Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

C480UA0-1

O20-C480UA0-1

WEDNESDAY, 4 NOVEMBER 2020 – MORNING

GEOLOGY – Component 1

Geological Principles (Paper version of on-screen assessment)

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1*(a)*(i)	**2**	
1*(a)*(ii)	**2**	
1*(b)*	**3**	
2*(a)*(i), (ii)	**2**	
2*(a)*(iii)	**2**	
2*(b)*(i), (ii)	**2**	
2*(b)*(iii), (iv)	**3**	
2*(c)*(i)	**2**	
2*(c)*(ii)	**1**	
2*(c)*(iii)	**3**	
3*(a)*(i)	**1**	
3*(a)*(ii)	**2**	
3*(b)*	**3**	
4*(a)*(i), (ii), (iii)	**5**	
4*(b)*(i)	**2**	
4*(b)*(ii)	**3**	
5*(a)*(i)	**1**	
5*(a)*(ii)	**2**	
5*(a)*(iii), (iv)	**2**	
5*(b)*(i)	**1**	
5*(b)*(ii)	**1**	
5*(c)*(i), (ii)	**2**	
5*(d)*	**6**	
6*(a)*(i)	**1**	
6*(a)*(ii)	**1**	
6*(a)*(iii)	**2**	
6*(a)*(iv)	**2**	
6*(b)*(i)	**2**	
6*(b)*(ii)	**1**	
6*(c)*	**6**	
7*(a)*(i)	**1**	
7*(a)*(ii)	**2**	
7*(b)*(i)	**1**	
7*(b)*(ii)	**2**	
7*(c)*(i)	**2**	
7*(c)*(ii)	**4**	
Total	**80**	

C480UA01
01

ADDITIONAL MATERIALS

In addition to this examination paper you will need:

- the Data Sheet
- a calculator
- a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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.

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 **5** and **6**.

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Answer **all** *questions.*

1. **Figure 1** is a diagram of the rock cycle.

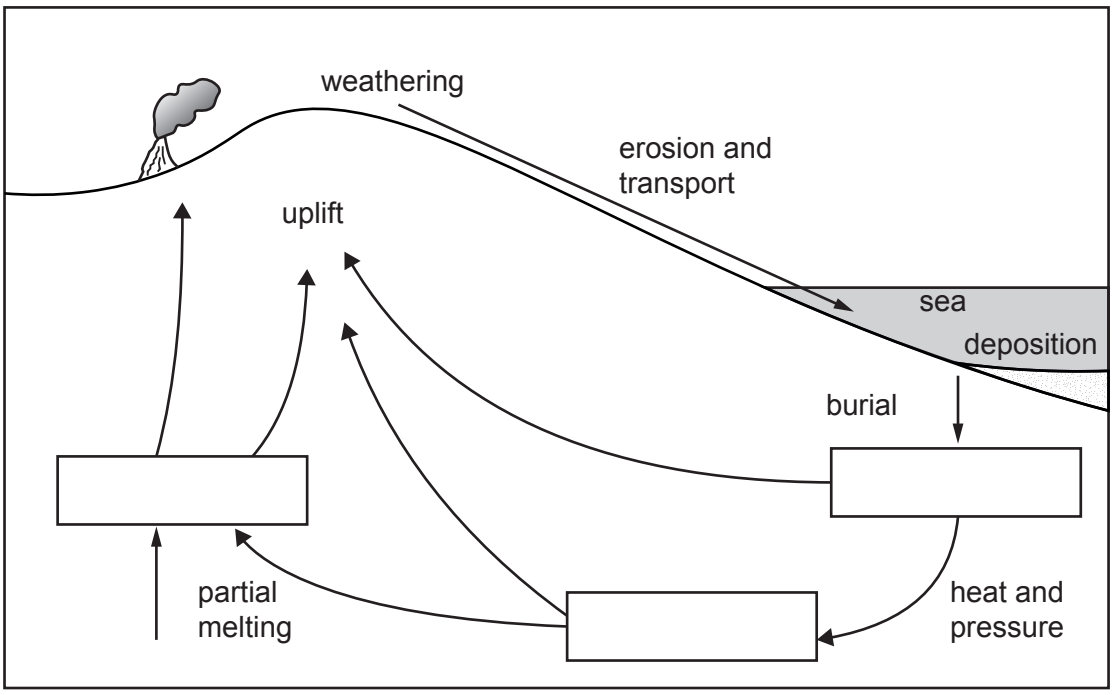

Figure 1

(a) (i) Insert the name of each of the major rock groups (metamorphic, igneous or sedimentary) into the correct box in **Figure 1**. [2]

(ii) A number of processes are described in **Table 1a**. Complete **Table 1a** by matching each of the descriptions to one of the processes given below. [2]

recrystallisation **weathering** **erosion** **cementation** **crystallisation**

Description	Process
Calcite and quartz precipitate in the pores of a sediment to convert it into a sedimentary rock	
The breakdown of rock materials in situ by mechanical, chemical and biological agents	
The conversion of a limestone into a marble during contact metamorphism	
The removal of weathered rock materials by the sea, rivers, wind and ice	

Table 1a

(b) Processes take place at different rates, from seconds (catastrophism) to millions of years (gradualism).
For each of the rock cycle processes listed in **Table 1b**, state whether it is a catastrophic or a gradualistic process by inserting either **ca** (catastrophic) or **gr** (gradualistic) in each box. [3]

Rock cycle process	Catastrophic (ca) or Gradualistic (gr)
Formation of an ocean basin	•
Meteorite impact	•
Formation of a mountain range	•
A large magnitude earthquake	•
A tsunami	•
Formation of a large river delta	•

Table 1b

7

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2. **Figure 2a** shows an ocean ridge with a simplified pattern of present day magnetic stripes in the oceanic crust.
Figure 2b shows the actual pattern of magnetic stripes in the area of Juan de Fuca Ridge in the Pacific Ocean.
Figure 2c shows the timescale for magnetic reversals in the oceanic crust over the last 2 million years.

