| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4250/01

# GEOLOGY

## Theory Paper
## (Paper version of on-screen assessment)

A.M. WEDNESDAY, 21 May 2014

1 hour 30 minutes

| For Examiner's use only | | |
|---|---|---|
| **Section** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **12** | |
| **2.** | **17** | |
| **3.** | **21** | |
| **4.** | **12** | |
| **5.** | **7** | |
| **6.** | **19** | |
| **7.** | **12** | |
| **Total** | **100** | |

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### ADDITIONAL MATERIALS

In addition to this examination paper you will need a:

- Data Sheet;
- calculator.

### INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Write your answers in the spaces provided.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets alongside each question.

You are reminded that assessment will take into account the quality of written communication *(QWC)* used in your answers to **Section 2 Q14** and **Section 3 Q10**.

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*Answer* **all** *questions in each section.*

**Section 1 – answer questions 1-6**

**Figure 1** is a photograph of part of a cliff section.

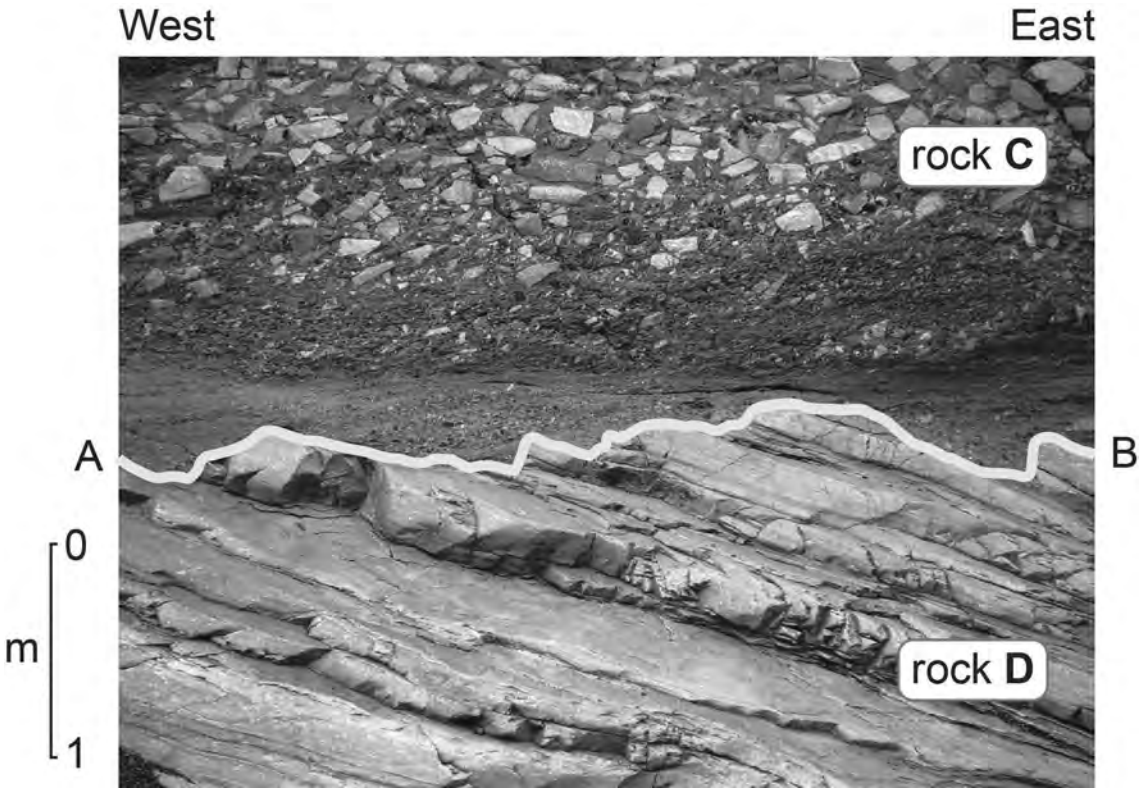


**Figure 1**

**1.** Name the structure shown by the line **A–B**. Tick (✓) only **one** box. [1]

| | |
|---|---|
| fault | ☐ |
| angular unconformity | ☐ |
| horizontal bedding plane | ☐ |
| axial plane trace of a fold | ☐ |
| metamorphic aureole | ☐ |

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**2.** Arrange the events below in the order they occurred to form the structure marked **A–B**. Write them in their correct positions in **Table 1**. [2]

erosion of rock **D**

deposition of rock **D**

deposition of rock **C**

uplift and tilting

youngest

oldest

**Table 1**







**Turn over.**

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**Figure 2** is a photograph of rock **C** in **Figure 1**.

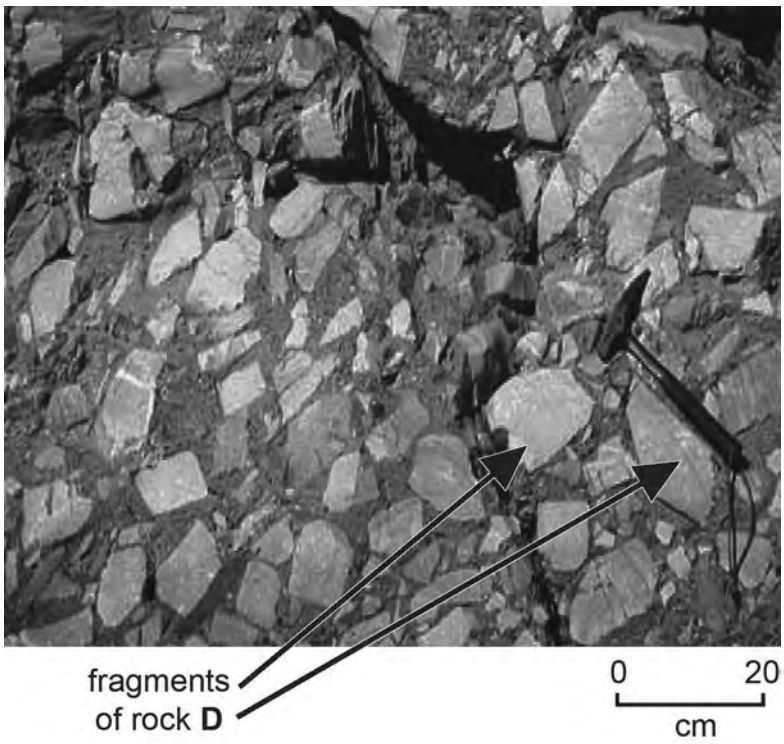


**Figure 2**

**3.** Describe the texture of rock **C**. Tick (✓) only **three** boxes. [3]

| | |
|---|---|
| crystalline | ☐ |
| well sorted | ☐ |
| coarse grained fragments | ☐ |
| poorly sorted | ☐ |
| medium grained fragments | ☐ |
| angular fragments | ☐ |
| foliated | ☐ |

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**4.** Name rock **C**. Tick (✓) only **one** box. [1]

| | |
|---|---|
| conglomerate | ☐ |
| sandstone | ☐ |
| shale | ☐ |
| limestone | ☐ |
| breccia | ☐ |

**5.** Explain **one** feature of the **texture** of rock **C** which suggests that the fragments were **not** transported very far before deposition. [2]

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**6.** Describe **one** type of physical weathering which could have produced the fragments of rock **D** in upland areas in present day northern Europe. [3]

