GCE A LEVEL
A480U10-1

TUESDAY, 4 JUNE 2024 – MORNING

GEOLOGY - A LEVEL COMPONENT 1
GEOLOGICAL INVESTIGATIONS

2 hours 15 minutes plus your additional time allowance

Surname

First Name(s)

Centre Number

Candidate Number

ADDITIONAL MATERIALS

- the Resource Sheet
- SPECIMENS C, E, G and K
- 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.

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 are provided on separate resource sheets.

Strips of plain paper may be obtained from the supervisor on request.

Four specimens, C, E, G and K, 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 6.

SECTION A

Answer ALL questions.

1 FIGURE 1a opposite is a sketch of a photomicrograph of rock R.

(a) Refer to FIGURE 1a.

(i) Identify mineral S. You may wish to use the Mineral Data Sheet. [1 mark]

Mineral S _____

(ii) State the name of rock R. [1 mark]

Rock R _____

1 (a)(iii) TABLE 1 opposite shows a range of silicate structures. Indicate, with ONE tick (✔) in EACH of the blank columns, the silicate structure represented by mineral S and plagioclase feldspar. [2 marks]

(b) FIGURE 1b opposite the following page is a phase diagram showing the experimental crystallisation of olivine over a range of compositions (from Mg-rich forsterite to Fe-rich fayalite).

Refer to FIGURE 1b.

(i) Name the variety of olivine to crystallise at the highest temperature. [1 mark]

1 (b)(ii) Melt X has the composition of 80% fayalite.

Complete TABLE 2 below to show the crystallisation characteristics of melt X as it cools. Assume that the melt remains in equilibrium with the crystals that form. [5 marks]

TABLE 2

	TEMPERATURE OF MELT (°C)	COMPOSITION OF MELT (% FAYALITE)	COMPOSITION OF CRYSTALS (% FAYALITE)
Initial crystallisation	•	80	•
Crystallisation at 1300 °C	1300	•	67
Final crystallisation	•		•

1 (c) FIGURE 1c opposite is a photomicrograph showing the texture of an igneous rock including a zoned phenocryst of olivine.

Refer to FIGURE 1b and to the zoned olivine phenocryst in FIGURE 1c.

(i) Describe and account for the probable difference in composition between zone 1 and zone 2 of the zoned olivine phenocryst. [3 marks]

1 (c)(ii) Explain why the olivine crystals in the groundmass are not zoned. [2 marks]

15

2 FIGURE 2a opposite shows a model of a divergent plate margin in which symmetrical spreading is taking place. The plates are moving at the same speed.

(a) Refer to FIGURE 2a.

(i) Mark on the right-hand edge of FIGURE 2a the position of the boundary between the crust and the mantle using an arrow labelled M (M→). [1 mark]

(ii) State the type of faults present in the basaltic lavas. Give the evidence for your answer. [2 marks]

Fault type _____

Evidence _____

_____

_____

_____

2 (a)(iii) Explain why magma is generated at location X.
[2 marks]

(b) FIGURE 2b opposite shows an alternative model of a divergent plate margin in which asymmetrical spreading is taking place. The plates are moving at different speeds.

Compare and contrast the:

- **lithology of the rocks that outcrop on the sea floor**
- **faulting present**

in FIGURE 2a and FIGURE 2b. [4 marks]

Lithology

Faulting

2 (c) Using FIGURE 2a, FIGURE 2b and your knowledge, explain how MAGNETIC data and OCEAN DRILLING could be used to determine the rate of sea floor spreading on either side of an ocean ridge. You may wish to use an annotated diagram(s) in your answer.

[6 marks QER]

15

SECTION B

Answer ALL questions.

3 SPECIMEN E was collected within ROCK UNIT E on MAP 1.

(a)(i) Complete TABLE 3 on the next page by:

- **stating the result of the test or observation described**
- **describing ONE other diagnostic test/observation which confirms the identity of the mineral forming SPECIMEN E, and stating the result.**

You may wish to refer to the Mineral Data Sheet.

[3 marks]

TABLE 3

DESCRIPTION OF TEST/OBSERVATION	RESULT OF TEST/OBSERVATION
Observe the colour of the light reflected by the surface	white
Observe the reaction with dilute HCl	no reaction
Observe the lustre (the appearance of the surface in reflected light)	•
•	•

3 (a)(ii) Name the mineral forming SPECIMEN E. [1 mark]

SPECIMEN E _____

_____

3 (b) Beds of halite were also found within ROCK UNIT E. Describe the environmental and climatic conditions required for the formation of beds of halite.

[3 marks]

7

4 SPECIMEN C was collected from ROCK UNIT C on MAP 1

(a) Describe the texture of SPECIMEN C. [3 marks]

4 (b) State the type of igneous body formed by ROCK UNIT C. Give ONE piece of evidence from each of SPECIMEN C and MAP 1. [3 marks]

Type of igneous body _____

Evidence from SPECIMEN C _____

_____

_____

_____

Evidence from MAP 1 _____

_____

_____

_____

4 (c) A student stated:

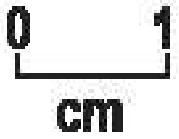
"The weathering of ROCK UNIT C could lead to the formation of economic deposits of china clay."