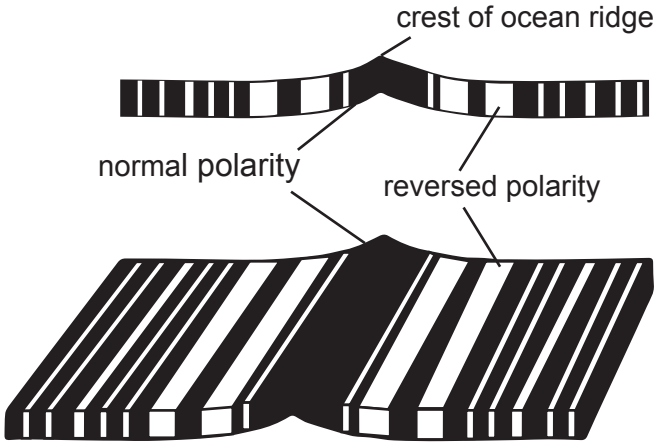

Figure 2a

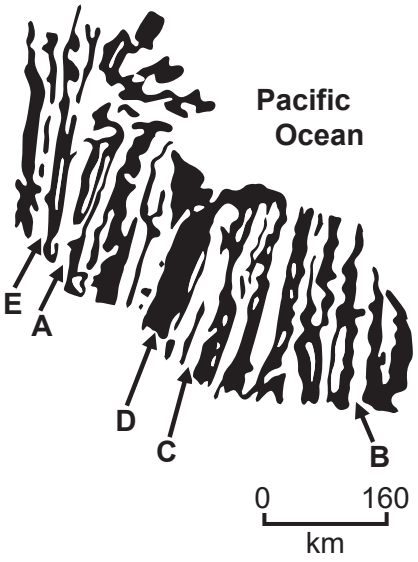

Figure 2b

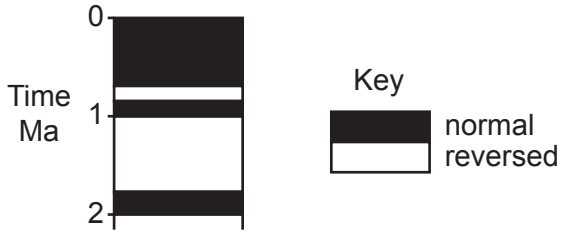

Figure 2c

(a) (i) State the type of plate boundary shown in **Figure 2a**. [1]

.....

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(ii) State which **one** of the following statements is **false** regarding the pattern shown by the magnetic stripes in **Figure 2a**. Tick (✓) only **one** box. [1]

The stripes run parallel to the ocean ridge ☐

The stripes show alternating bands of normal and reversed polarities ☐

The stripes show a symmetrical pattern on either side of the ocean ridge ☐

The oldest magnetic stripes are closest to the ocean ridge ☐

Normal polarity is dominant compared to reversed polarity ☐

(iii) Refer to **Figure 2b**. State which of the letters **A**, **B**, **C**, **D** or **E** is most likely to represent the position of the Juan de Fuca Ridge. Give **one** reason for your choice of letter. [2]

Letter representing the position of the Juan de Fuca Ridge .....

Reason .....

.....

(b) Refer to **Figure 2c**.

(i) State how long the current period of normal polarity has lasted. [1]

..... years

(ii) State the number of times the magnetic field has changed on **Figure 2c**. [1]

Number of times the magnetic field has changed .....

(iii) State the mean length of time that each of the magnetic reversals has lasted during the last 2 million years. Tick (✓) only **one** box. [1]

600,000 years ☐

250,000 years ☐

180,000 years ☐

400,000 years ☐

320,000 years ☐

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05

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(iv) State which **two** of the following may explain why the pattern of magnetic stripes on the Pacific sea floor is more complex than the simplified model shown in **Figure 2a**. Tick (✓) only **two** boxes. [2]

The volcanic activity along the Juan de Fuca Ridge is constant	☐
The oceanic crust has undergone folding	☐
The magnetic reversals may have been displaced by transform faults	☐
The magnetic reversals have been obscured in places by submarine landslides	☐
The magnetic reversals have been affected by recent climate change	☐
The rate of sea floor spreading varies along the Juan de Fuca Ridge	☐

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(c) **Figure 2d** shows the relationship between the age of the oceanic crust and its distance from an oceanic ridge in two oceans.

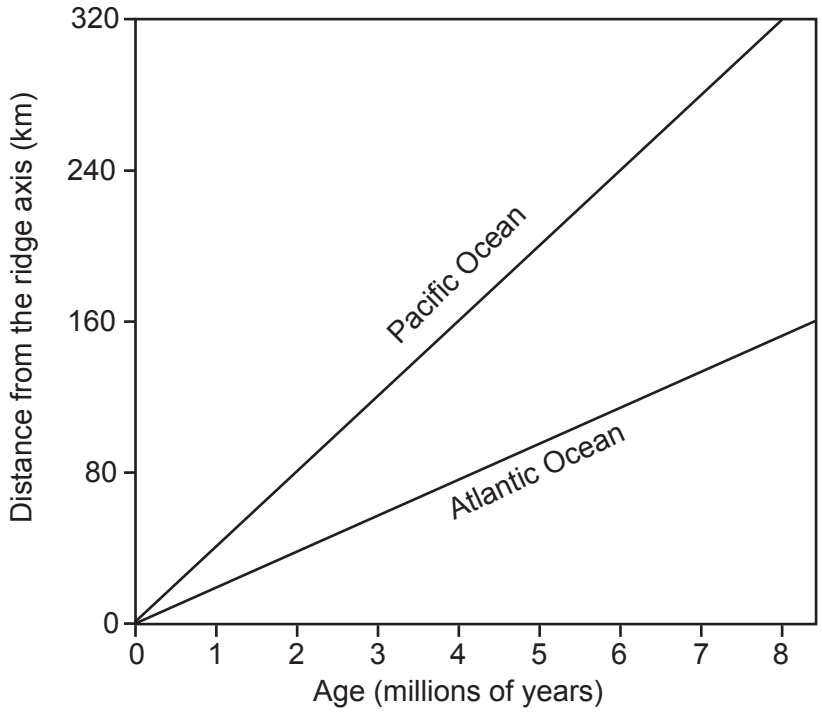

Figure 2d

Refer to **Figure 2d**.

