Surname	Centre Number	Candidate Number
First name(s)		2

GCE A LEVEL

A480U20-1

S24-A480U20-1

eduqas
Part of WJEC

WEDNESDAY, 12 JUNE 2024 – AFTERNOON

GEOLOGY – A level component 2

Geological Principles and Processes

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**14**	
2.	**14**	
3.	**16**	
4.	**15**	
5.	**16**	
6.	**15**	
Total	**90**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need:
- a calculator
- a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.
You may use a pencil for graphs and diagrams only.
Write your name, centre number and candidate number in the spaces at the top of this 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 **1** and **5**.

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Answer **all** questions in the spaces provided.

1. **Figure 1a** shows a cliff section together with sketches of three fossils (**A**, **B** and **C**) collected from the Jurassic limestone.

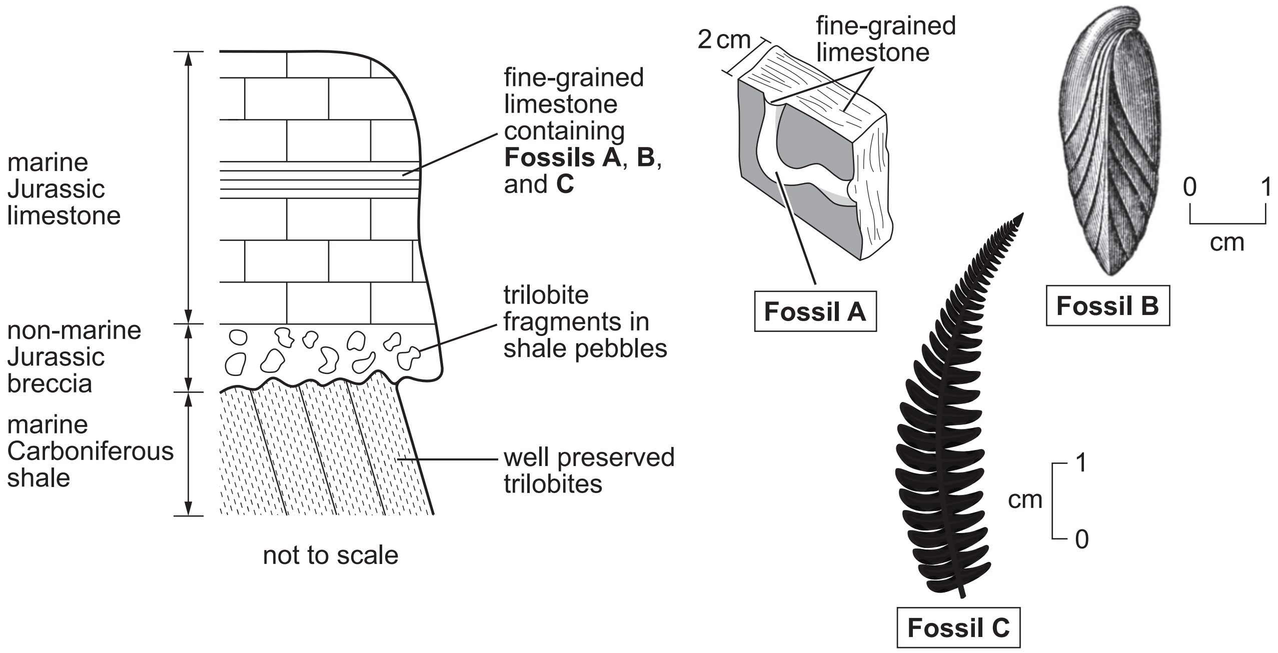

Figure 1a

(a) Refer to **Figure 1a**.

(i) State the fossil groups to which fossils **A**, **B** and **C** belong. [2]

Fossil **A**: ....

Fossil **B**: ....

Fossil **C**: ....

(ii) A student concluded that the fossils preserved in the Jurassic limestone may not give an accurate record of marine life during the Jurassic. Evaluate the student's conclusion. [3]

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(iii) Trilobites became extinct at the end of the Permian. Explain the presence of the trilobite fossils in the Jurassic breccia. [3]

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(b) **Figure 1b** shows the processes that may preserve organisms such as **Fossil B** in **Figure 1a**.

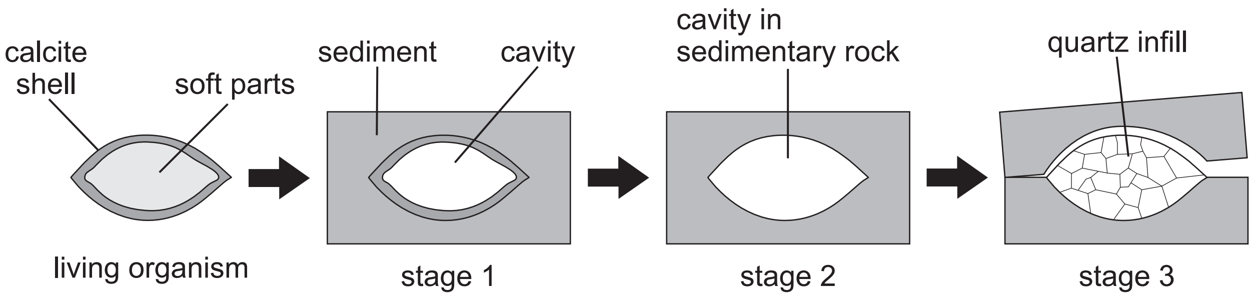

Figure 1b

Describe the fossilisation processes shown on **Figure 1b**. [6 QER]

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2. **Figure 2a** is a cross-section across a convergent plate boundary with isotherms showing the variation in temperature with depth.
Figure 2b shows melting point curves for dry and wet peridotite and a partly completed graph of depth against temperature along the line **X–Y** beneath the volcano on **Figure 2a**.