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**Turn over.**

**Section 2 – answer questions 7-14**

**Figure 3** is a geological map of part of north Pembrokeshire.

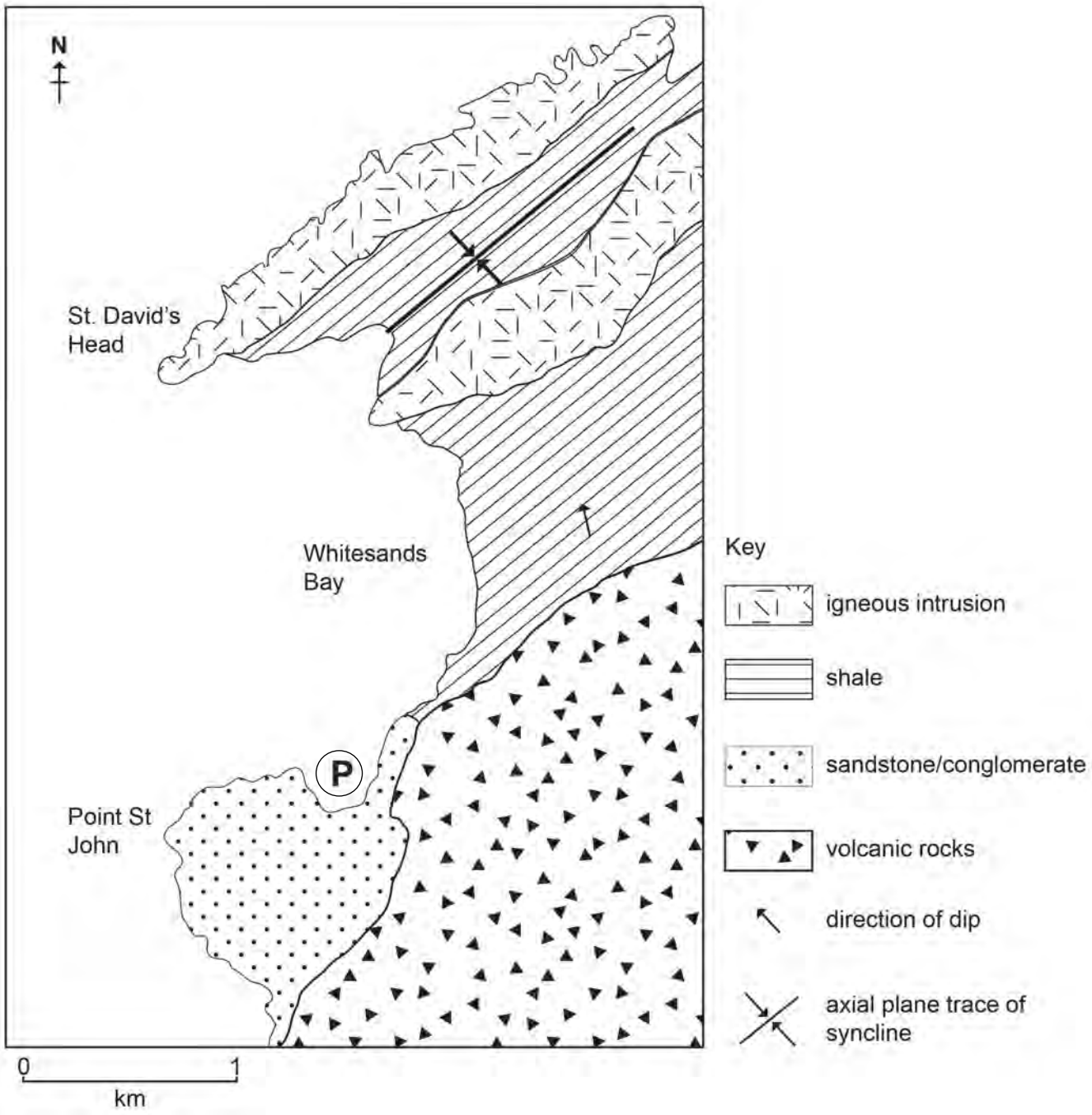


**Figure 3**

**Figure 4** is a microscopic view of the rock forming the igneous intrusion shown in **Figure 3**.

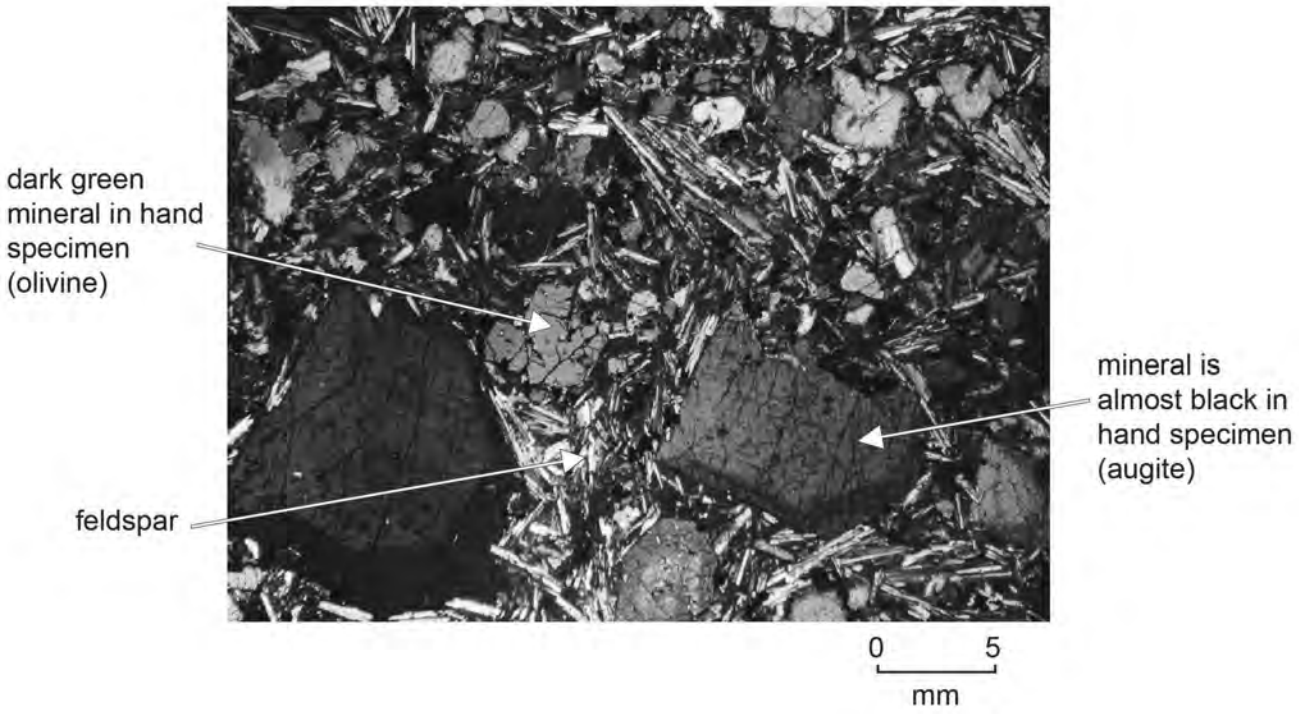


**Figure 4**



**7.** Which of the following statements about the rock in **Figure 4** are **correct**? Tick (✓) only **two** boxes. [2]

| | |
|---|---|
| the rock is granite | ☐ |
| the texture suggests two stages of cooling | ☐ |
| the texture is poorly sorted | ☐ |
| the rock is basalt | ☐ |
| the texture suggests slow cooling at the surface | ☐ |
| the rock is gabbro | ☐ |