(i) Calculate the average spreading rate in myr^{-1} for the **Pacific Ocean**. [2]
Show your working.

..... myr^{-1}

(ii) State which ocean, Atlantic or Pacific has the **faster** spreading rate. Using evidence from **Figure 2d** give **one** reason to support your answer. [1]

.....Ocean

Reason .....

.....

(iii) Explain how **one** piece of evidence, other than magnetic stripes, can be used to indicate past plate movements. [3]

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07

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3. **Figure 3** shows a cross-section through the Earth showing detail of its internal structure.

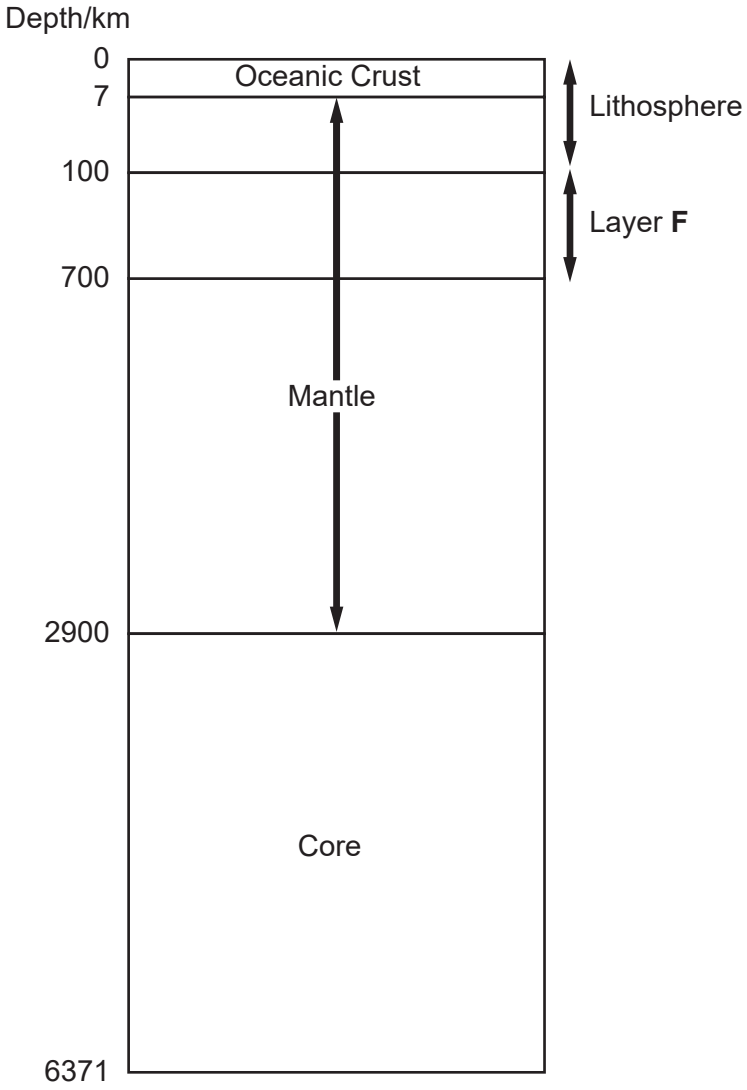

Figure 3

(a) Refer to **Figure 3**.

(i) State the name of layer **F**. [1]

.....

Examiner only

(ii) State which **two** of the following correctly describe the lithosphere. Tick (✓) only **two** boxes. [2]

Composed of the crust and upper mantle	☐
Composed of mantle rock only	☐
Hot, weak and partially molten	☐
Hot, weak and solid	☐
Formed only of continental crust	☐
Cool, rigid and solid	☐

(b) The layers of the Earth shown in **Figure 3** can be compared to characteristic rock types found at the Earth's surface. Complete **Table 2** by drawing lines from each Earth layer to the correct rock type. Only **one** rock type should be linked to each layer of the Earth. [3]

Earth Layers
Oceanic Crust
Mantle
Core

Rock Types
Peridotite
Granite
Basalt
Schist
Iron Meteorite

Table 2

6

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09

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4. **Figure 4a** shows a satellite image of Mars with Valles Marineris, a large canyon, in the centre of the image. Points **J** and **K** mark the two ends of Valles Marineris. **Figure 4b** shows one interpretation of the geological structure (not to scale) along section line **L–M** on **Figure 4a**.