Evaluate this statement. [3 marks]

9

5 SPECIMEN K was found at LOCALITY 1 on MAP 1.

(a) Draw an internal view of SPECIMEN K using the scale provided. [4 marks]



5 (b) State the fossil group represented by SPECIMEN K. Explain your answer with reference to the symmetry of this valve. [2 marks]

Fossil group _____

_____

Explanation _____

_____

_____

_____

5 (c) FIGURE 5 opposite shows internal and external views of another modern shell L, found at LOCALITY 1.

Complete TABLE 4 to interpret the mode of life of the organisms represented by SPECIMEN K and shell L. Explain your answers. [6 marks]

TABLE 4

	MODE OF LIFE	EXPLANATIONS
K	•	• •
L	•	• •

12

6 FIGURE 6a opposite shows part of ROCK UNIT D on MAP 1. FIGURE 6b opposite shows a bedding plane surface found within ROCK UNIT D.

Plan a field investigation to collect information to determine:

- **the environment of deposition of ROCK UNIT D**
- **the information that the trace fossils in FIGURE 6b indicates about the animals that lived in that environment.**

Your answer should include details of the observations and measurements you would make and justifications for why you have chosen these observations and measurements. You may wish to use an annotated diagram(s) in your answer. [9 marks QER]

9

7 SPECIMEN G is a type of coal found within ROCK UNIT G on MAP 1.

(a) State, giving TWO reasons, the rank of coal (peat, lignite, bituminous, anthracite) represented by SPECIMEN G. [3 marks]

Rank _____

Reason 1 _____

_____

_____

_____

Reason 2 _____

_____

_____

_____

7 (b) A student concluded that SPECIMEN G:

- **was deposited in a well-oxygenated tropical sea**
- **has undergone burial to a maximum depth of 100 m.**

Evaluate the student's conclusion, giving reasons for your answer. [4 marks]

7

8 (a) MAP 2 is a reduction of MAP 1. The key for the rock units is the same as for MAP 1.

On MAP 2 clearly mark and label the position of:

- TWO fold axial plane traces to the WEST of F1 (using the symbols in the key)
- ONE fold axial plane trace to the SOUTH of F2 (using the symbols in the key)
- an unconformity to the EAST of F1 (using an arrow labelled U (U→). [4 marks]

(b) MAP 1 shows two faults, F1 and F2.

Complete TABLE 5 to describe the features of faults F1 and F2 on MAP 1. [3 marks]

TABLE 5

FEATURE OF FAULT	FAULT F1	FAULT F2
Angle of dip of the fault plane	75°	•
Direction of dip of the fault plane	East	
Type of fault (dip-slip, thrust, strike-slip)	•	•

7

9 The topographic profile opposite was taken along the line X–Y on MAP 1.

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

- **The true thickness of ROCK UNIT G is 150 metres.**
- **Draw the rock units. Use similar ornament, or letters, to those on MAP 1.**
- **Draw and label any FOLD AXES, with the correct symbol.**
- **Draw any FAULTS.**
- **PROJECT the rock units and structures ABOVE the ground surface to illustrate any cross-cutting relationships and the reactivation of the fault.**

[14 marks]

14

10 FIGURE 10 opposite shows an included fragment found within ROCK UNIT A on MAP 1.

(a) State, giving TWO reasons, the name of the rock shown in FIGURE 10. [3 marks]

Name _____

Reason 1 _____

_____

_____

_____

Reason 2 _____

_____

_____

_____

10 (b) The rock in FIGURE 10 was radiometrically dated using the Potassium-Argon method as being 422 (±2%) Ma.

(i) Calculate the maximum age of the rock. Give your answer to the correct number of significant figures. Show your working. [2 marks]

Maximum age _____ Ma

10 (b)(ii) State TWO assumptions or limitations of using the Potassium-Argon method to date rocks.

[2 marks]

1. _____

_____

_____

_____

2. _____

_____

_____

_____

10 (c) Refer to MAP 1 and FIGURE 6b. ROCK UNIT C is Palaeogene in age.

(i) State in which unit of geological time ROCK UNIT A could have been deposited. Tick (✔) only ONE box.

[1 mark]

Precambrian	Cambrian	Cretaceous	Neogene
☐	☐	☐	☐

(ii) Explain TWO reasons to support your answer to (c)(i).

