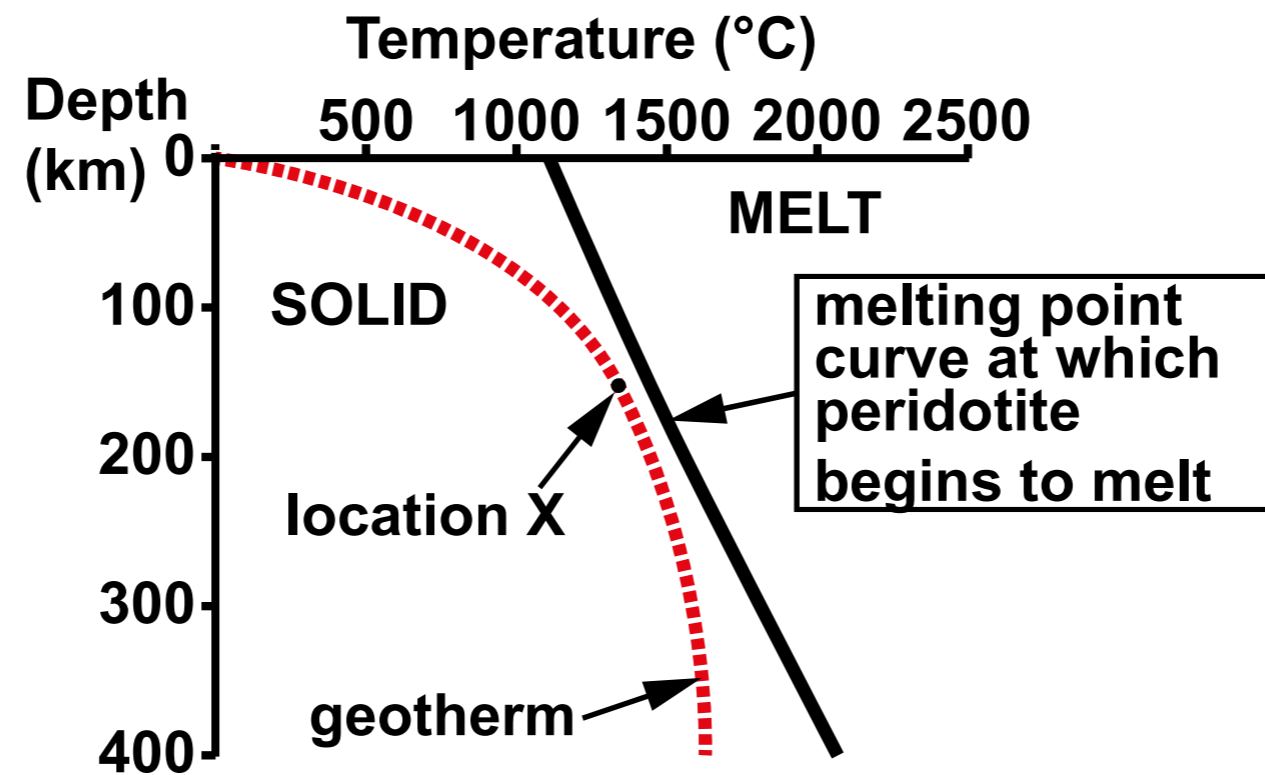