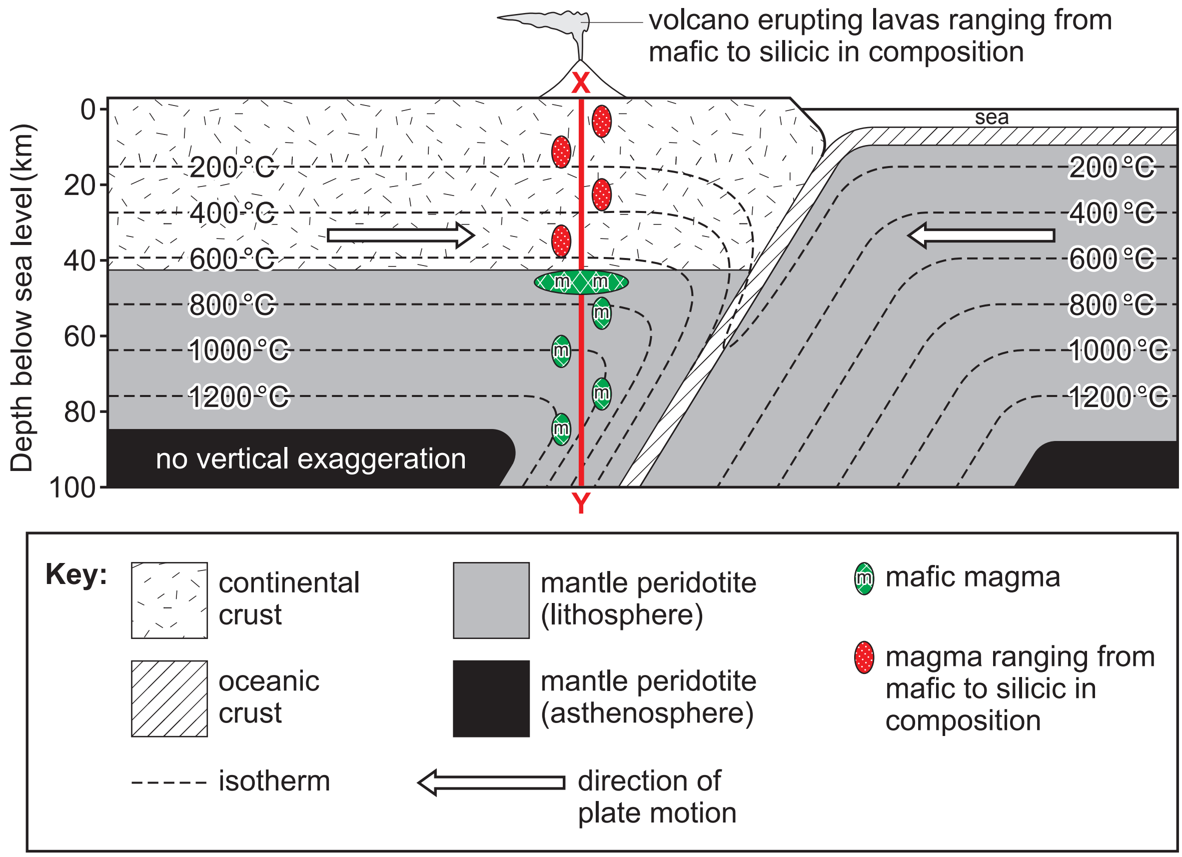

Figure 2a

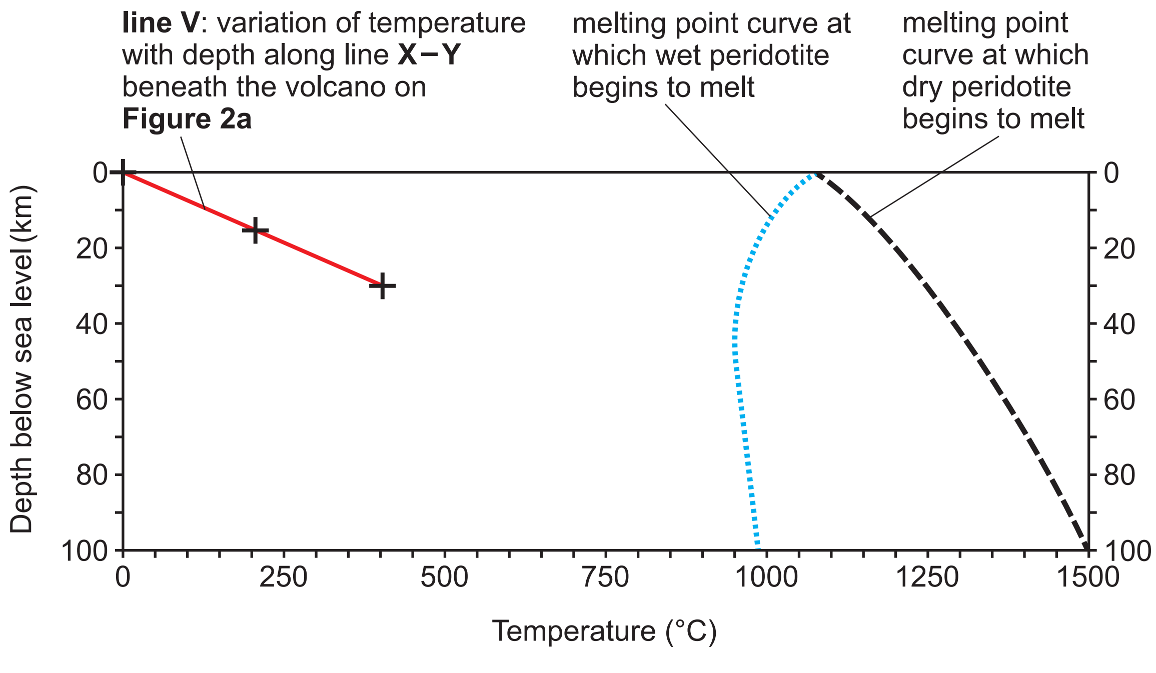

Figure 2b

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(a) Describe the melting point curve for wet peridotite between depths of 0 km and 100 km in **Figure 2b**. [2]

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(b) Refer to **Figure 2a** and **Figure 2b**.

(i) Plot the points to complete **line V** on **Figure 2b** using the isotherms beneath the volcano on **Figure 2a**. The first three points have been plotted for you. Join the points to show the variation in temperature with depth beneath the volcano between 0 km and 100 km. A vertical line **(X–Y)** has been drawn on **Figure 2a** to assist you. [3]

(ii) Explain why the magma beneath the volcano on **Figure 2a** must originate from wet rather than dry peridotite. [2]

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(c) **Figure 2c** shows two photographs of granites (**Photograph C** and **Photograph D**) both of which formed at a convergent plate boundary. The granites contain either xenoliths or enclaves.