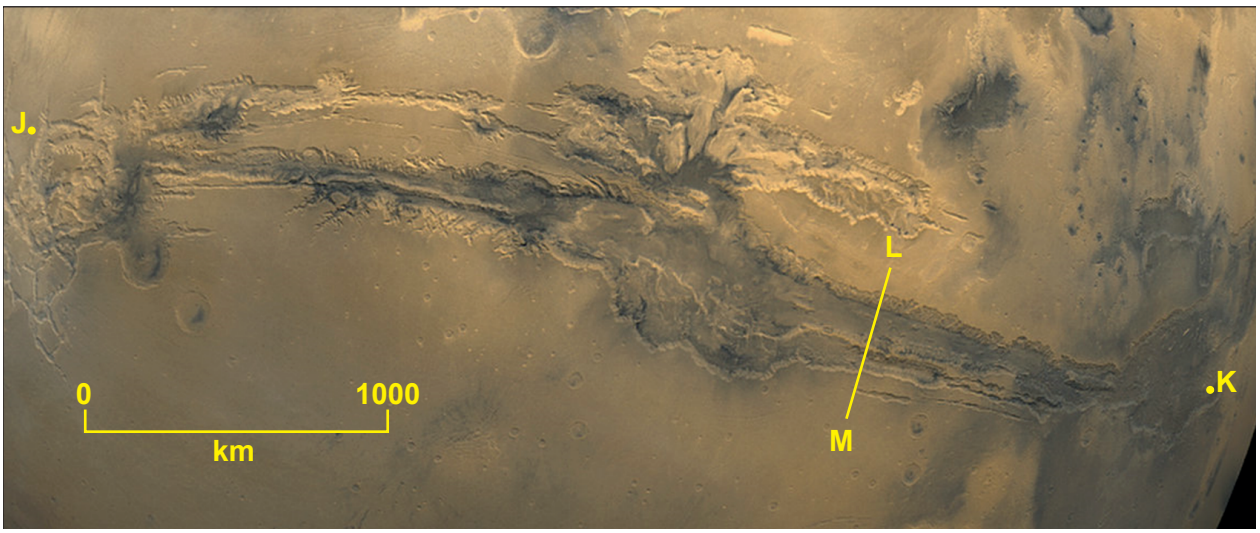


Figure 4a

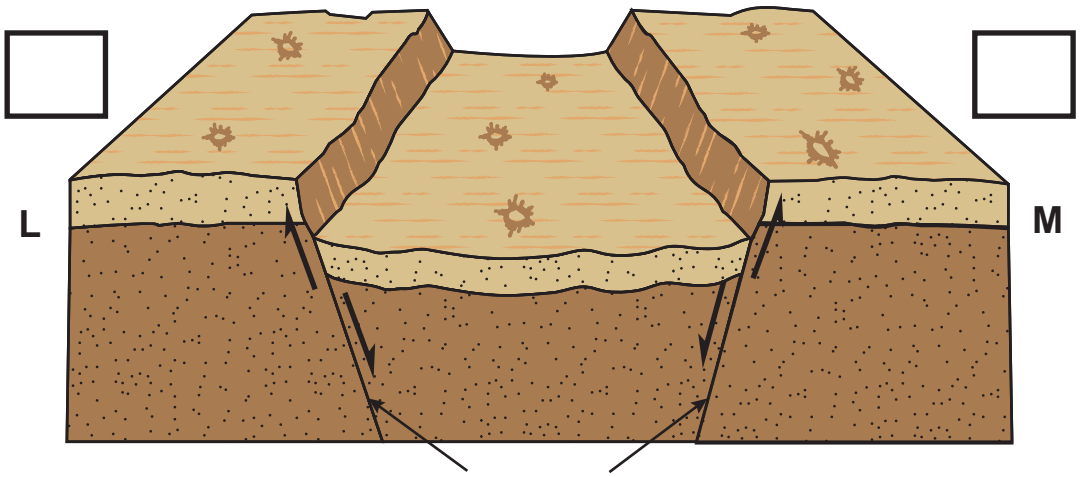


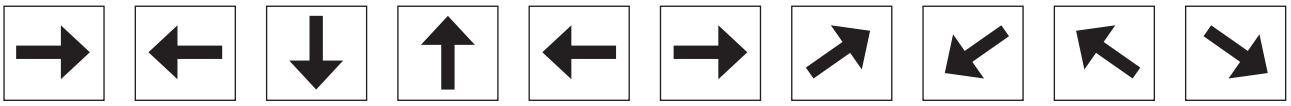
Figure 4b

(a) (i) Using the scale in **Figure 4a**, calculate the length of Valles Marineris from point **J** to **K** on **Figure 4a**. State the length in kilometres. Show your working. [2]

..... km

Examiner only

(ii) Insert arrows in the blank boxes on **Figure 4b** to show the tectonic stress directions involved in the formation of Valles Marineris. Choose from the arrows below. [1]



(iii) State which **two** of the following relate to the geological structure shown in **Figure 4b**. Tick (✓) only **two** boxes. [2]

Formed by compressional stress	☐
Rift valley	☐
Trench formed by subduction	☐
Formed by crustal tension	☐
Formed by shearing forces	☐
Formed by thrust faulting	☐

Examiner only

(b) Refer to **Figure 4c** which shows an enlarged view of part of the Valles Marineris in which a meteorite impact crater has been formed.