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**8.** The igneous intrusion in **Figure 3** has been dated radiometrically to be 450 million years old. State the age of the shale in **Figure 3**. Tick (✓) only **one** box. [1]

| | |
|---|---|
| younger than 450 million years | ☐ |
| 450 million years old | ☐ |
| older than 450 million years | ☐ |
| 40.5 million years old | ☐ |
| Carboniferous | ☐ |

**9.** For radiometric dating, state the minimum information you need to calculate the age of a mineral (and therefore the rock that the mineral comes from). Tick (✓) only **two** boxes. [2]

| | |
|---|---|
| half-life of the parent isotope | ☐ |
| total amount of the unstable parent isotope at the start of radioactive decay | ☐ |
| total amount of the stable daughter isotope | ☐ |
| ratio of the parent isotope to the daughter isotope | ☐ |
| percentage of the mineral present in the rock | ☐ |

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**10.** A mineral in an igneous rock contains 40 % of the unstable parent isotope. State the number of half-lives that have elapsed since the mineral crystallised. Tick (✓) only **one** box. [1]

| | |
|---|---|
| less than one | ☐ |
| one | ☐ |
| between 1 and 2 | ☐ |
| two | ☐ |
| between 2 and 3 | ☐ |
| more than three | ☐ |

**11.** The igneous intrusion in **Figure 3** has been identified as a large **sill**. Suggest **two** pieces of evidence for identifying the igneous intrusion as a large **sill** rather than a pluton. [2]

1. .....

.....

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2. .....

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**Turn over.**

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**Figure 5** is a photograph of graptolites collected from the shale shown in **Figure 3**.

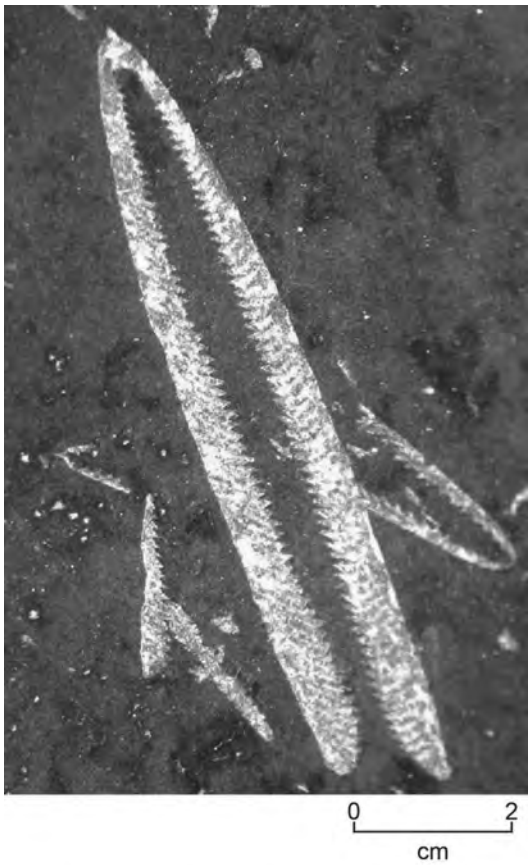


**Figure 5**

**12.** Which of the following statements about graptolites and the shale are **correct**? Tick (✓) only **three** boxes. [3]

| | |
|---|---|
| the shale accumulated in a low energy environment | ☐ |
| graptolites evolved slowly so are useful in the relative dating of rocks | ☐ |
| the large graptolite in **Figure 5** has many stipes and thecae grow on both sides of the stipe | ☐ |
| graptolites live on the sea bed and therefore have a wide geographic distribution | ☐ |
| the large graptolite in **Figure 5** has one stipe with thecae on both sides | ☐ |
| graptolites are useful fossils for correlating rocks | ☐ |
| the large graptolite in **Figure 5** has thecae on one side of the stipe and they point inwards | ☐ |

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**Figure 6** shows sketches of four different graptolites found in rocks of different ages from the Lower Palaeozoic.

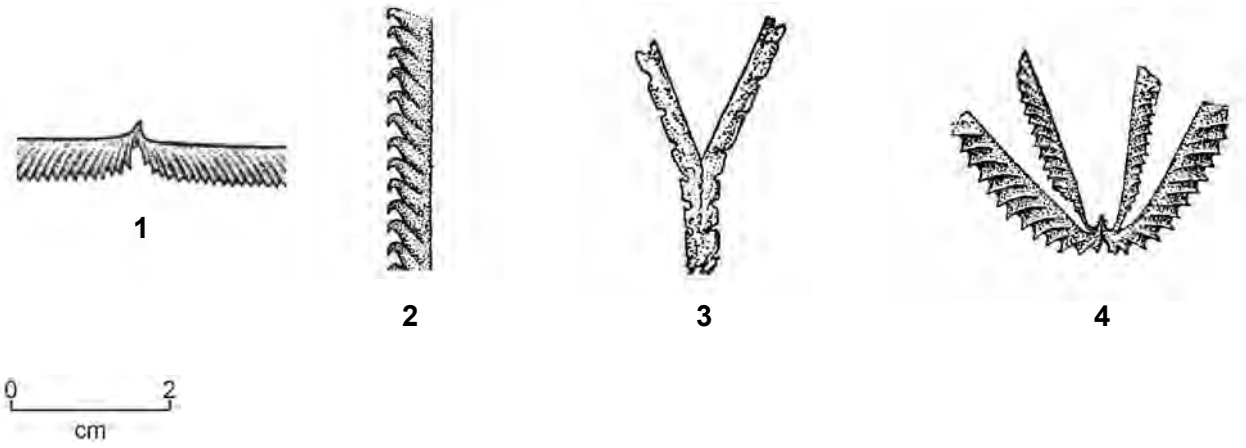


**Figure 6**

**13.** Place the graptolites in their correct order of age in **Table 2**. You may sketch the graptolites in the appropriate boxes in **Table 2** or use the numbers **1**, **2**, **3** and **4** to represent them. [2]



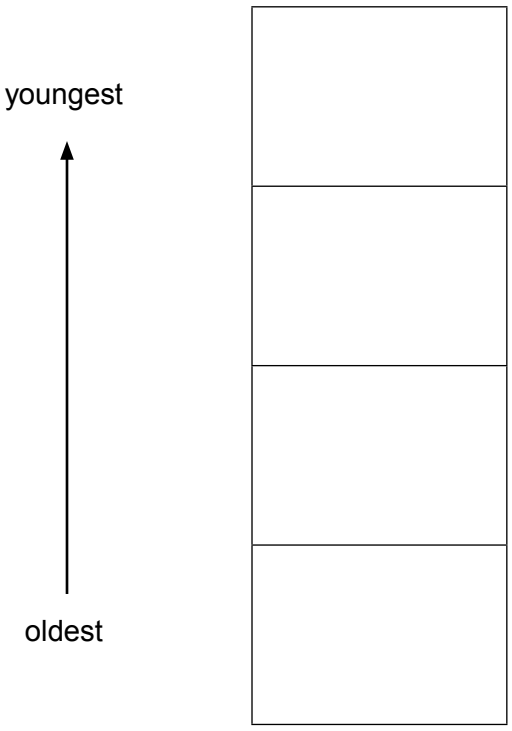


**Table 2**

Examiner only

**Figure 7** is a photograph taken looking **north** from the location marked (P) in **Figure 3**.


**Figure 7**

**14.** Using the photograph and **Figure 3**, explain how the landforms of the area have been influenced by the geology. *QWC* [4]

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## Section 3 – answer questions 1-10