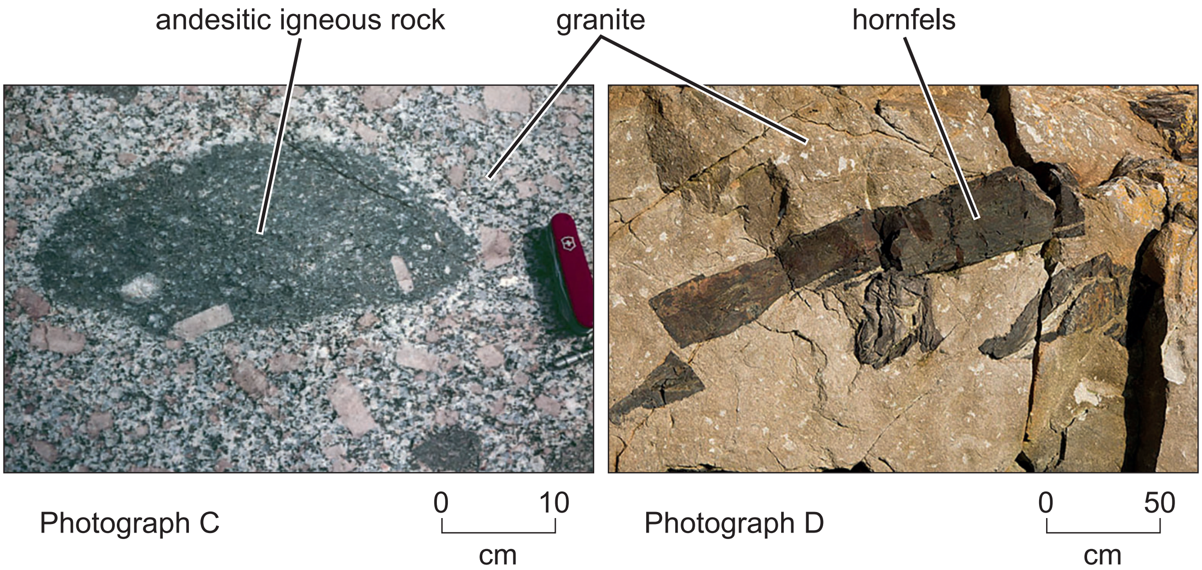

Figure 2c

(i) State which photograph on **Figure 2c** (**Photograph C** or **Photograph D**) shows an enclave. Explain your answer. [3]

Photograph ....

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(ii) The volcano shown on **Figure 2a** erupts lavas with a range of compositions from mafic to silicic. Use **Figure 2a** and **Figure 2c** to suggest reasons for this variation in composition. [4]

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3. **Figure 3a** is a field sketch showing minor folding of Carboniferous limestones in a road cutting at Ecton, Staffordshire.
Figure 3b is a polar equal area 'stereonet' of dip measurements recorded by a student on **Fold F** on **Figure 3a**.
Table 1 contains one additional dip measurement on **Fold F** recorded by the student.

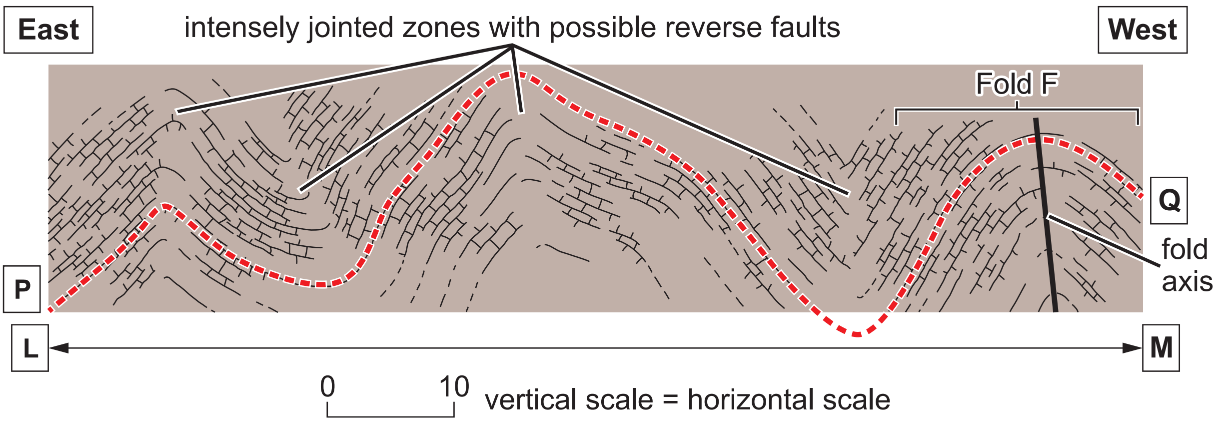
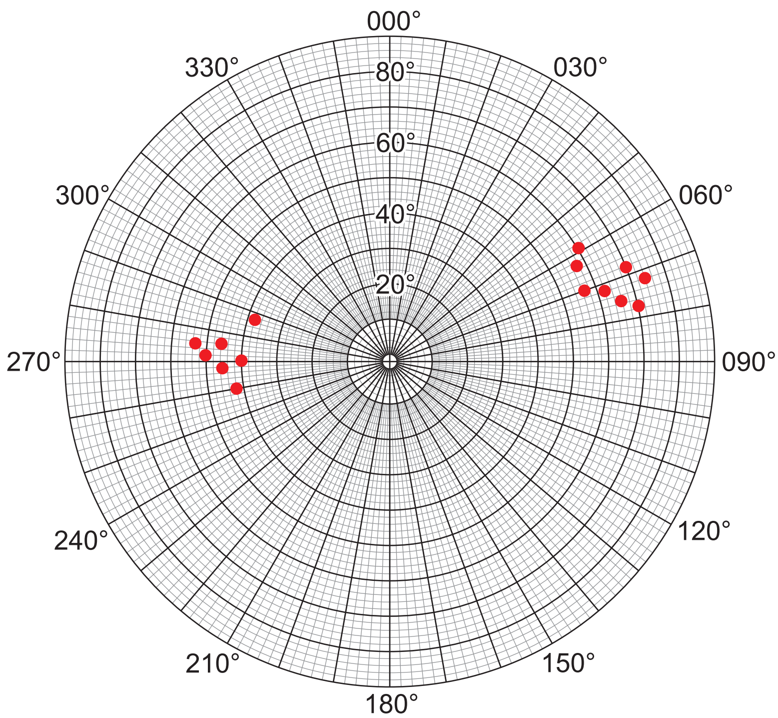


Figure 3a



● Dip angle and dip direction measurement of limestone bedding planes on **Fold F**

Figure 3b

dip angle of limestone bedding plane	dip direction of limestone bedding plane
45°	280°

Table 1

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(a) Refer to **Figure 3a**, **Figure 3b** and **Table 1**.