[2 marks]

Explanation 1 _____

_____

_____

_____

Explanation 2 _____

_____

_____

_____

☐

10

END OF PAPER

ACKNOWLEDGEMENTS

FIGURE 1c
https://www.alexstrekeisen.it/immagini/vulc/zoning2020(4).jpg

FIGURES 2a and 2b
https://teacheratseablog.wordpress.com/2017/04/17/a-level-geology/

FIGURE 5
Photograph M. Walsh

FIGURE 6a
https://www.sciencephoto.com/media/169095/view/dipping-rock-strata

FIGURE 6b
https://www.nhm.ac.uk/discover/

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

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	For Examiner's use only		
	Question	Maximum Mark	Mark Awarded
Section A	1	15	
	2	15	
Section B	3	7	
	4	9	
	5	12	
	6	9	
	7	7	
	8	7	
	9	14	
	10	10	
	Total	105	

FIGURE 1a

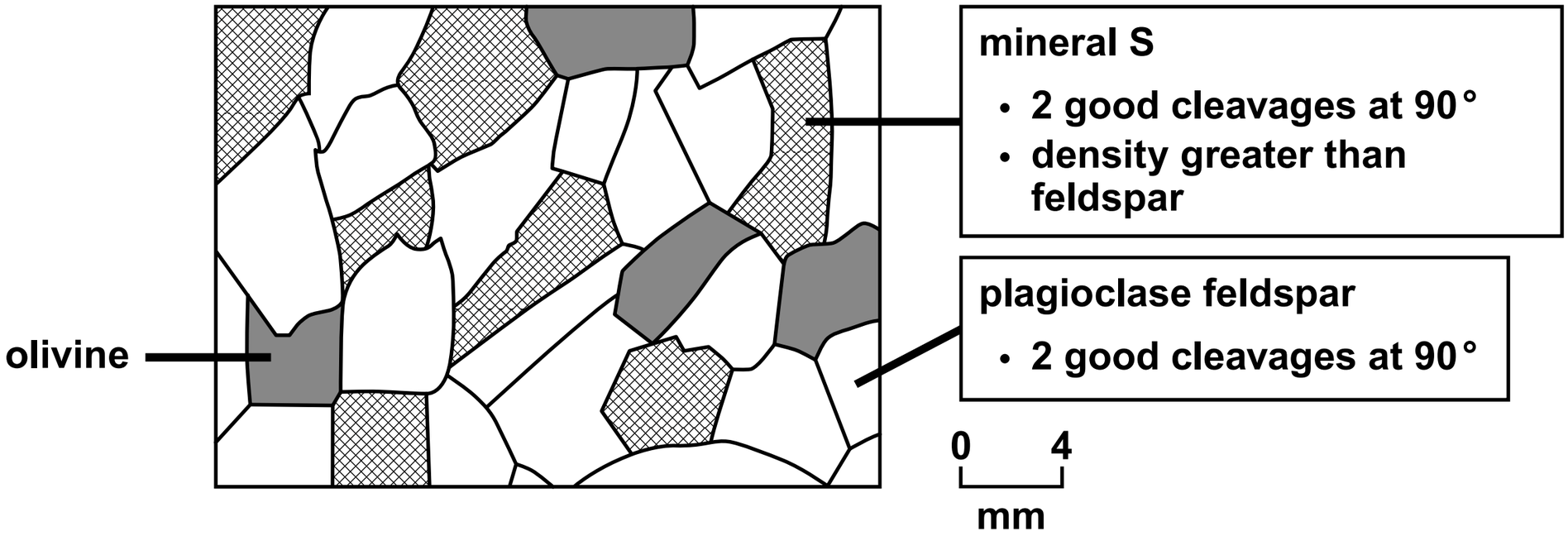

mineral S
• 2 good cleavages at 90°
• density greater than feldspar
plagioclase feldspar
• 2 good cleavages at 90°
olivine
0
4
mm