**Figure 8** is a map showing the geological features of the South American and Nazca plate boundaries.

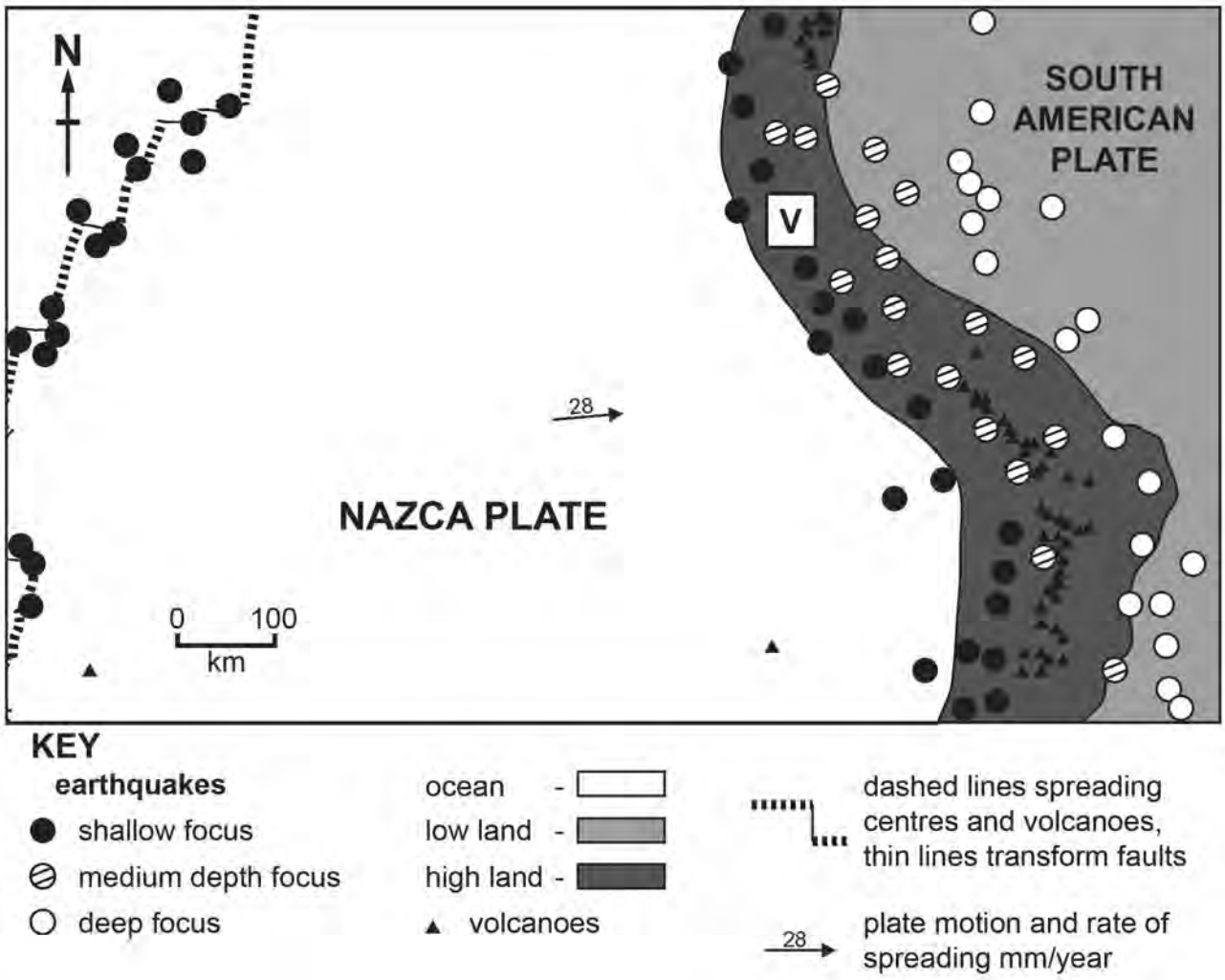


**Figure 8**

Examiner only

**1.** State which of the following geological features are present at the **western** boundary of the **Nazca Plate**. Tick (✓) only **two** boxes. [2]

- ocean ridge ☐
- deep, medium depth and shallow focus earthquakes ☐
- displacement by thrust faults ☐
- mainly andesitic volcanic activity ☐
- volcanic island arc ☐
- shallow focus earthquakes only ☐

**2.** Name the type of plate boundary formed by the **western** boundary of the **Nazca Plate**. Tick (✓) only **one** box. [1]

- convergent (destructive) oceanic-oceanic ☐
- convergent (destructive) oceanic-continental ☐
- divergent (constructive) ☐
- conservative ☐
- convergent (destructive) continental-continental ☐

**3.** State which of the following geological features are present along the boundary between the **Nazca Plate** and the **South American Plate**. Tick (✓) only **two** boxes. [2]

- ocean ridge ☐
- deep, medium depth and shallow focus earthquakes ☐
- coastal mountain chain ☐
- mainly basaltic volcanic activity ☐
- volcanic island arc ☐
- shallow focus earthquakes only ☐

Examiner only

**4.** Name the type of plate boundary formed between the **Nazca Plate** and the **South American Plate**. Tick (✓) only **one** box. [1]

convergent (destructive) oceanic-oceanic ☐

convergent (destructive) oceanic-continental ☐

divergent (constructive) ☐

conservative ☐

convergent (destructive) continental-continental ☐

**5.** Describe and explain the pattern of earthquake foci along the plate boundary between the **Nazca Plate** and the **South American Plate**. [3]

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Examiner only

**Figure 9** shows the results of a magnetic survey measured at right angles across the Mid-Atlantic ridge.

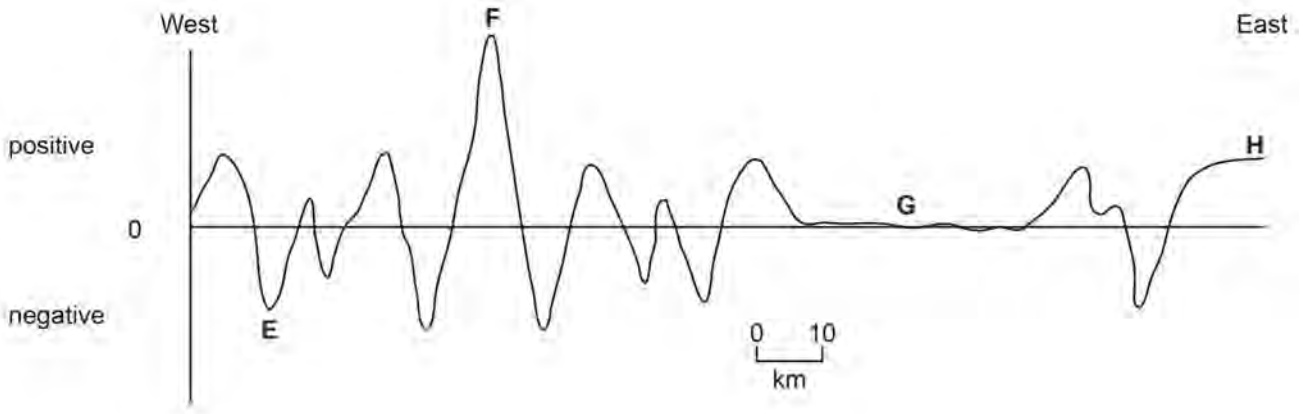


**Figure 9**

**6.** Letters **E–H** on **Figure 9** represent locations across the Mid-Atlantic ridge. Draw a line from each letter to the most appropriate description of that location. [4]

| | |
|---|---|
| **E** | ridge crest |
| **F** | ocean trench |
| **G** | oldest portion of oceanic crust in this area |
| **H** | wide area where there is no magnetic anomaly |
| | area of reversely magnetised ocean crust |

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**Turn over.**

Examiner only

**7.** State which of the following may contribute to plate movement. Tick (✓) only **two** boxes. [2]

cold rigid continental lithosphere ☐

magnetic stripes ☐

low heat flow at the ocean ridge ☐

thermal convection in the mantle ☐

transform faults ☐

weak partially molten asthenosphere ☐

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The letter **V** on **Figure 8** marks the site of the Nevado del Ruiz volcano which erupted in 1985 producing an enormous volcanic mudflow (lahar). The lahar caused an estimated 25,000 deaths and buried much of the town of Armero as shown in **Figure 10**.