(i) Mark on **Figure 3b**, with a cross **(+)**, the dip angle and dip direction of the limestone bedding plane represented by the data in **Table 1**. [1]

(ii) The length of folded surface **P** to **Q** is 125 m. Using the formula below, calculate the percentage of crustal shortening of the folded surface between **L** and **M** on **Figure 3a**. Show your working. [2]

$$\text{Percentage of crustal shortening} = \frac{(\text{length of the folded surface } \mathbf{P} \text{ to } \mathbf{Q} - \text{length of the horizontal surface } \mathbf{L} \text{ to } \mathbf{M})}{\text{length of the folded surface } \mathbf{P} \text{ to } \mathbf{Q}} \times 100$$

Percentage of crustal shortening = ... %

(iii) Explain the presence of the 'intensely jointed zones with possible reverse faults' labelled on **Figure 3a**. [3]

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(b) (i) Mark on the 'stereonet', **Figure 3b**, a line to show the approximate trend of the fold axial plane trace of **Fold F**. [1]

(ii) In analysing the data on **Figure 3a** and **Figure 3b** the student concluded that **Fold F** is:

- an anticline
- that is plunging
- and tight
- with an axial plane that dips to the ENE.

Evaluate the student's conclusion. [4]

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(c) **Figure 3c** shows a geological map of the area surrounding the road cutting shown in **Figure 3a**.

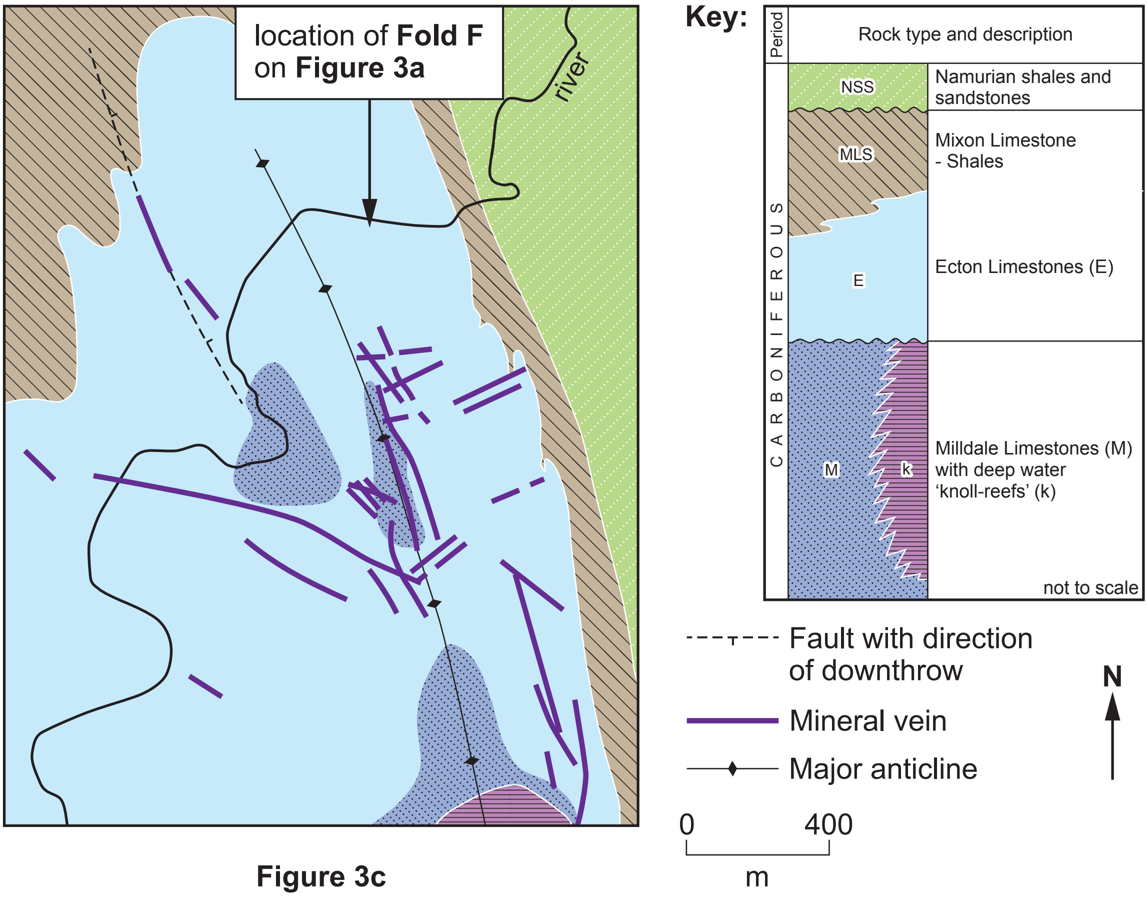

Figure 3c

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Refer to **Figure 3c**.

(i) Mark on the map on **Figure 3c**, a line to show the axial plane trace of **Fold F**. [1]

(ii) The mineral veins on **Figure 3c** are believed to have been formed by 'precipitation from acidic hydrothermal fluids derived from deeply buried sedimentary rocks'. Evaluate the extent to which the distribution of the mineral veins on **Figure 3c** is controlled by lithology and structure. [4]

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4. **Figure 4a** shows the plate tectonic development of the southern hemisphere between 65 and 20 Ma.