TABLE 1

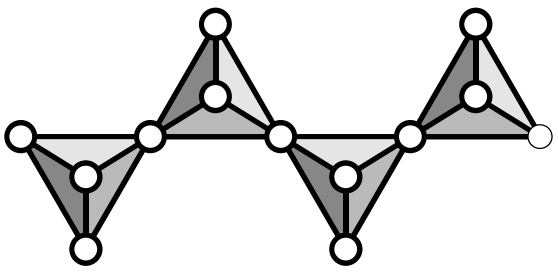
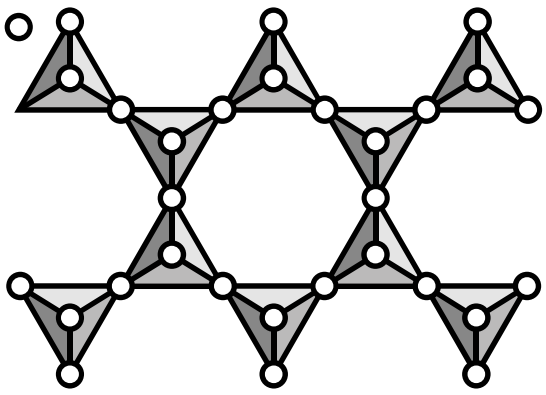
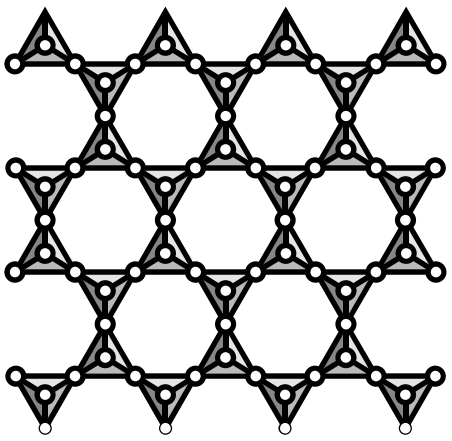
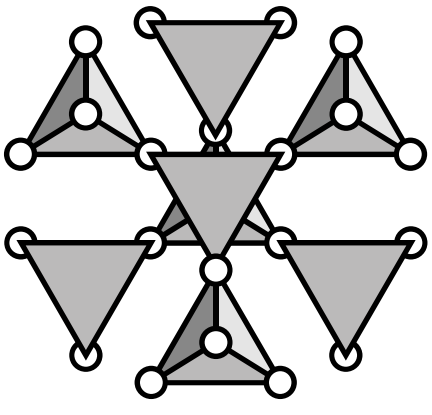
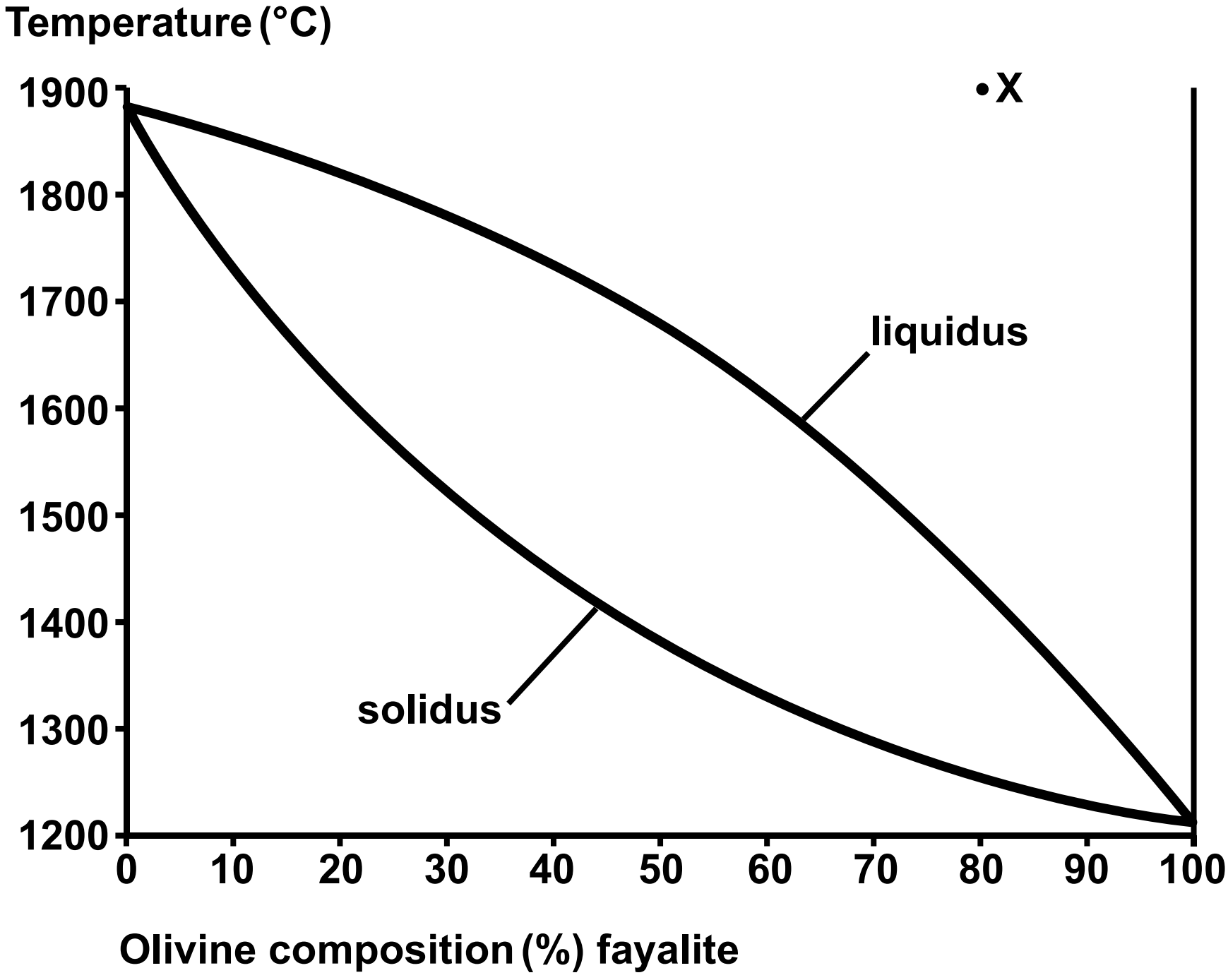
Silicate Structure	Mineral S	Plagioclase feldspar
Single Chain 		
Double Chain 		
Sheet 		
Framework 		