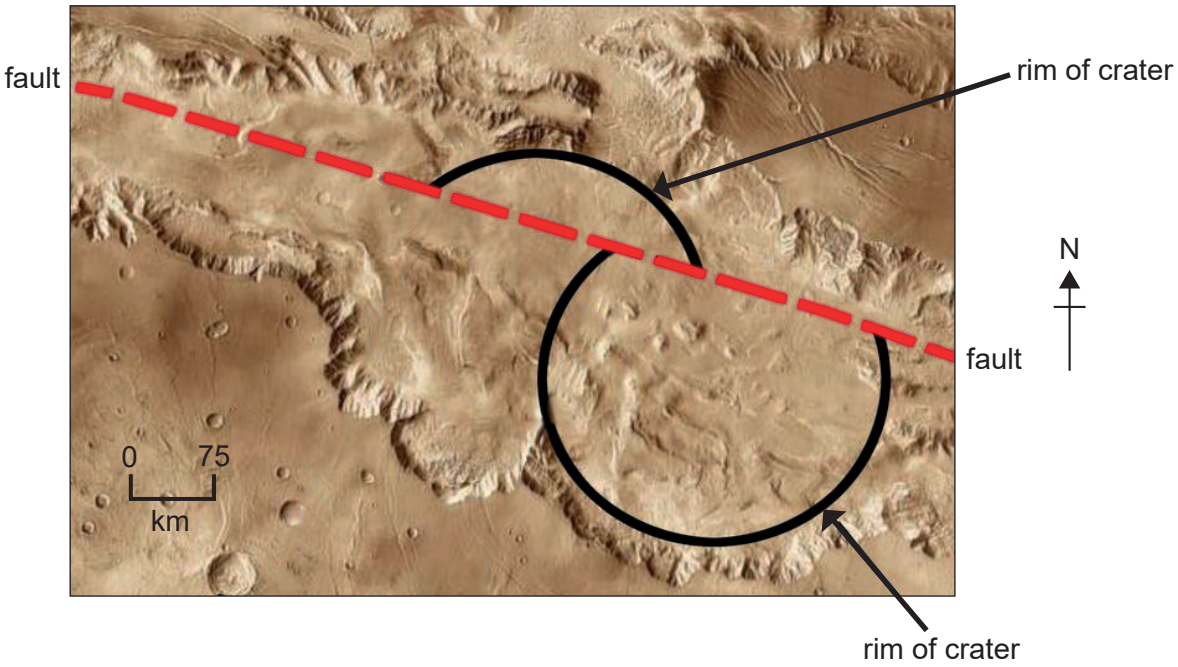


Figure 4c

(i) State which **two** of the following **best** describe the fault shown in **Figure 4c**. Tick (✓) only **two** boxes. [2]

Reverse fault with the northern side downthrown	☐
Strike-slip fault with displacement to the left	☐
Formed by plate collision	☐
Strike-slip fault with displacement to the right	☐
Formed by shear stress	☐
Fault has caused crustal shortening	☐

Examiner only

(ii) Complete **Table 3**, using letters **A**, **B**, **C** and **D**, to show the chronological order in which the following geological events **A**, **B**, **C** and **D** in **Figure 4c** occurred. [3]

A	Formation of meteorite crater
B	Displacement of meteorite crater
C	Formation of Martian crustal rocks
D	Formation of Valles Marineris

	Youngest
	↑
	Oldest

Table 3

10

C480UA01
13

Turn over.

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5. **Figure 5a** is a map showing the epicentres of earthquakes in Mexico (an **LEDC**) leading up to the magnitude 8.0 event of 19th September 1985.

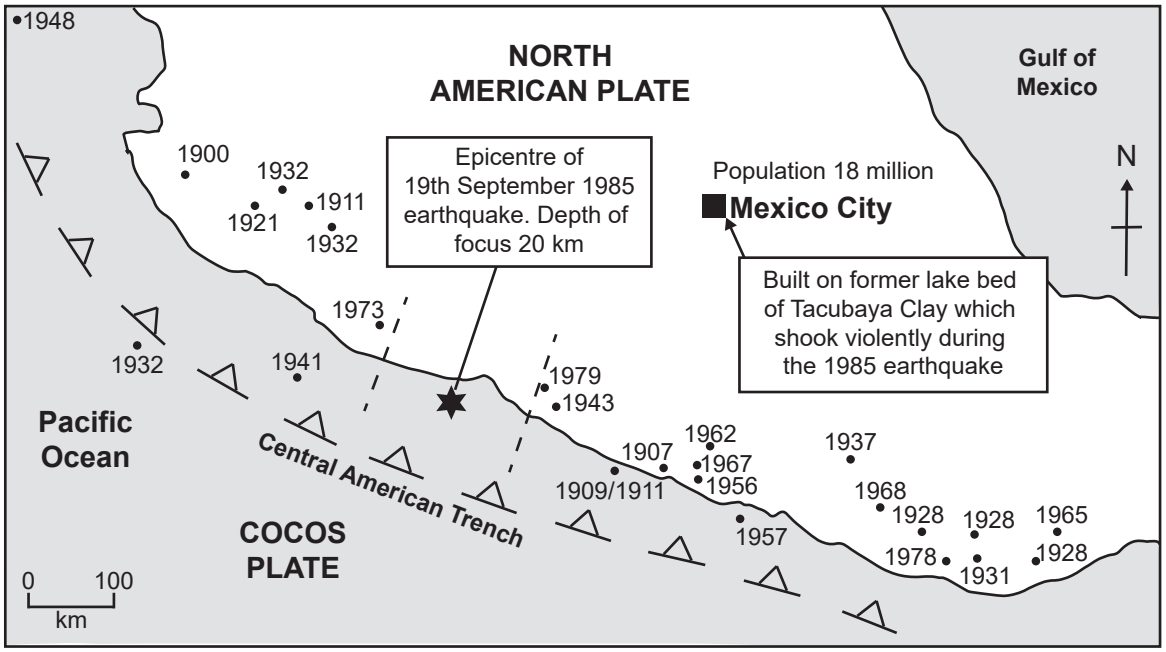

Figure 5a

(a) (i) State the type of plate boundary indicated in **Figure 5a**. Tick (✓) only **one** box. [1]

Convergent oceanic-oceanic boundary ☐

Conservative boundary ☐

Convergent continental-continental boundary ☐

Divergent boundary ☐

Convergent oceanic-continental boundary ☐

(ii) Using the epicentre data in **Figure 5a**, calculate the average time in years between earthquakes for the period 1900 to 1979. Show your working. [2]

..... years

(iii) Explain why some geologists expected a major earthquake greater than magnitude 7.75 to occur in Mexico before 1985. [1]

.....

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Examiner only

(iv) Explain why the 1985 earthquake might have been predicted to occur at this locality along the plate boundary. [1]

.....

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(b) **Figure 5b** and **Figure 5c** show data on the damage related to the 1985 Mexican earthquake.