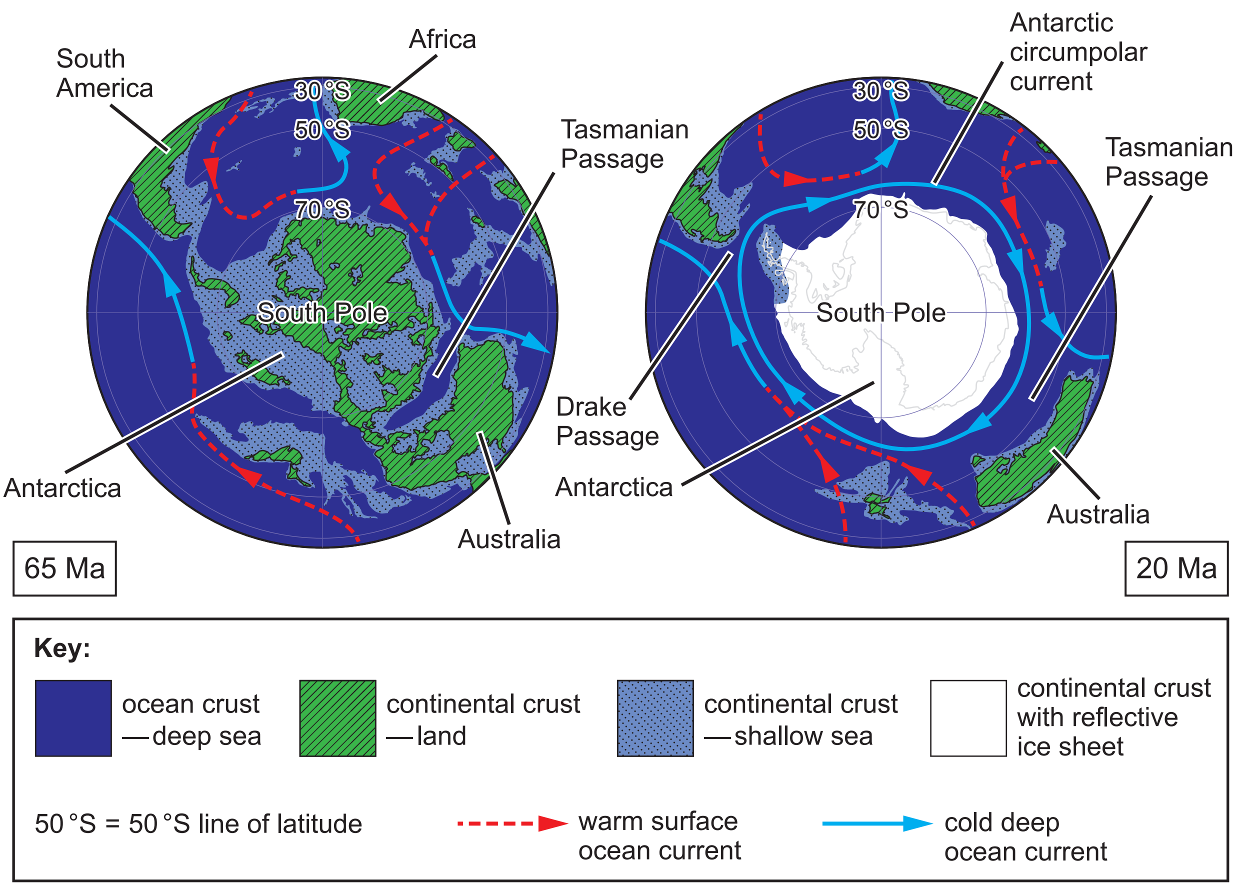

Figure 4a

(a) Refer to **Figure 4a**.

(i) Describe the change in latitude of Australia and Antarctica between 65 and 20 Ma. [2]

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(ii) **Table 2** shows four stages of the Wilson Cycle of ocean development. Identify the **two** stages of the Wilson Cycle that correspond to the Tasmanian Passage at 65 Ma and 20 Ma. Explain your answers. [4]

Mature stage: widening of the narrow sea into a wider ocean by seafloor spreading.	**Young stage:** formation of new spreading centres with narrow seas between the rifted continents.
End stage: all oceanic lithosphere has been subducted and an active continental orogenic belt is formed.	**Embryonic stage:** extension of continental areas and formation of continental rift valleys.

Table 2

Stage of Wilson Cycle at 65 Ma ....

Explanation: ....

....

Stage of Wilson Cycle at 20 Ma ....

Explanation: ....

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 (A480U20-1) **Turn over.**

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(b) **Figure 4b** shows the change in Antarctic sea water temperature and global atmospheric CO_2 concentration between 65 and 20 Ma.

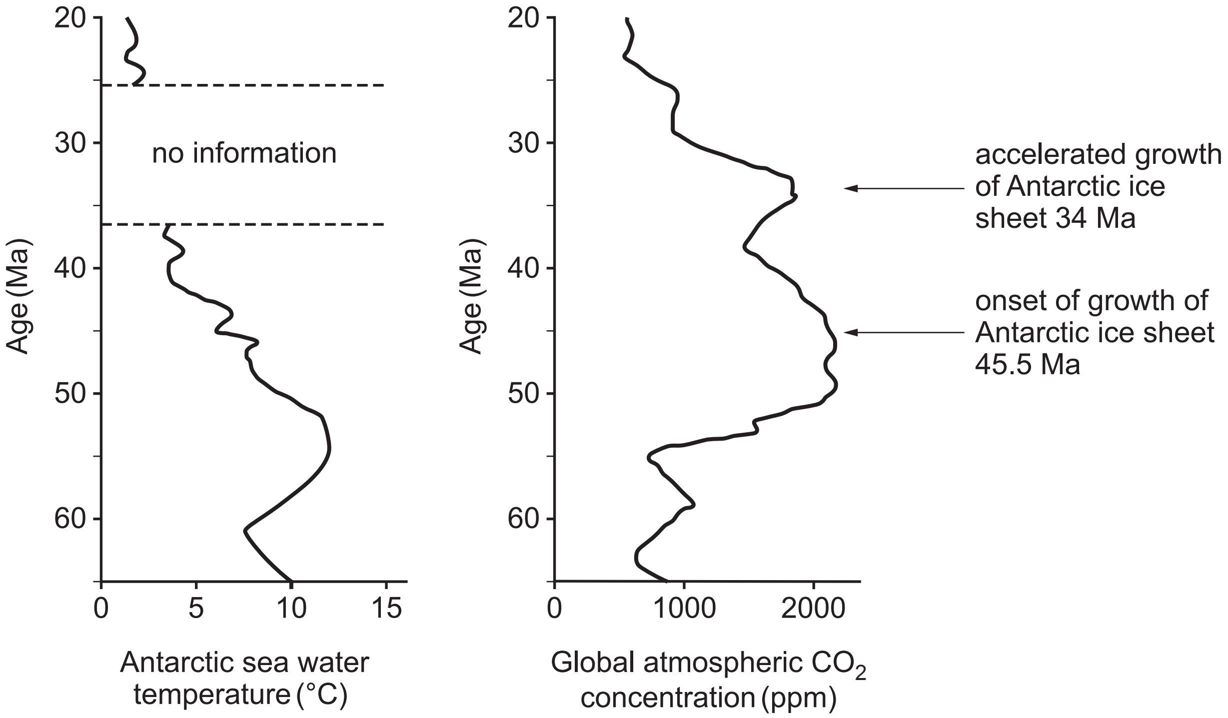

Figure 4b

Refer to **Figure 4b**.