FIGURE 1b



Forsterite

Mg_2SiO_4

(iron-deficient)

Fayalite

Fe_2SiO_4

(iron-rich)

FIGURE 1c

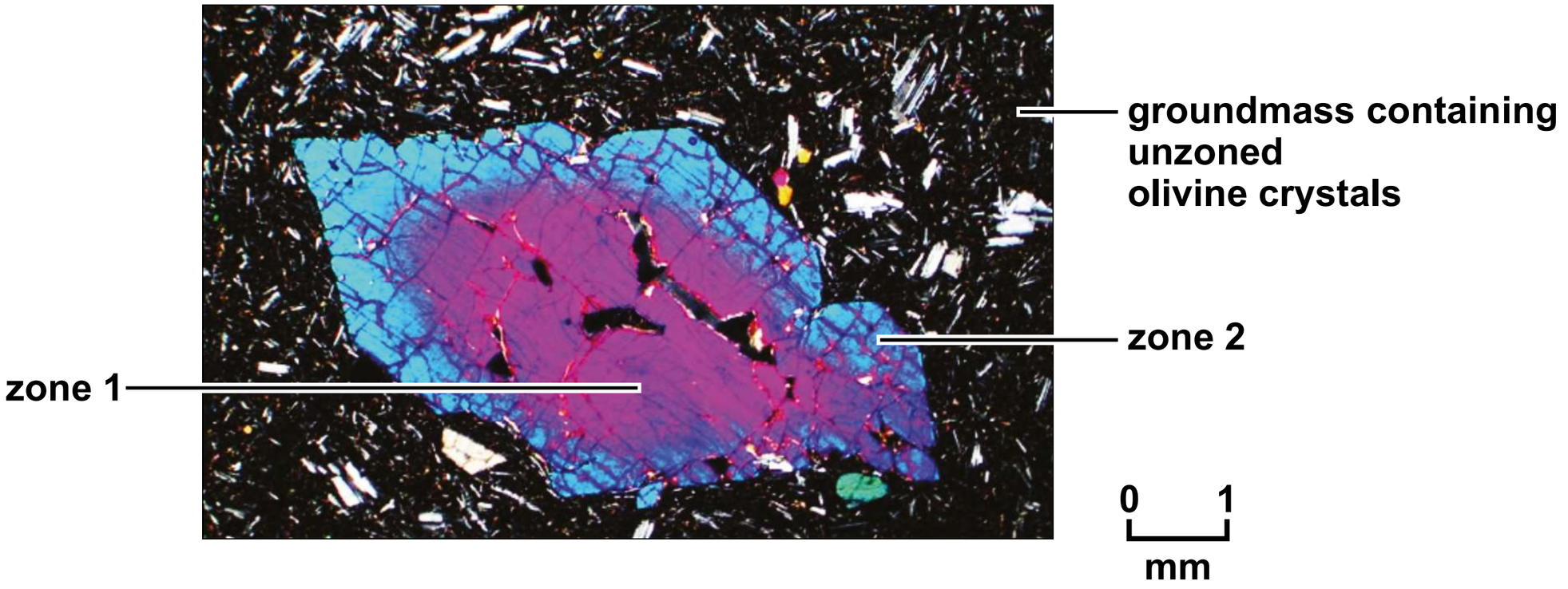

groundmass containing
unzoned
olivine crystals
zone 2
zone 1
0
1
mm

FIGURE 2a

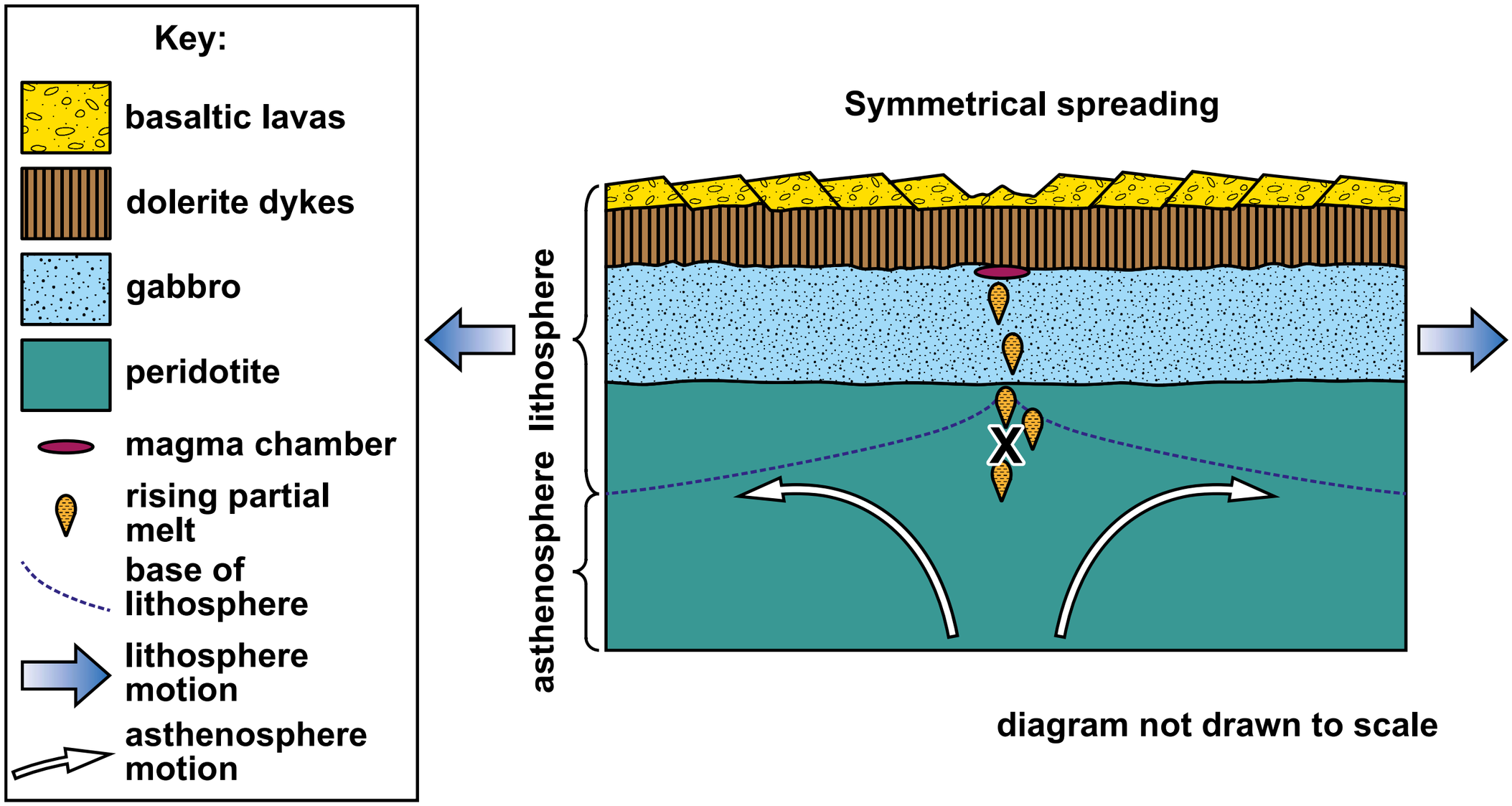

Key:
basaltic lavas
dolerite dykes
gabbro
peridotite
magma chamber
rising partial melt
base of lithosphere
lithosphere motion
asthenosphere motion
Symmetrical spreading
lithosphere
asthenosphere
X
diagram not drawn to scale