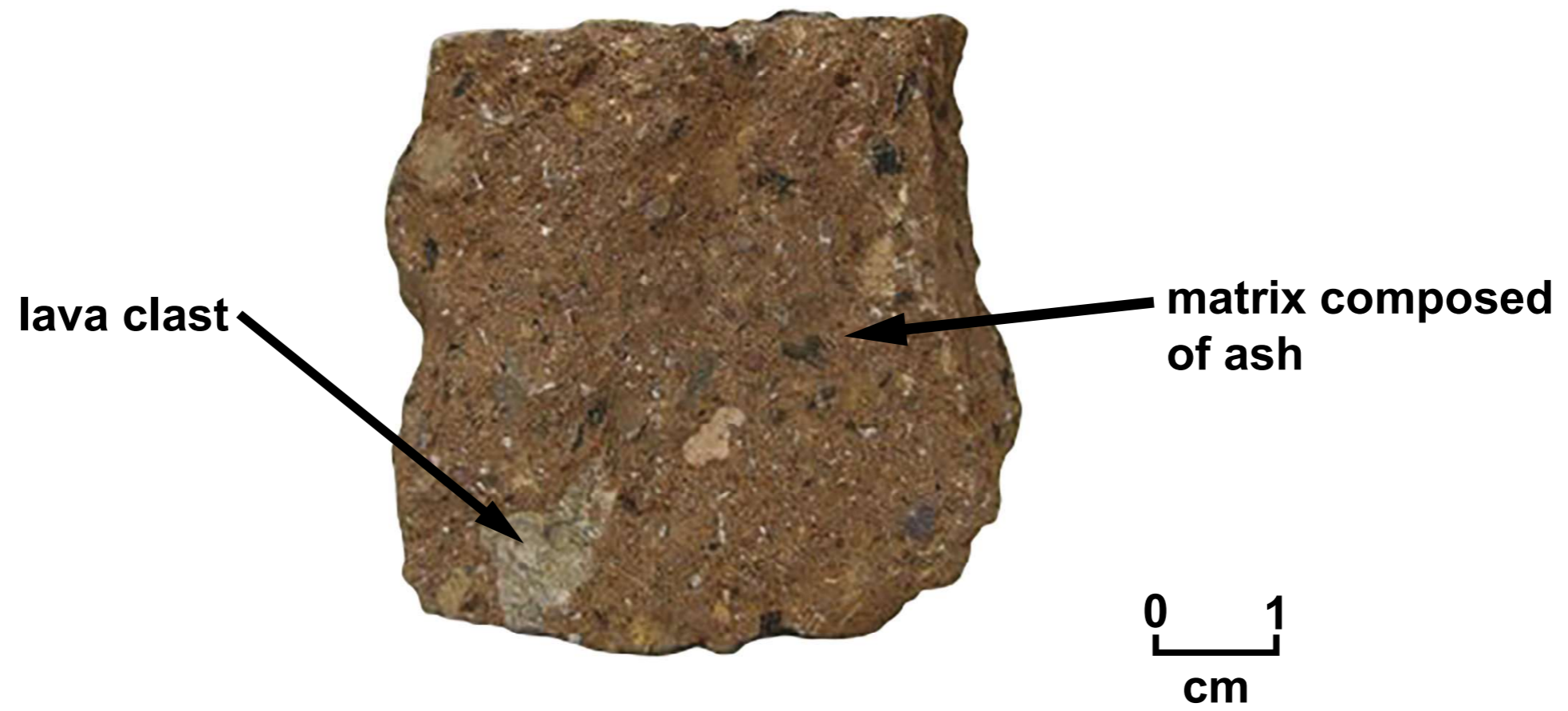