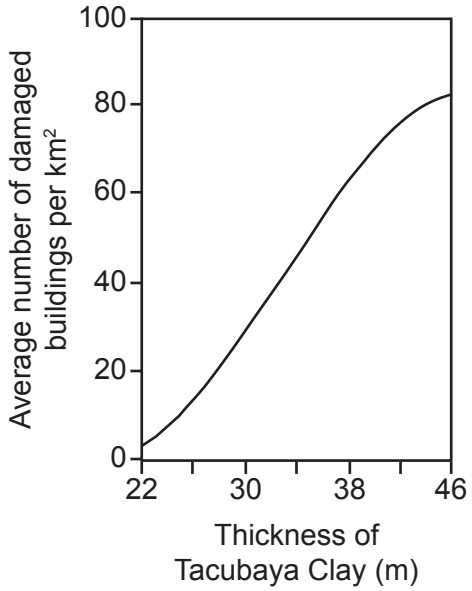

Figure 5b

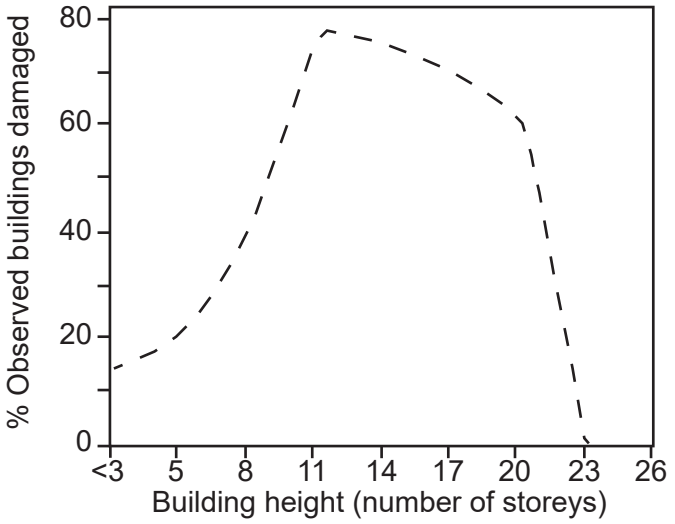

Figure 5c

Refer to **Figure 5b**.

(i) State which **one** of the following best describes the relationship between the thickness of the Tacubaya Clay and damage to buildings in Mexico City. Tick (✓) only **one** box. [1]

As the clay thickness increases there is damage to fewer buildings	☐
Damage to most buildings occurred where clay thickness was 22 metres	☐
There is no clear relationship between clay thickness and damage to buildings	☐
As clay thickness increases there is damage to more buildings	☐
Clay thickness and the number of buildings damaged shows a negative correlation	☐

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(ii) Explain why the damage caused to buildings by the earthquake varied with the thickness of the Tacubaya Clay. [1]

.....

.....

(c) Refer to **Figure 5c**.

(i) State between which two building heights (number of storeys) more than 60% of buildings were damaged. [1]

From ..... to ..... storeys

(ii) Suggest **one** reason why buildings outside this range were less likely to be damaged by this earthquake. [1]

.....

.....

(d) The 1985 Mexican earthquake is estimated to have caused up to 10,000 deaths and damage costing 4 billion dollars. Using **Figure 5a**, **Figure 5b**, and **Figure 5c**, explain the factors that contributed to this earthquake having such a devastating impact on this region. [6 QER]

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Examiner only

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6. **Figure 6a** shows the relationship between atmospheric CO_2 concentrations (ppm) and the average global temperature (°C) from 550 million years ago to 2018.