(i) One hypothesis for the onset and growth of the Antarctic Ice Sheet is that it was caused by changes in global atmospheric CO_2 concentrations and Antarctic sea water temperatures. Evaluate this hypothesis using the data on **Figure 4b**. [3]

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(ii) An alternative hypothesis for the onset and growth of the Antarctic Ice Sheet is that it was caused by the opening of the Drake and Tasmanian Passages. Explain the reasoning behind this hypothesis using the data on **Figure 4a** only. [3]

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(c) Using **Figure 4a**, suggest why the growth of the Antarctic Ice Sheet is thought to have resulted in further cooling of the Earth's climate. [3]

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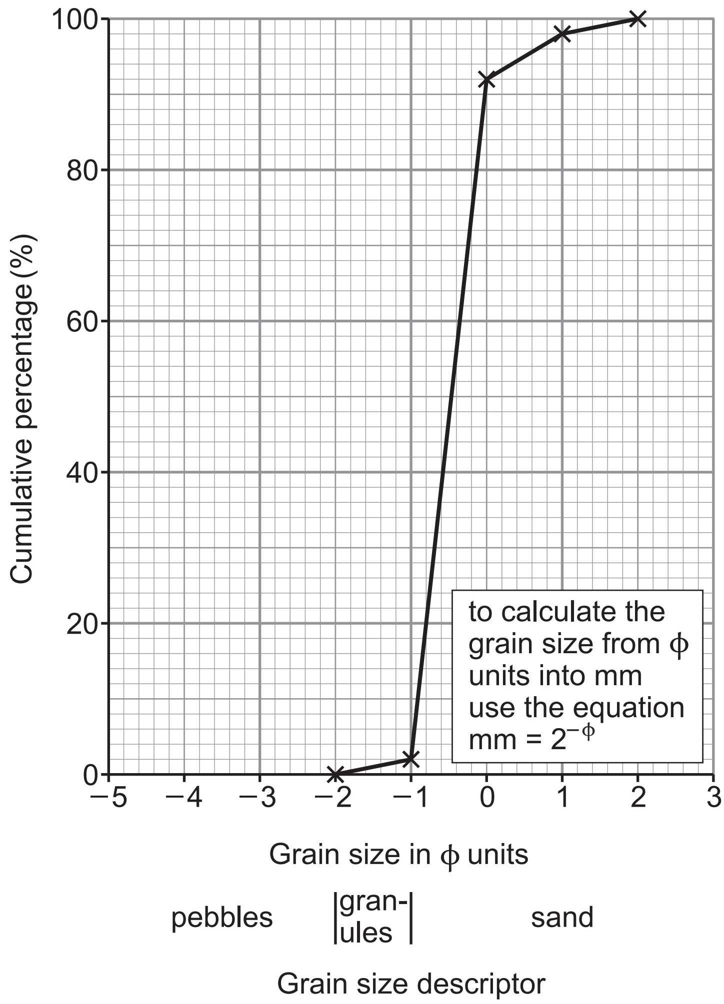
5. **Figure 5a** shows a cumulative frequency grain size graph for an orthoquartzite and information on how to determine the coefficient of sorting.
Figure 5b shows the possible locations in a desert environment where this orthoquartzite may have been deposited.



Coefficient of sorting = $\frac{\phi_{84} - \phi_{16}}{2}$

(ϕ_{84} is the ϕ grain size value at 84% cumulative percent)

Sorting descriptor	Coefficient of sorting
very well sorted	<0.35
well sorted	≥0.35 and <0.50
moderately well sorted	≥0.50 and <0.70
moderately sorted	≥0.70 and <1.00
poorly sorted	≥1.00 and <2.00
very poorly sorted	≥2.00 and <4.00
extremely poorly sorted	≥4.00

Figure 5a

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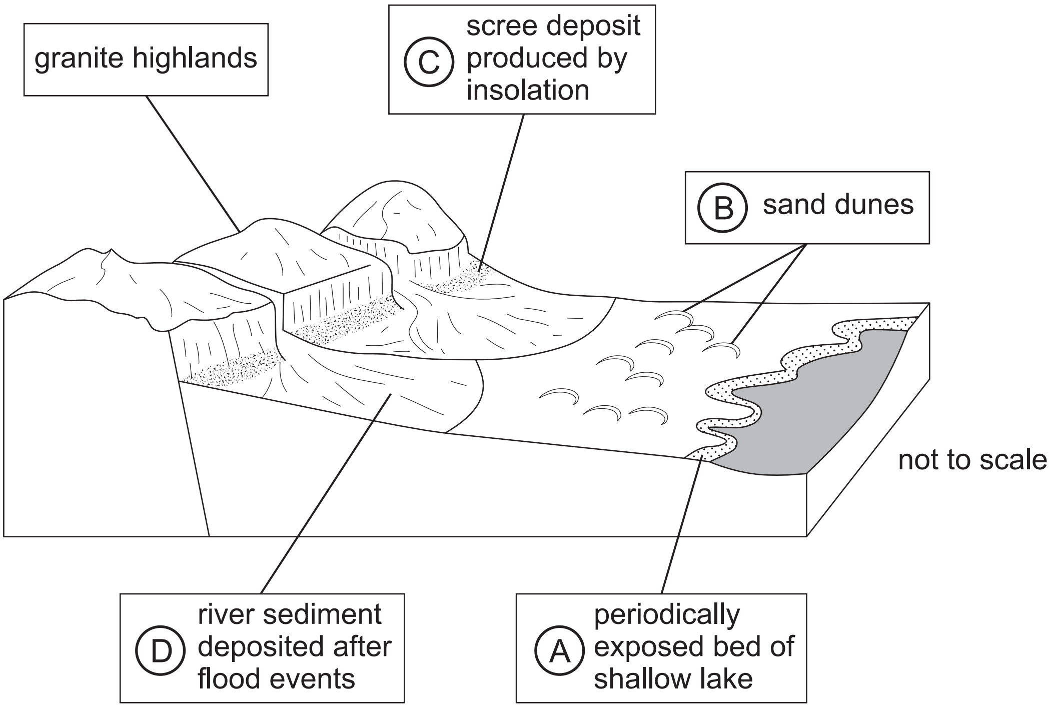

Figure 5b

(a) Refer to **Figure 5a** and **Figure 5b**.