FIGURE 2b

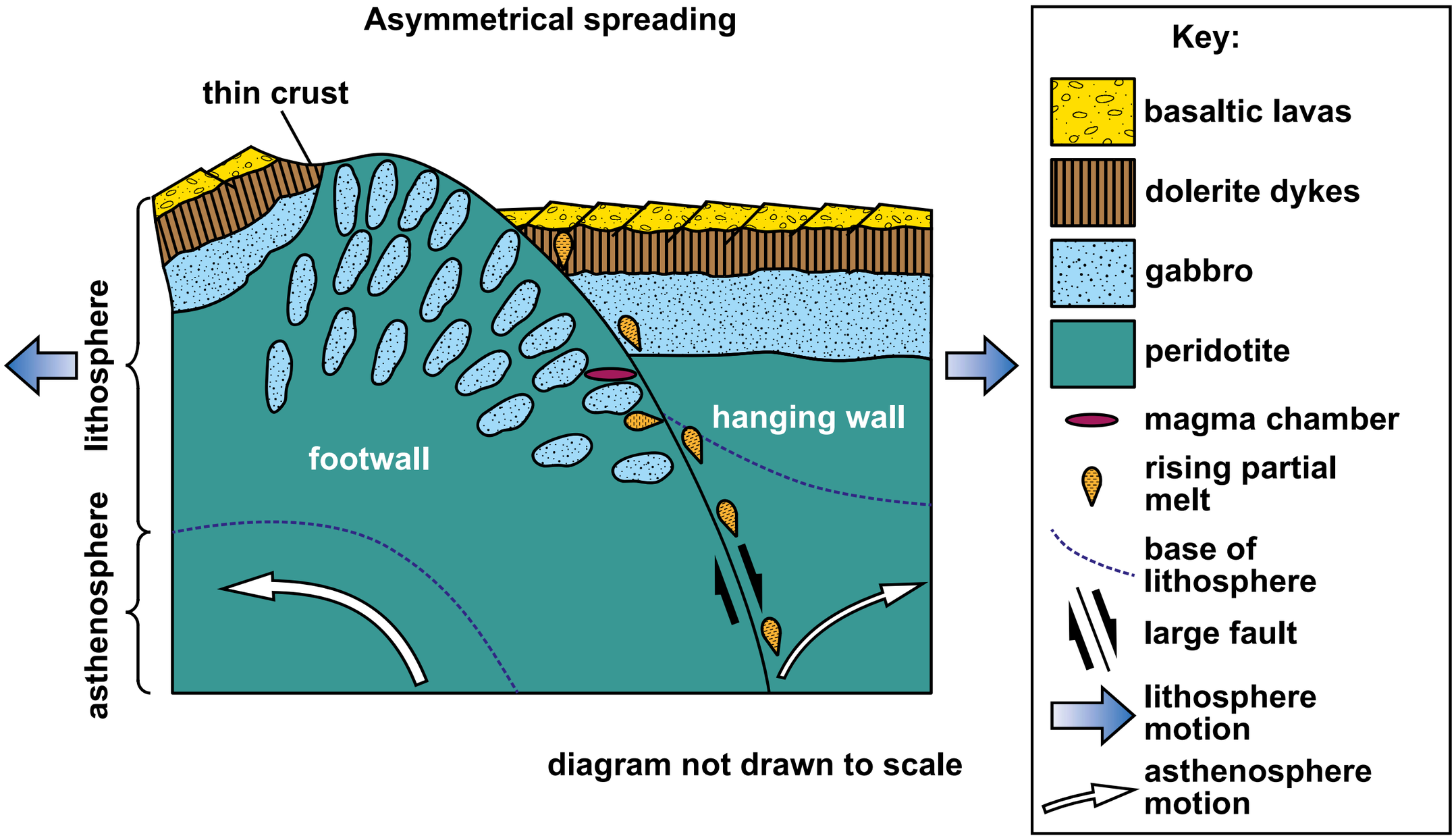