FIGURE 3c



X



Y

FIGURE 4a

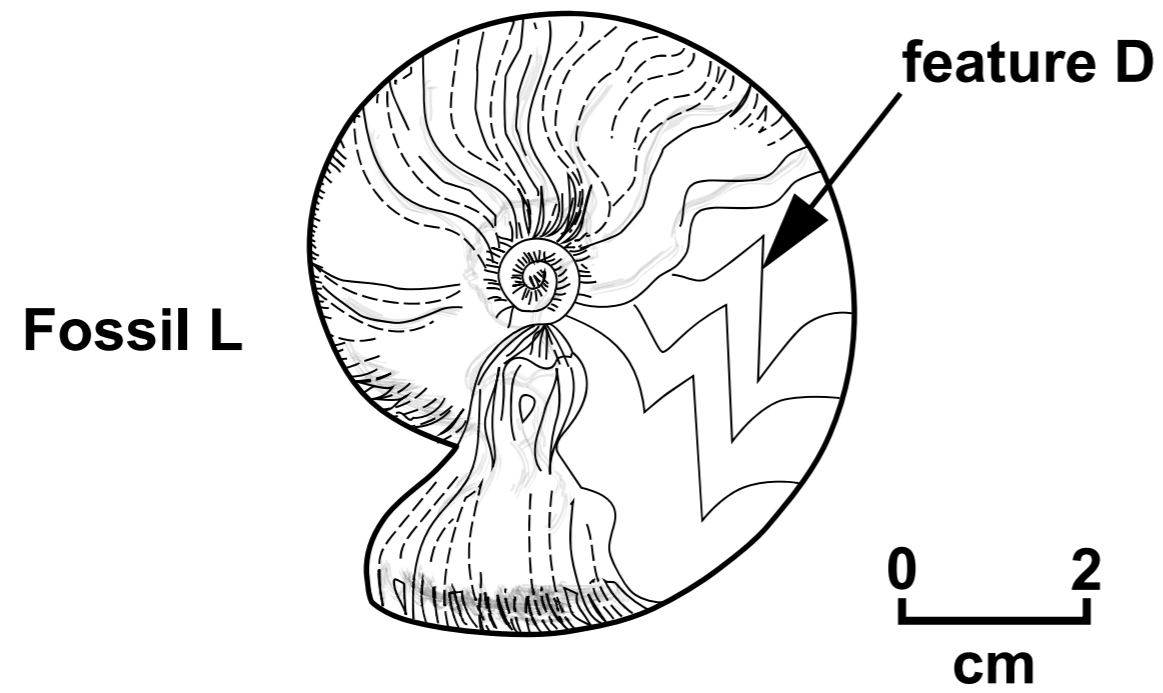


FIGURE 4b

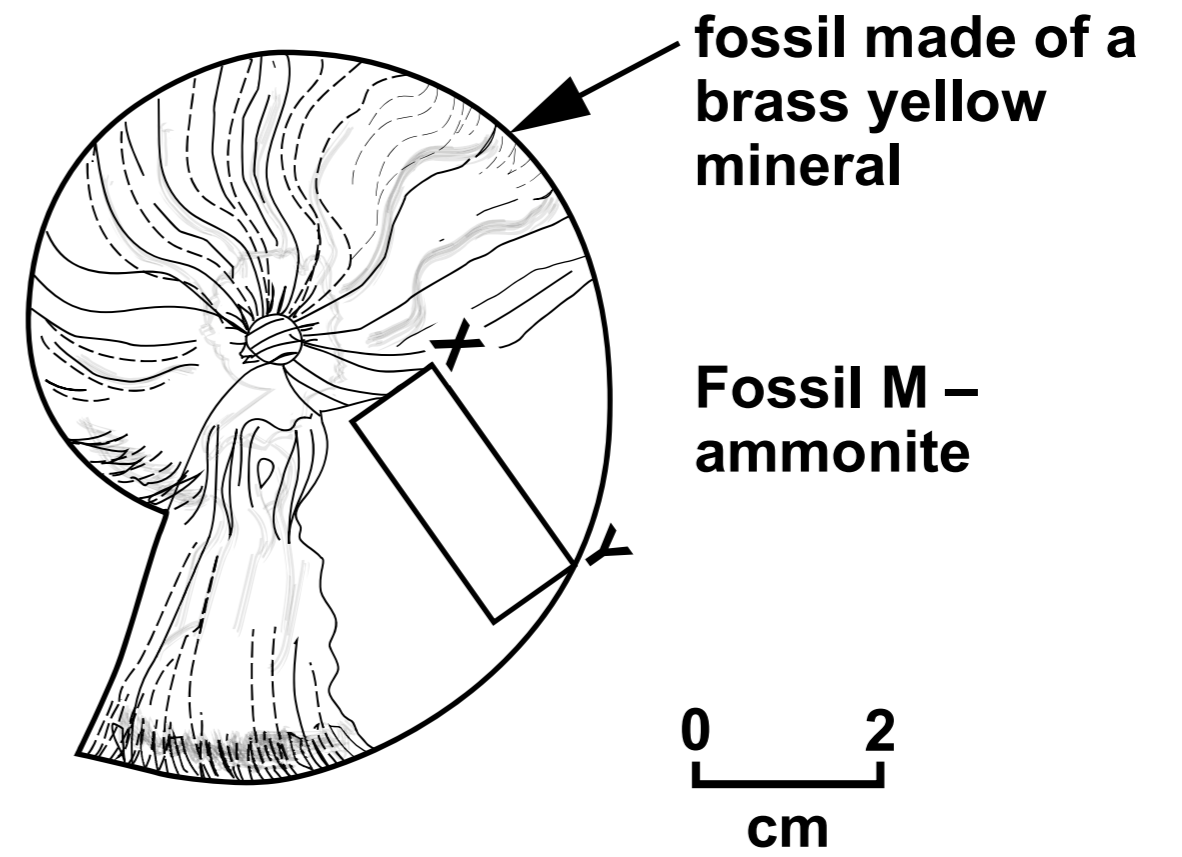


FIGURE 4c

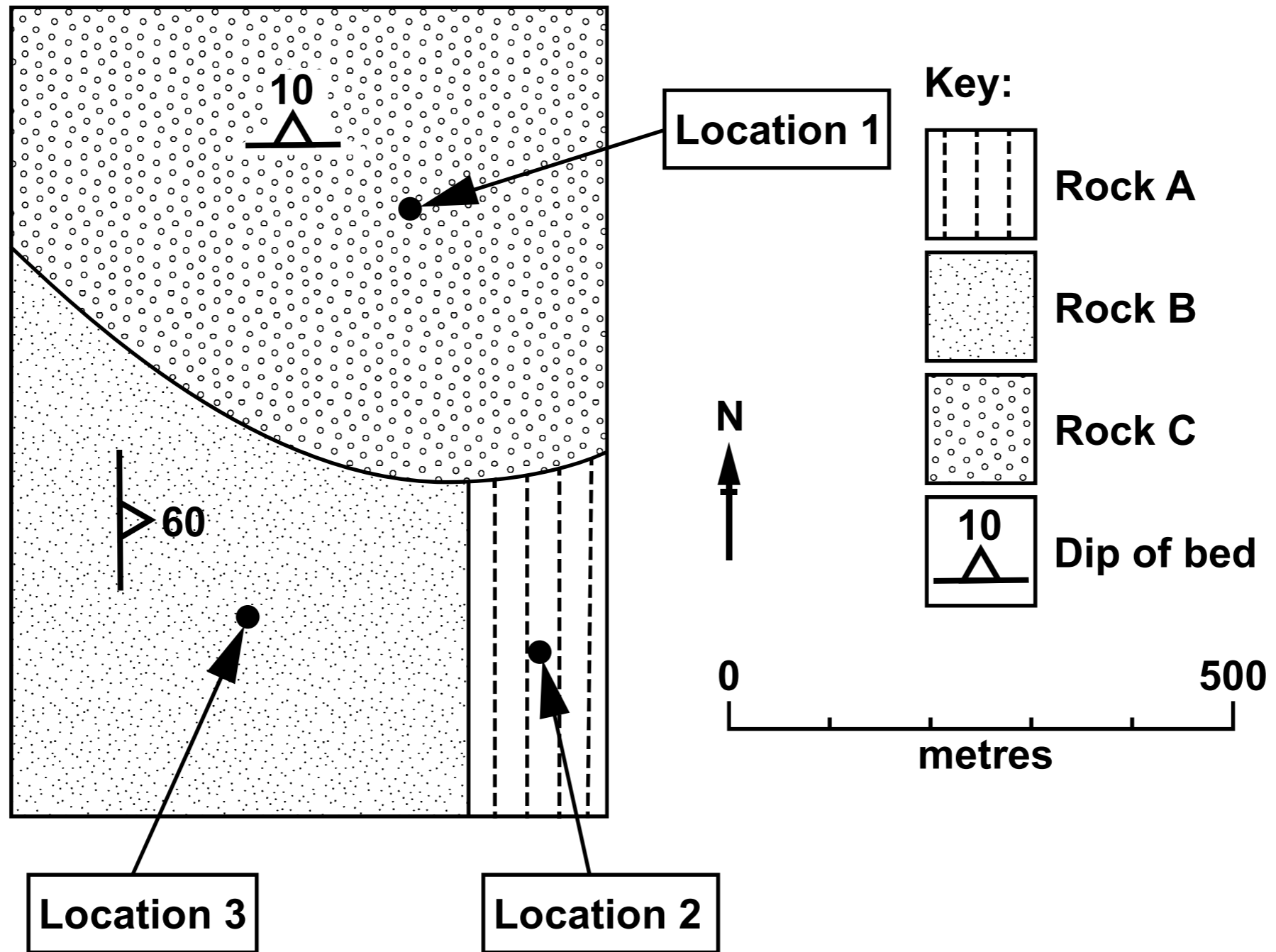


FIGURE 5

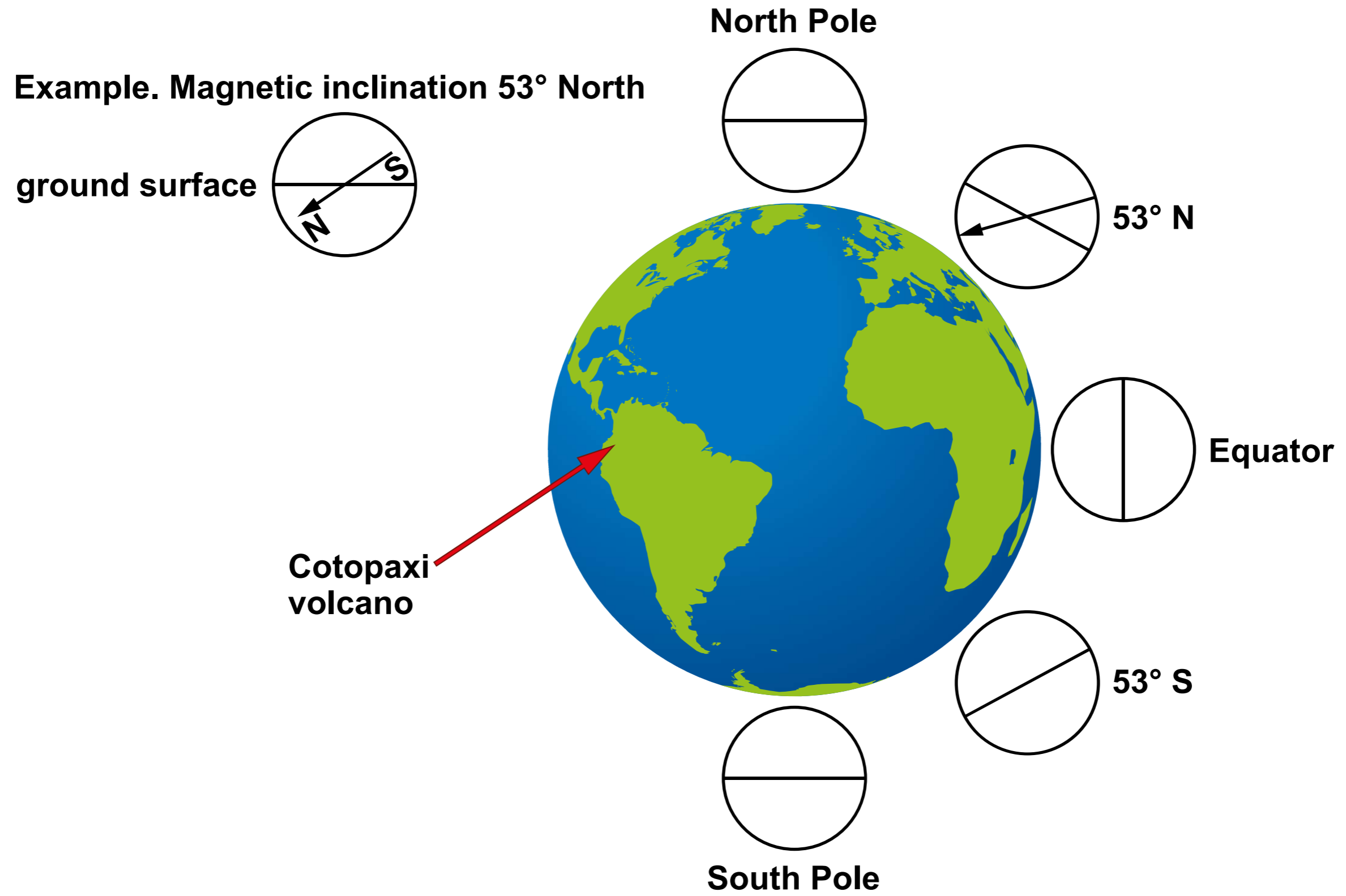
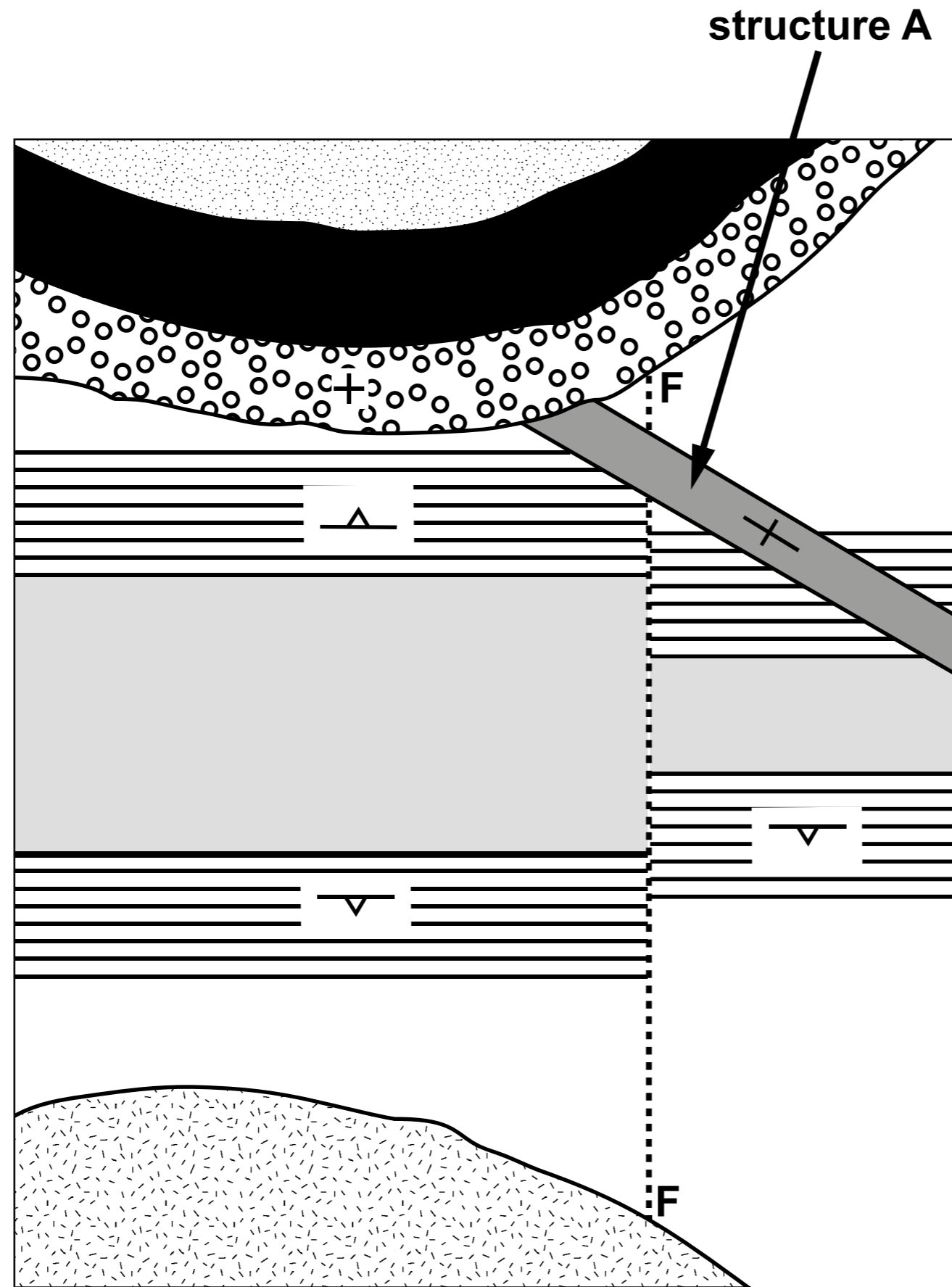