(i) The median is the 50th percentile on a cumulative frequency graph. Use all the information on **Figure 5a** to determine the median grain size of the orthoquartzite in the following units: ϕ units and mm. [2]

Median grain size .... ϕ

Median grain size .... mm

(ii) Use the formula on **Figure 5a** to calculate the coefficient of sorting of the orthoquartzite. Show your working. [2]

Coefficient of sorting = ...

(iii) Use your answer to (a)(ii) and **Figure 5a** to state the sorting of the orthoquartzite. [1]

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Turn over.

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(iv) State the most likely environment (**A**, **B**, or **C**) on **Figure 5b** in which the orthoquartzite was deposited. Explain your answer. [3]

Location: ....

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(b) **Figure 5c** is a photograph of another sedimentary rock which was also deposited in a desert environment. Its composition is shown.
Table 3 shows grain size data for this sedimentary rock.
Figure 5d is a simplified version of **Figure 5a**.

Mineralology:
quartz 62%
feldspar 31%
rock fragments 5%
clay 1%
others 1%

0 6
cm

Figure 5c

 (A480U20-1)

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Grain size ϕ	Percentage mass of sediment (%)
$-5 \geq \phi > -6$	0
$-4 \geq \phi > -5$	5
$-3 \geq \phi > -4$	38
$-2 \geq \phi > -3$	27
$-1 \geq \phi > -2$	19
$0 \geq \phi > -1$	8
$1 \geq \phi > 0$	3
$2 \geq \phi > 1$	0

Table 3

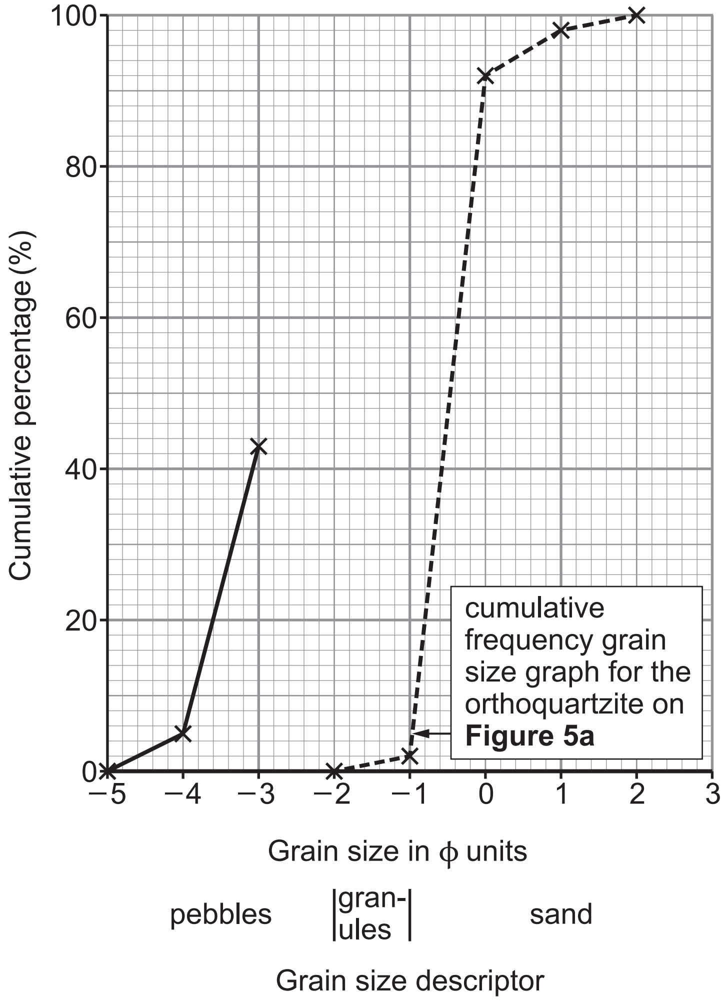

Figure 5d

(i) Use the data in **Table 3** to complete the cumulative frequency curve for this sedimentary rock on **Figure 5d**. The first three points have been plotted for you. [2]

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(ii) A student correctly concluded that this sedimentary rock was deposited in environment **D** on **Figure 5b**. Using **Figure 5c** and **Figure 5d**, explain the evidence for this conclusion. [6 QER]

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6. **Figure 6a** shows some of the forces acting on tectonic plates which drive or oppose their motion.