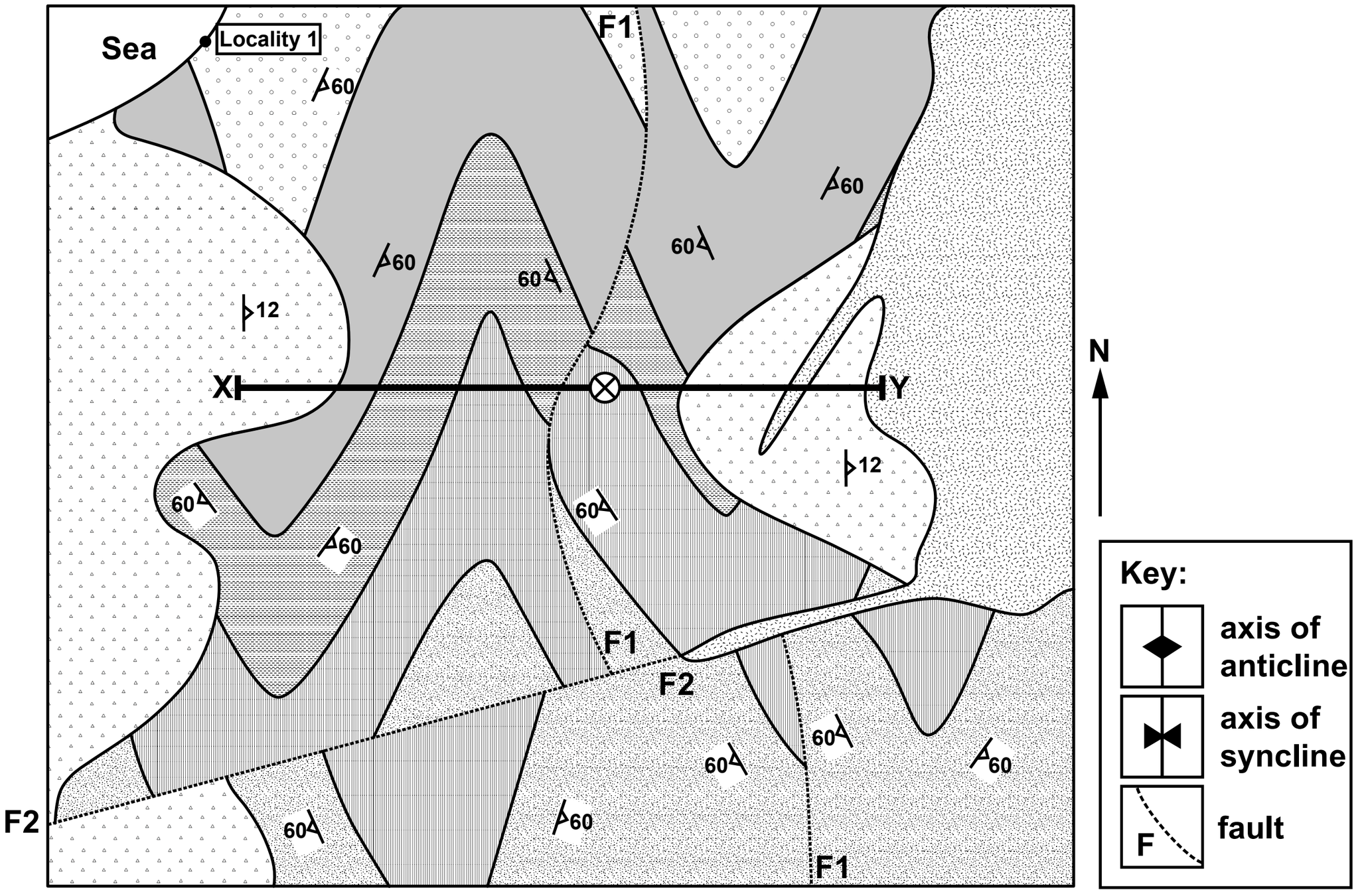