**Figure 10**

**8.** State why volcanic mudflows (lahars) created by explosive volcanoes are particularly destructive. Tick (✓) only **one** box. [1]

- they are landslides ☐
- they flow on top of a cushion of hot air and gas ☐
- they gain energy as eruptions eject material out of the volcanic vent ☐
- they form when an entire volcano collapses ☐
- they are a dense mass of water and ash that flow down slopes at high speed ☐

**9.** State which of the following does **not** cause a volcanic mudflow (lahar). Tick (✓) only **one** box. [1]

- melting of snow by an eruption on a volcano summit ☐
- flow of lava into the ocean ☐
- pyroclastic flow enters a river ☐
- heavy rainfall during eruption of volcanic ash ☐
- collapse of a crater lake combining with ash ☐

Examiner only

**10.** The disaster at Armero could have been avoided as geologists had predicted that there was *'100 percent probability of volcanic mudflows (lahars) … with great danger for Armero.'*

Describe **two** methods which could have been used to help predict this volcanic eruption and so minimise the effects of the disaster. *QWC* [4]

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Examiner only

## Section 4 – answer questions 11-17

**Figure 11** is a photograph of part of a cliff section.


**Figure 11**

**11.** State which of the following statements about the folds are **correct**. Tick (✓) only **two** boxes. [2]

| | |
|---|---|
| the folding is caused by tensional stress | ☐ |
| the strike of the folds is N–S | ☐ |
| fold limbs dip at different angles | ☐ |
| the strike of the folds is E–W | ☐ |
| the axial planes of the folds dip to the south | ☐ |
| fold limbs have similar dip angles | ☐ |

Examiner only

**Figure 12** is a geological map. **The land in the area is flat**.

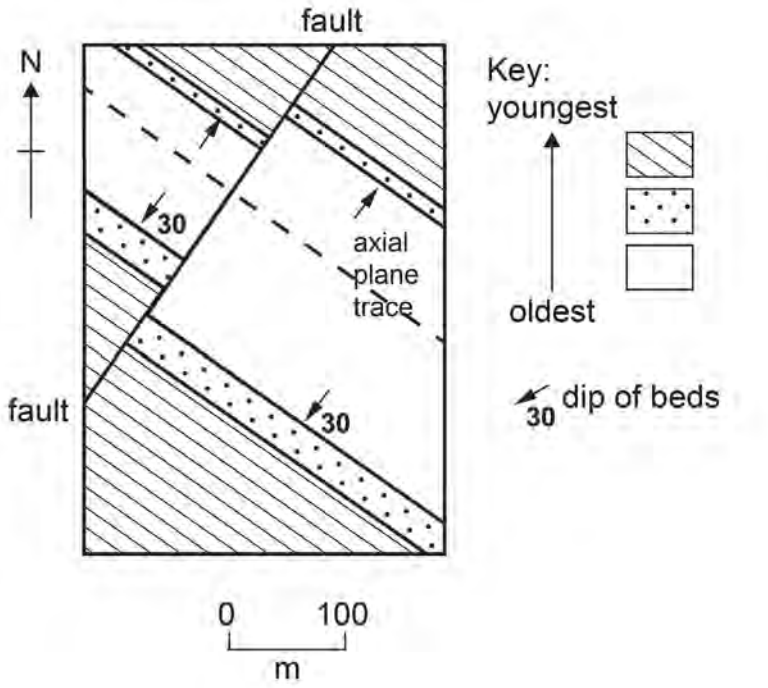


**Figure 12**

**12.** State which of the following statements about the map are **correct**. Tick (✓) only **three** boxes. [3]

| | |
|---|---|
| the fold is an anticline | ☐ |
| the angle of dip on the north eastern limb of the fold is less than 30° | ☐ |
| the fault is a strike-slip fault | ☐ |
| the fold is a syncline | ☐ |
| the fault is a dip-slip fault (normal/reverse/thrust) | ☐ |
| the angle of dip on the north eastern limb of the fold is more than 30° | ☐ |

Examiner only

**Figure 13** is a cross-section drawn from the results of a seismic survey in an area where oil and gas are trapped.

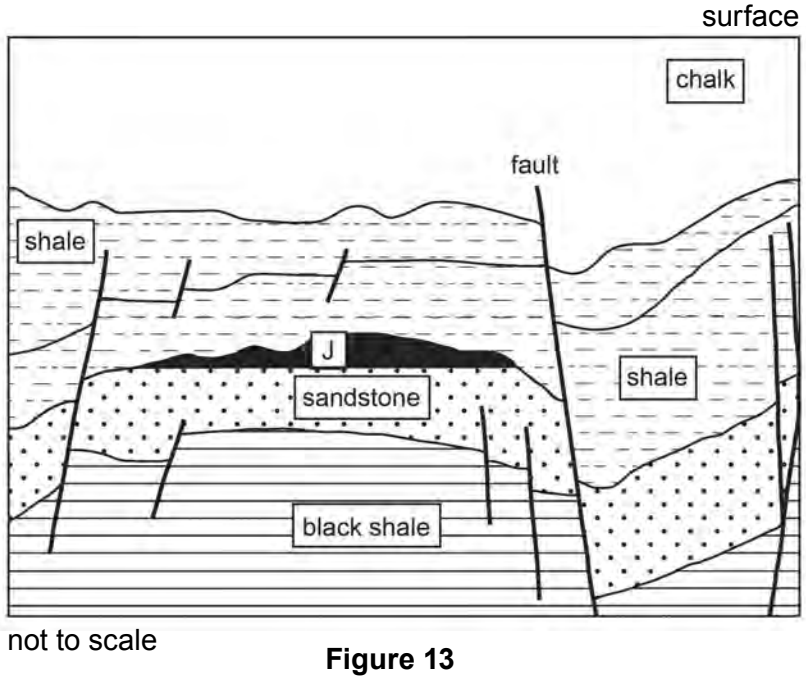


**Figure 13**

**13.** Name the type of oil trap at **J**. Tick (✓) only **one** box. [1]

anticline ☐

fault ☐

salt dome ☐

syncline ☐

**14.** Which of the following is **not** involved in the formation of oil and gas reservoirs? Tick (✓) only **one** box. [1]

migration of hydrocarbons ☐

seepage of oil at the surface ☐

migration blocked by a trap ☐

deposition of organic-rich material ☐

heating to between 50 °C and 100 °C at depths of approximately 3 km ☐

Examiner only

**15.** State which of the following would **prove** the presence of oil underground. Tick (✓) only **one** box. [1]

| | |
|---|---|
| geophysical survey showing presence of salt domes | ☐ |
| seismic survey showing presence of a structural trap | ☐ |
| oil in the drilling mud | ☐ |
| gas in the drilling mud | ☐ |
| geological mapping showing presence of a fault at the surface | ☐ |

**16.** State which of the following **does not** cause damage to the environment as a result of oil and gas extraction and use. Tick (✓) only **one** box. [1]

| | |
|---|---|
| seismic exploration for oil and gas | ☐ |
| presence of oil platforms and drilling rigs | ☐ |
| burning oil and gas in cars and power stations | ☐ |
| geological mapping | ☐ |
| leakage of oil during drilling and transport | ☐ |

**17.** Explain why depleted oil and gas fields are suitable for the storage of carbon dioxide produced by power stations. [3]

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**Turn over.**

Examiner only

## Section 5 – answer questions 1-5

**Figure 14** is a map showing the results of a geochemical analysis of river sediment near a granite pluton intruded by mineral veins. Shown below the map are the results of a magnetic survey along the line **K–L**.