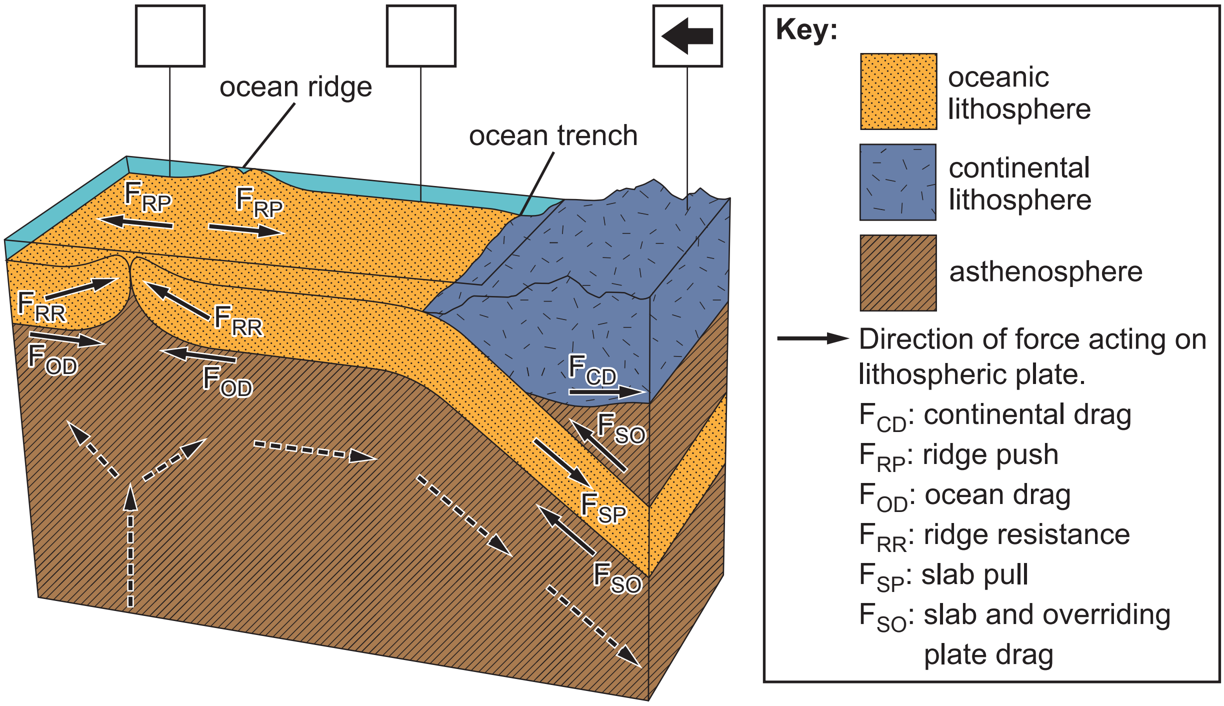

Figure 6a

(a) Refer to **Figure 6a**.

(i) Draw an arrow (←) in each of the two blank boxes on **Figure 6a** to show the relative direction of motion of the tectonic plate at that location. [1]

(ii) State **one** example of a force from **Figure 6a** which opposes the motion of tectonic plates. Explain your answer. [2]

Name: ....

Explanation: ....

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(b) (i) In 1931 Arthur Holmes suggested a process to explain the continental drift hypothesis of Alfred Wegener. Explain how this process, shown by the dashed arrows on **Figure 6a**, has been used to explain the motion of tectonic plates. [3]

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(ii) In 1975 geophysicists Donald Forsyth and Seiya Uyeda suggested that the slab pull force (F_{SP}) is the main driver of tectonic plate motion. Use **Figure 6a** and your knowledge to explain how the slab pull force drives the motion of tectonic plates. [2]

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(c) GPS data shows that a location on a continental tectonic plate is moving towards the north-east with a bearing of 055° from north. This motion is measured in a northward and in an eastward direction as shown on **Figure 6b**. **Figure 6c** is a displacement-time graph showing the northward component of this motion.

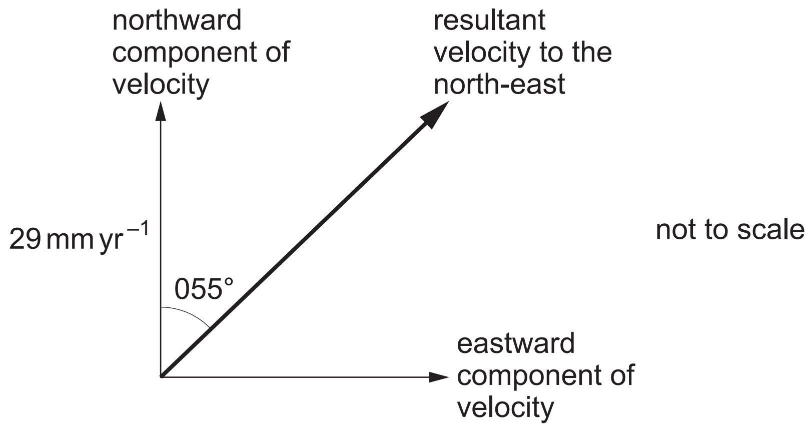

Figure 6b

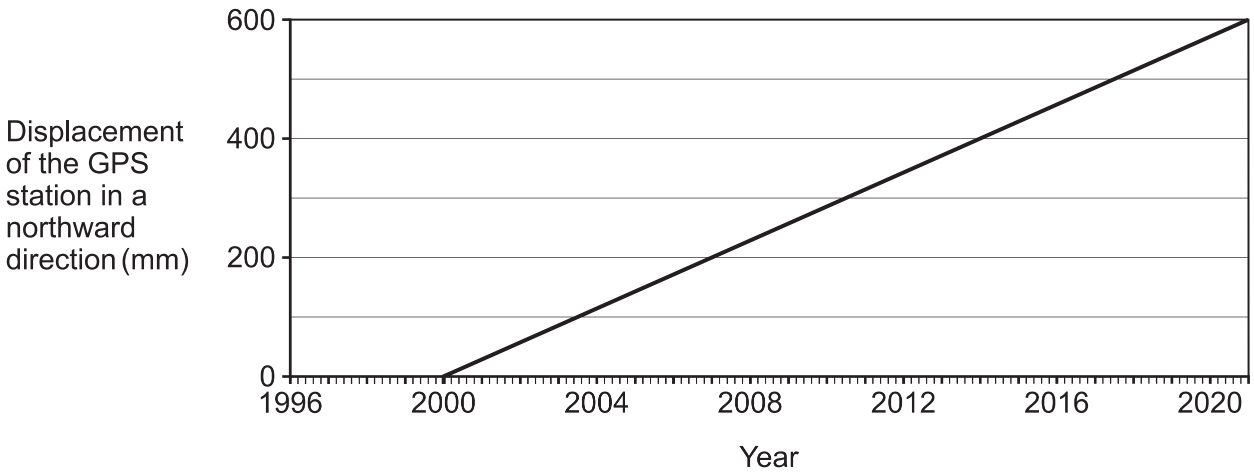

Figure 6c

(i) Use **Figure 6c** to show, in the space below, that the northward component of the continental tectonic plate's velocity at this location is approximately 29 mm yr^{-1}. [1]

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(ii) Refer to **Figure 6b**. The continental tectonic plate is moving towards the north-east with a bearing of 055° from north. Use trigonometry to calculate the resultant velocity (in mm yr^{-1}) of the continental tectonic plate at this location. Show your working. [2]

resultant velocity of the continental tectonic plate = ... mm yr^{-1}

(iii) Explain what the resultant velocity of this continental plate at this location suggests about the forces that drive and oppose its motion. [2]

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(d) Using your knowledge, explain how palaeomagnetic data can be used to show the motion of continental plates. [2]

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END OF PAPER

Acknowledgements

Figure 2c

Photograph C https://www.researchgate.net/publication/275938342_Granites_Really_Are_Magmatic_Using_Microstructural_Evidence_to_Refute_Some_Obstinate_Hypotheses
Acknowledgement not found

Photograph D https://southwestcoastphotos.com/photo_13716275.html Photograph David Evans

Figure 5c https://twitter.com/ajmartin1991/status/1250463834218860544 Photograph Andrew J Martin

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