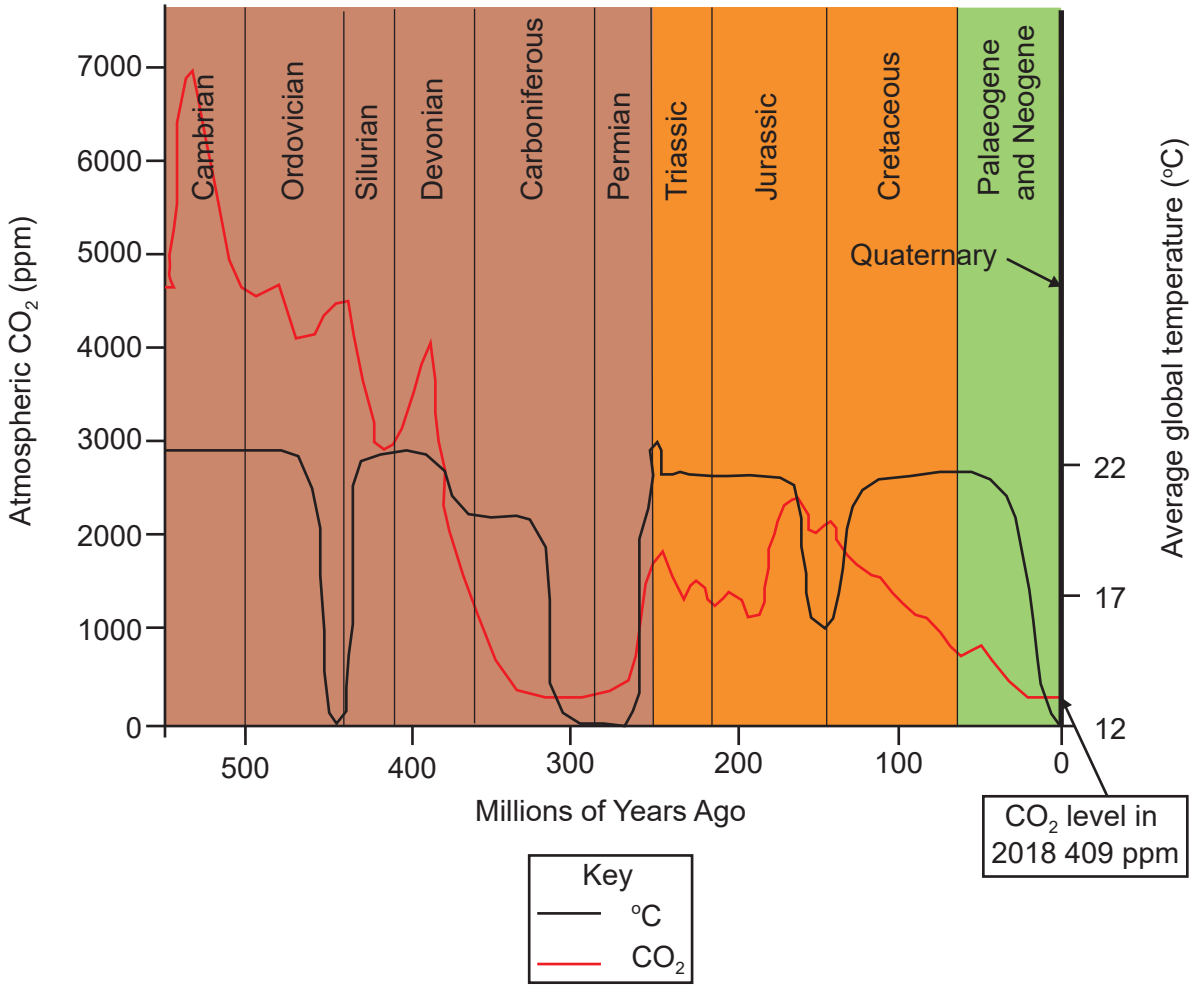

Figure 6a

Refer to **Figure 6a**.

(a) The Earth's climate fluctuates between icehouse and greenhouse conditions. Icehouse conditions can be defined by the average global temperature being below 17 °C.

(i) State the number of times that icehouse conditions have occurred since the Cambrian. [1]

..... times

Examiner only

(ii) State which **one** of the following is **false** regarding atmospheric CO_2 levels. Tick (✓) only **one** box. [1]

CO_2 levels declined from the Cambrian to the Carboniferous ☐

CO_2 levels during the late Carboniferous and early Permian were similar to the present day ☐

CO_2 levels generally increased from the early Permian to the Jurassic ☐

CO_2 levels have gradually declined from the Cretaceous to the present day ☐

CO_2 levels were generally higher in the Cenozoic compared to the Mesozoic ☐

(iii) Calculate how many times more concentrated CO_2 levels were at the peak in the Cambrian compared to the level in 2018. Show your working. [2]

..... times more concentrated than in 2018

(iv) State the **two** major sources of evidence for changes in atmospheric CO_2 levels over geological time. Tick (✓) only **two** boxes. [2]

Burning fossil fuels ☐

Volcanic emissions ☐

Antarctic and Greenland ice cores ☐

Seismic tomography ☐

Changing latitude of the UK through geological time ☐

Deep sea sediment cores ☐

Examiner only

(b) **Figure 6b** shows changing levels of atmospheric CO_2 from 1998 to 2018.
Figure 6c shows changing sea level since 1997.

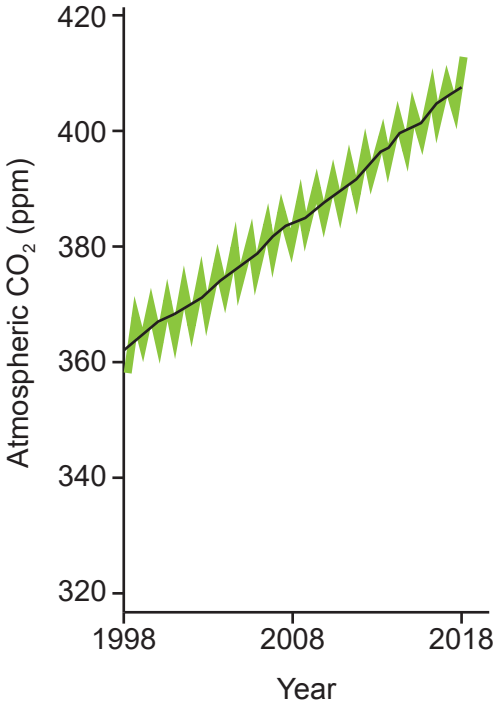

Figure 6b

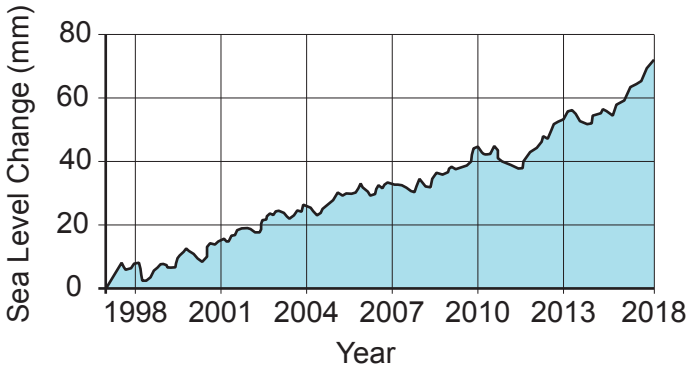

Figure 6c

(i) Describe the relationship between CO_2 levels in **Figure 6b** and sea level change in **Figure 6c**. [2]

.....

.....

.....

(ii) State **one** piece of evidence that might indicate sea levels were lower in the recent geological past. Tick (✓) only **one** box. [1]

A subduction zone ☐

Drowned forests ☐

Carboniferous tillites ☐

An unconformity ☐

Pillow lavas ☐

Examiner only

(c) Explain the relationships between CO_2 levels in the atmosphere, continental ice sheet dimensions and global sea levels. [6 QER]

15

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7. **Figure 7a** is a geological cross-section showing igneous, sedimentary and metamorphic rocks.