Asymmetrical spreading
thin crust
lithosphere
asthenosphere
footwall
hanging wall
diagram not drawn to scale
Key:
basaltic lavas
dolerite dykes
gabbro
peridotite
magma chamber
rising partial melt
base of lithosphere
large fault
lithosphere motion
asthenosphere motion

FIGURE 5

FIGURE 6a

FIGURE 6b

MAP 2


Sea
Locality 1
F1
60
12
X
Y
N
F2
Key:
axis of anticline
axis of syncline
fault
F

Question 9

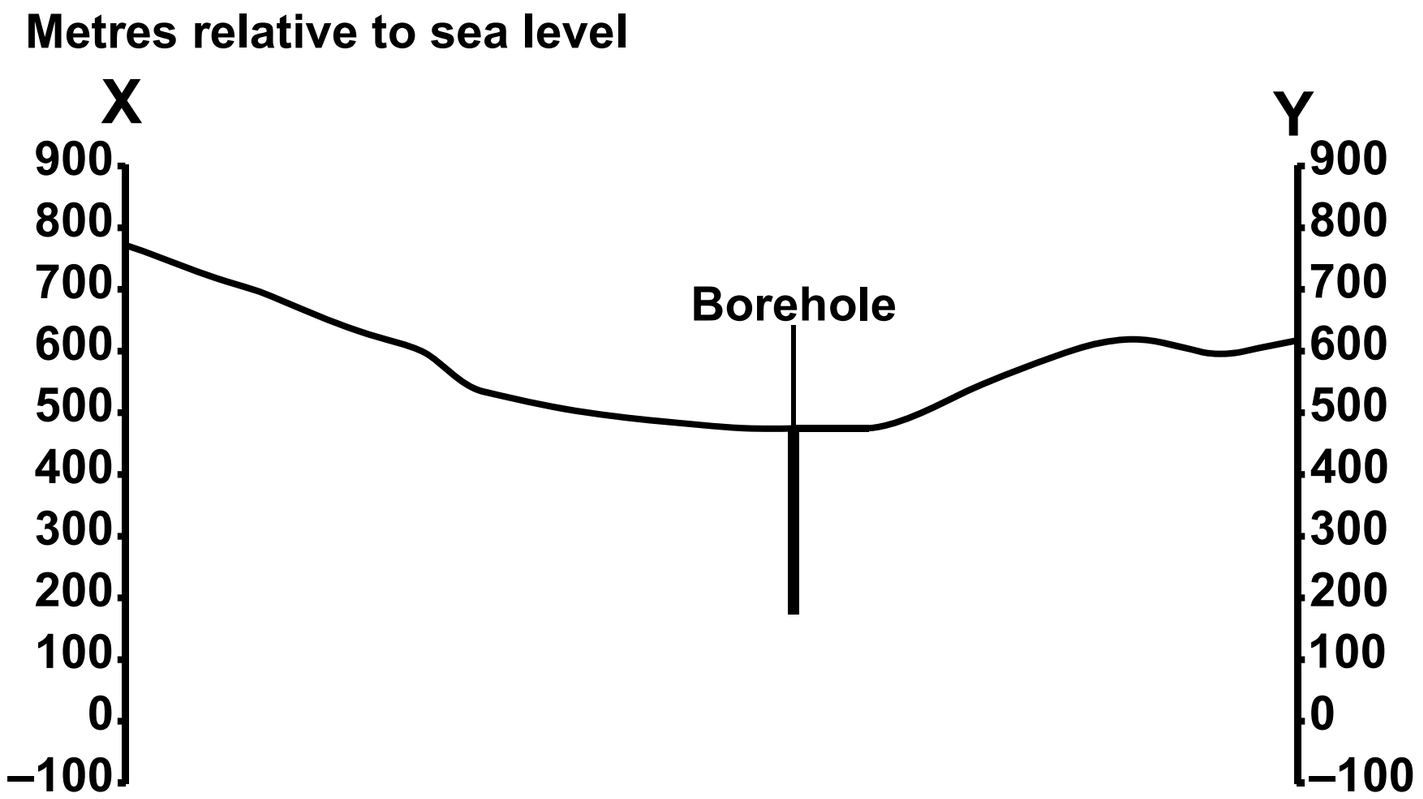

Metres relative to sea level
X
Y
900
800
700
600
500
400
300
200
100
0
–100
Borehole

FIGURE 10