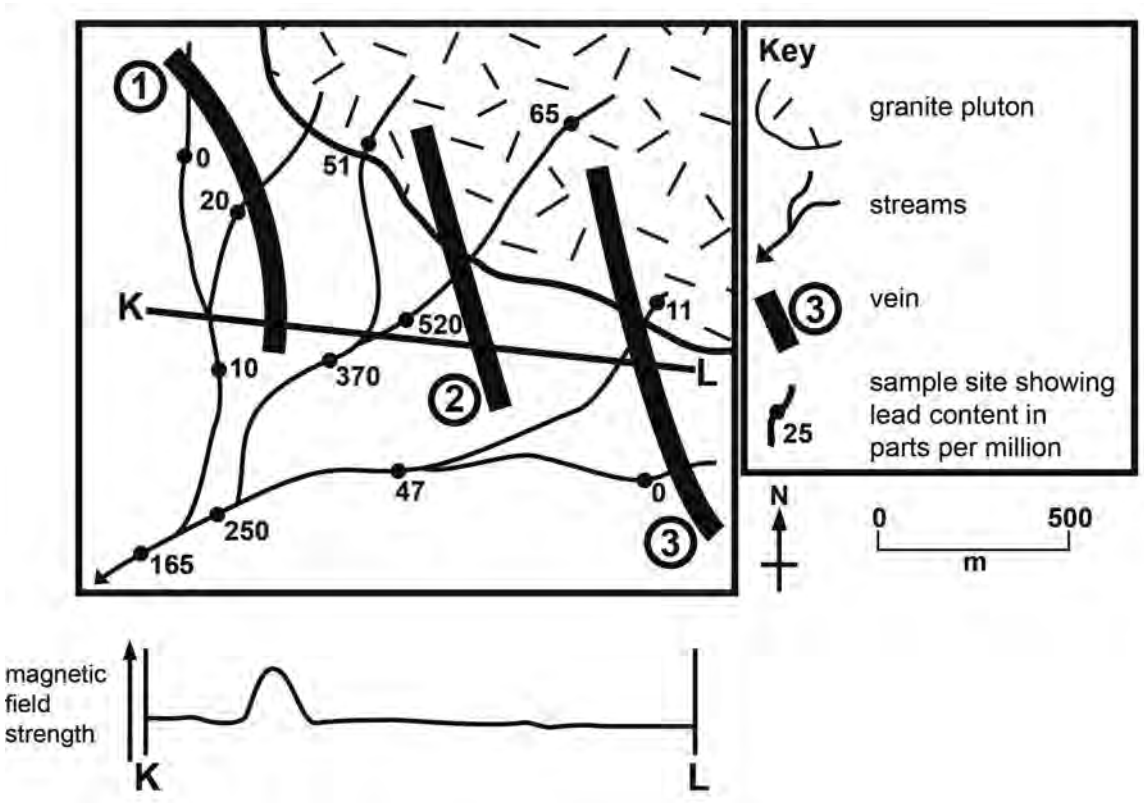


**Figure 14**

**1.** State which of the mineral veins (**1**, **2** or **3**) contains a possible lead ore deposit. [1]

mineral vein ☐

**2.** Name the mineral which is the ore of lead. Tick (✓) only **one** box. [1]

gold ☐

diamond ☐

haematite ☐

galena ☐

halite ☐

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**3.** State the most likely origin of the mineral containing lead. Tick (✓) only **one** box. [1]

| | |
|---|---|
| metamorphic recrystallisation in the metamorphic aureole | ☐ |
| crystallisation from an evaporating solution | ☐ |
| crystallisation of granite magma | ☐ |
| crystallisation from hydrothermal fluids | ☐ |
| crystallisation as a cement in pore waters | ☐ |

**4.** Give **one** explanation for the results of the magnetic survey along the line **K–L** shown in **Figure 14**. [2]

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**5.** Describe **one** environmental problem caused by the mining of metallic mineral ores. [2]

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**Turn over.**

Examiner only

## Section 6 – answer questions 6-16

**Figure 15** is a sedimentary log of Upper Palaeozoic rocks sketched by a student.

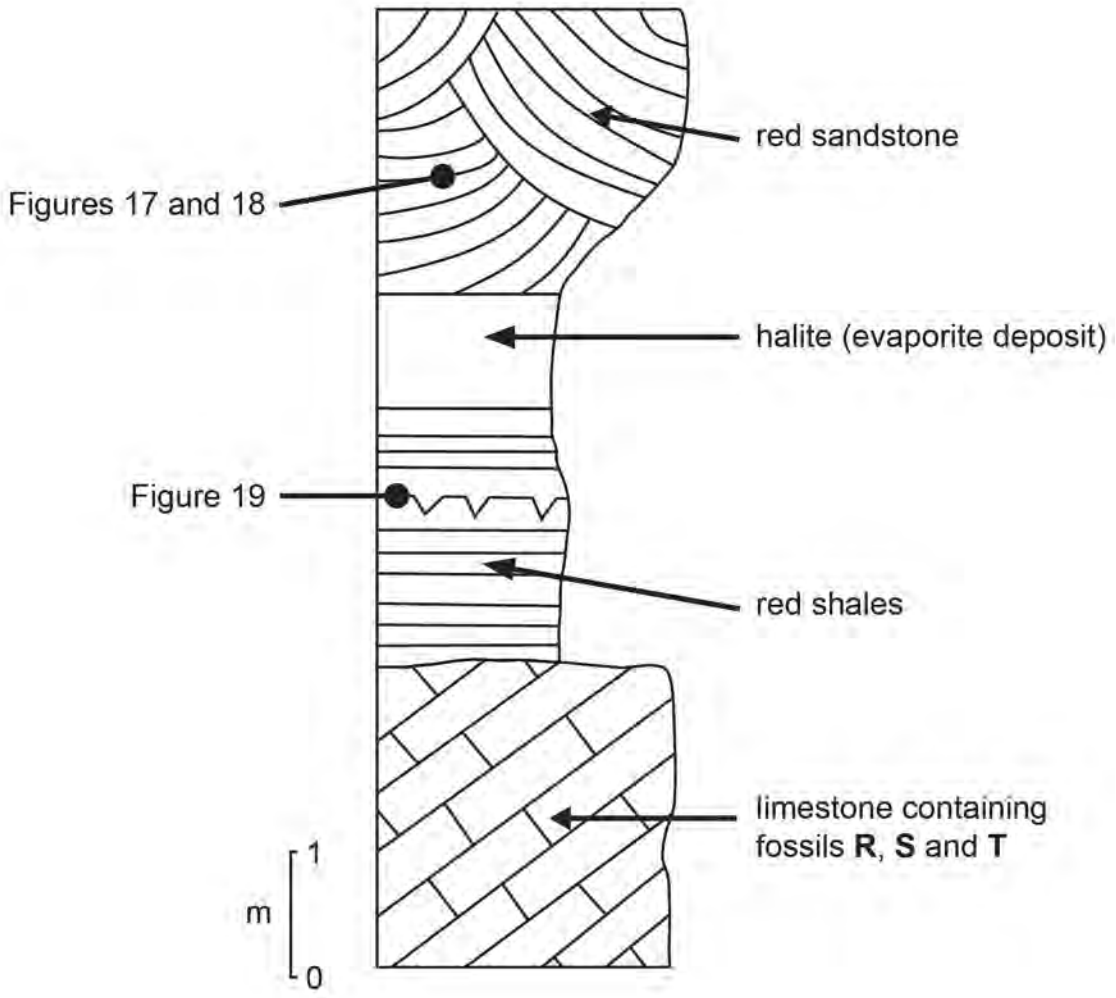


**Figure 15**

Examiner only

**Figure 16** shows fossils **R**, **S** and **T** found within the limestone in **Figure 15**. Fossil **T** was found growing vertically upwards in the limestone.