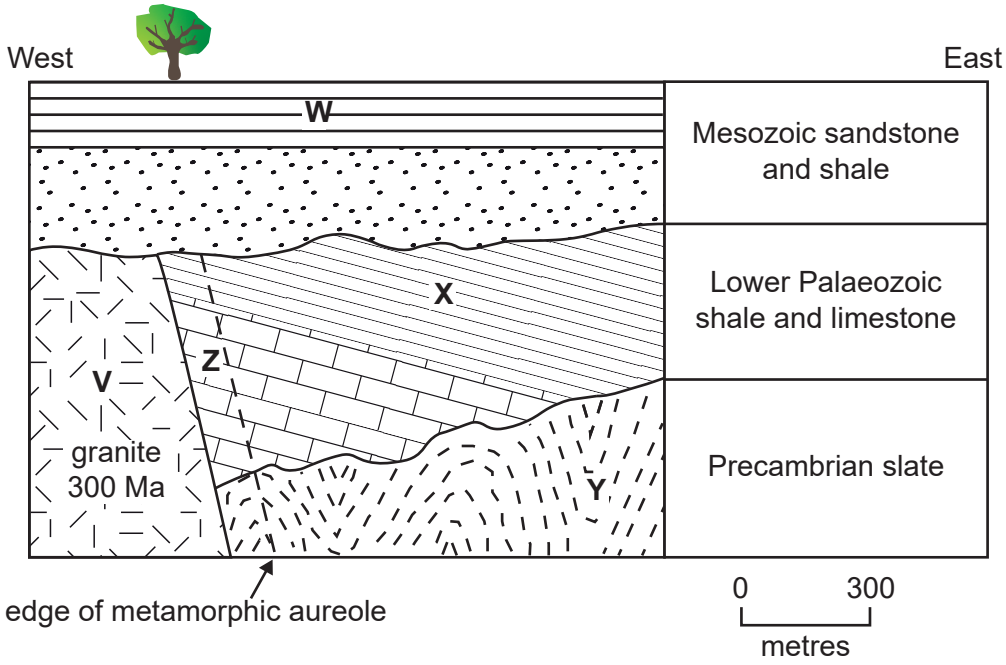

Figure 7a

(a) (i) The age of geological materials can be determined using absolute or relative dating methods. State what is meant by *absolute age*. [1]

.....

.....

(ii) State which **two** of the following best describe the relative age of the granite intrusion shown in **Figure 7a**. Tick (✓) only **two** boxes. [2]

Older than the Precambrian slate and Lower Palaeozoic rocks ☐

Younger than the Mesozoic rocks ☐

Younger than the Precambrian slate and Lower Palaeozoic rocks ☐

The same age as the Lower Palaeozoic rocks ☐

Older than the Mesozoic rocks ☐

The granite is 300 million years old ☐

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(b) The granite intrusion and the Precambrian slate shown in **Figure 7a** can be given absolute ages based on the decay of radioactive isotopes. **Table 4** shows information about radioactive isotopes and their relationship to the number of half-lives elapsed.

Number of half-lives elapsed	% parent isotope	% daughter isotope
0	100	0
1	50	50
2	25	75
3	12.5	•
4	6.25	•

Table 4

(i) Complete **Table 4** to show the percentage of daughter isotopes after three and four half-lives. [1]

(ii) The Precambrian slate in **Figure 7a** contains 6.25% radioactive parent isotope ^{235}**U**. The half-life of the radioactive ^{235}**U** is 703.8 million years. Calculate the absolute age of the Precambrian slate.
Show your working. [2]

Absolute age of the Precambrian slate ..... million years

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(c) **Figure 7b** and **Figure 7c** show fossils collected at different locations from the rocks in **Figure 7a**.

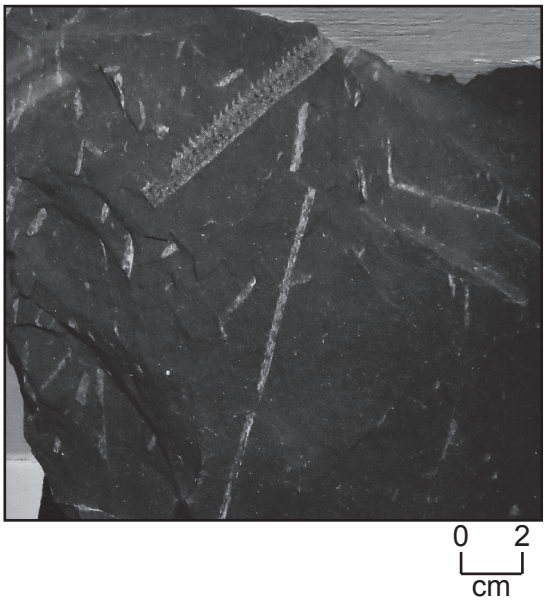

Figure 7b

Figure 7c

(i) Name the fossil groups shown in **Figure 7b** and **Figure 7c**. [2]

Figure 7b ..... **Figure 7c** .....

(ii) State which **one** of the localities, **V**, **W**, **X**, **Y** or **Z** in **Figure 7a**, the fossil shown in **Figure 7c** is most likely to have been collected from. Explain your choice with reference to the localities on **Figure 7a**. [4]

Locality of fossil in **Figure 7c** .....

Explanation .....

.....

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12

END OF PAPER

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Acknowledgements:

Figure 2d https://opentextbc.ca/geology/wp-content/uploads/sites/110/2015/08/Schematic-representation-of-the-lithologic-layers.png

Figure 4a https://www.space.com/20446-valles-marineris.html

Figure 4b https://nasa.gov/mission_pages/LRO/news

Figure 6a https://edberry.com/blog/climate-physics/agw-hypothesis/temperature-and-co2-history/

Figure 6b https://esrl.noaa.gov/gmd/obop/mlo/programs/programs.html

Figure 6c https://infograph.venngage.com/p/195522/sea-level-rise

Figure 7b https://commons.wikimedia.org/wiki/File:

Figure 7c assets3.fossilera.com/Fossils/

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