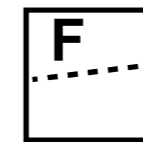


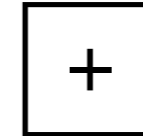
FIGURE 6



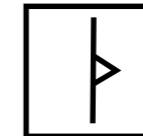
Key:



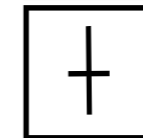
Fault



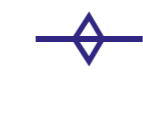
Horizontal bed



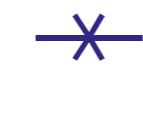
Dip of bed



Vertical feature





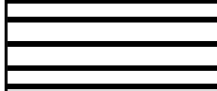





Axial plane trace (antiform)



Axial plane trace (synform)

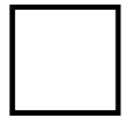


The rock units are not in order of age. Their ornament is not necessarily representative of rock type.

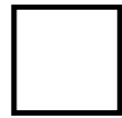
	Rock Unit A
	Rock Unit B (granite)
	Rock Unit C
	Rock Unit D
	Rock Unit E
	Rock Unit F
	Rock Unit G
	Rock Unit H (igneous)

0 100
metres

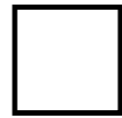
Thrust



Normal



Strike-slip



Reverse



Dip-slip