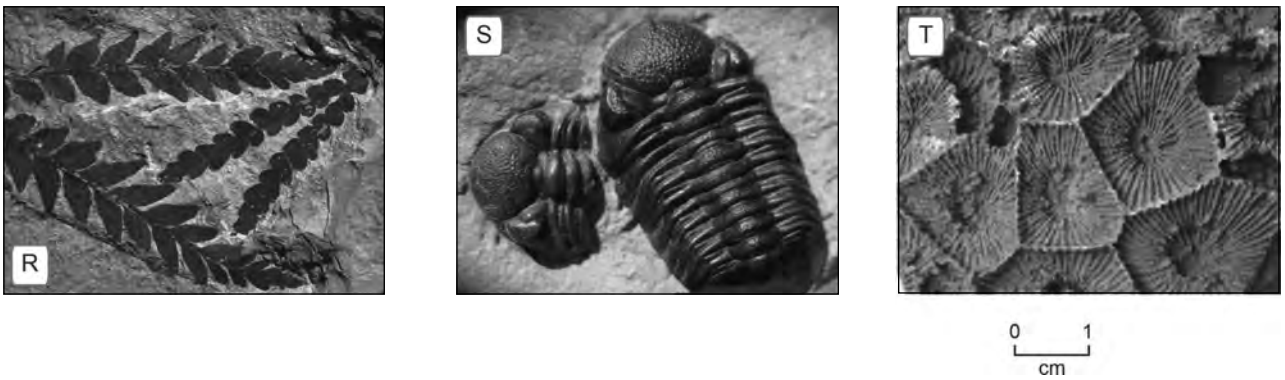


**Figure 16**

**6.** Identify fossils **R**, **S** and **T**. Draw a line from each letter to the correct name. [3]

| | |
|---|---|
| | reef-building coral |
| **R** | plant |
| | trilobite |
| **S** | graptolite |
| **T** | cephalopod |
| | trace fossil |

Examiner only

**7.** Describe the mode of life of fossils **R**, **S** and **T**. Draw a line from each letter to the correct description. [3]

| | |
|---|---|
| | crawled around on land |
| **R** | lived as a colony fixed to the sea bed |
| **S** | swam in fresh water |
| **T** | not mobile and lived on land |
| | crawled around on the sea bed |

**8.** State the likely environment for the fossil assemblage (**R**, **S** and **T**) found in the limestone. Tick (✓) only **one** box. [1]

| | |
|---|---|
| delta | ☐ |
| shallow marine shelf | ☐ |
| deep marine environment | ☐ |
| river | ☐ |
| desert and shallow lake | ☐ |

**9.** Explain how all the different fossils in this assemblage were preserved in the same bed of limestone. [2]

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Examiner only

**Figure 17** is a microscopic view of the red sandstone in **Figure 15**.

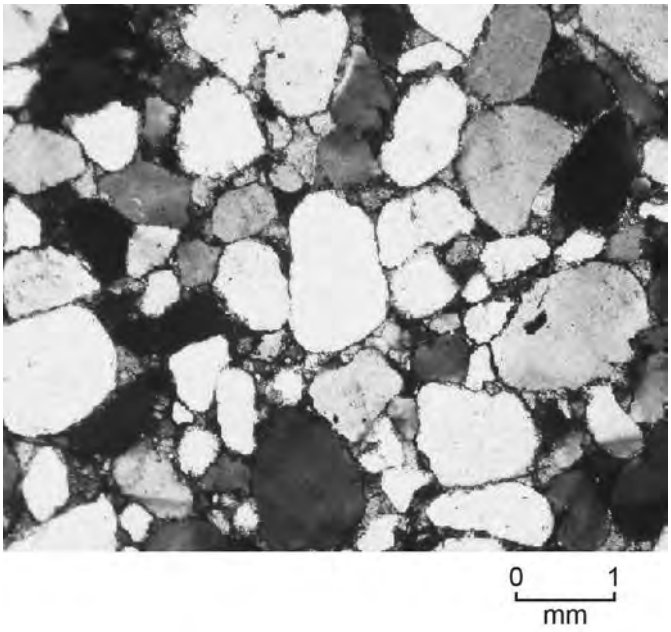



**Figure 17**

**10.** Describe the texture of the red sandstone. Tick (✓) only **two** boxes. [2]

| | |
|---|---|
| coarse grained | ☐ |
| rounded grains | ☐ |
| very poorly sorted | ☐ |
| fine grained | ☐ |
| crystalline | ☐ |
| good to moderate sorting | ☐ |
| very angular grains | ☐ |

Examiner only

**Figure 18** shows a sedimentary structure in a section through the red sandstone in **Figure 15**.

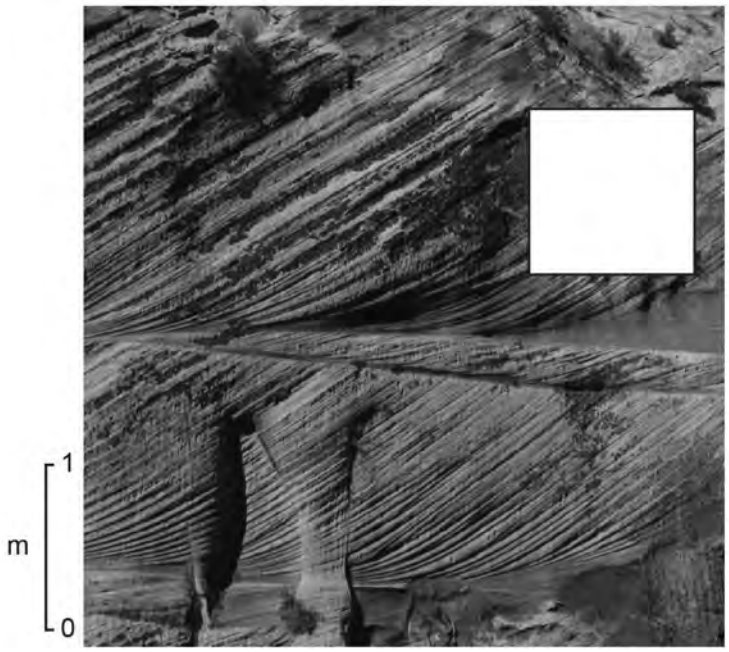
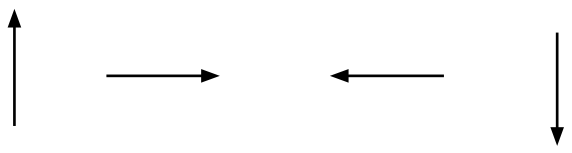



**Figure 18**

**11.** Name the sedimentary structure. Tick (✓) only **one** box. [1]

| | |
|---|---|
| graded bedding | ☐ |
| cross bedding | ☐ |
| desiccation cracks | ☐ |
| ripple marks | ☐ |
| unconformity | ☐ |

**12.** Selecting from the choice below, draw an arrow in the empty box in **Figure 18** to show the current direction at the time of deposition. [1]



Examiner only

**Figure 19** shows a sedimentary structure on a bedding surface of the red shale in **Figure 15**.

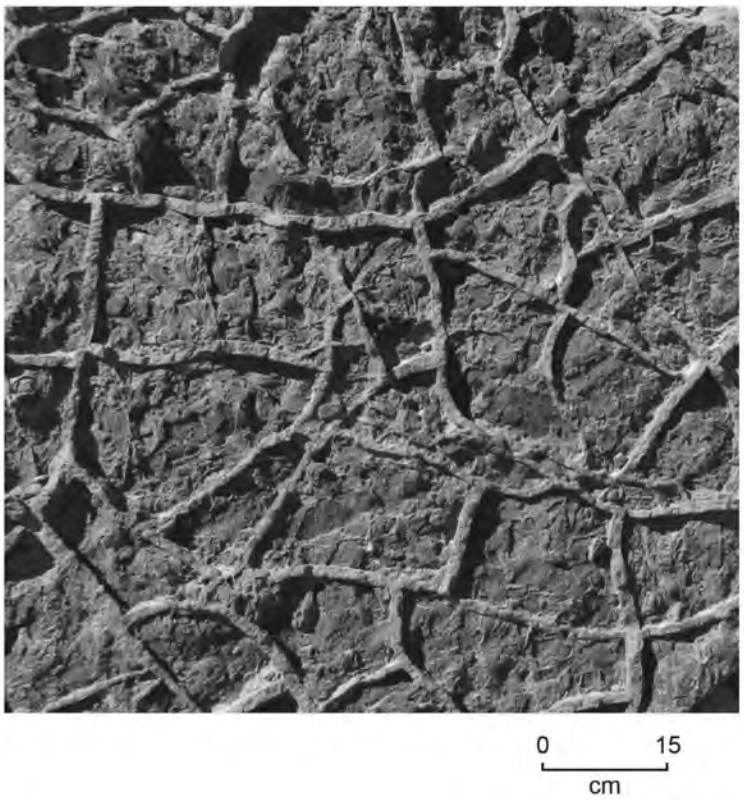



**Figure 19**

**13.** Describe the formation of this structure. [2]

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.....

.....

**14.** Suggest the most likely environment of deposition for both the red sandstone and the red shale. Tick (✓) only **one** box. [1]

| | |
|---|---|
| delta | ☐ |
| shallow marine shelf | ☐ |
| deep marine environment | ☐ |
| river | ☐ |
| desert and shallow lake | ☐ |

Examiner only

**Figure 20** is a graph showing the relative amounts of **evaporite** deposits (such as halite) at each latitude at the present day.

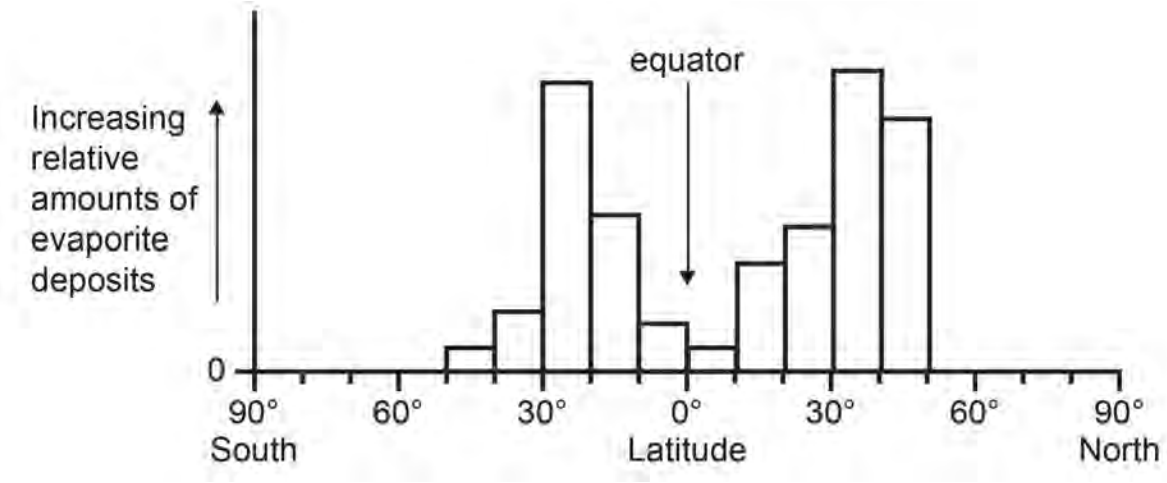


**Figure 20**

**15.** Between which latitudes are evaporite deposits most frequently found in the **northern hemisphere**? Tick (✓) only **one** box. [1]

0° – 10° ☐

20° – 30° ☐

30° – 40° ☐

40° – 50° ☐

50° – 60° ☐

**16.** There are evaporite deposits in the UK of Upper Palaeozoic age as shown in **Figure 15**. Suggest reasons to explain this. [2]

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Examiner only

## Section 7 – answer questions 1-8

**Figure 21** is a chart showing the energy resources used to generate electricity in the UK in 2011.

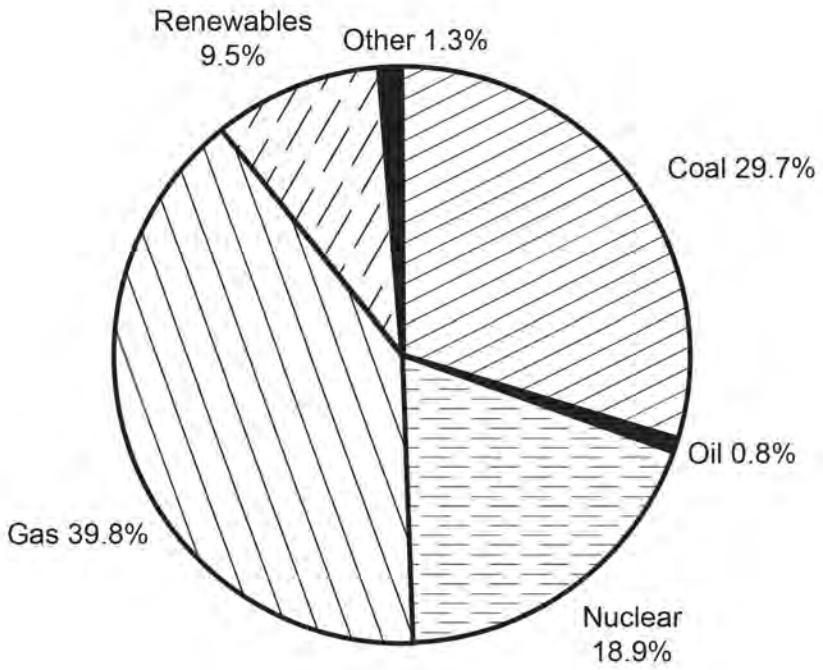


**Figure 21**

**1.** Estimate the percentage of UK energy provided by fossil fuels. Tick (✓) only **one** box. [1]

approximately 10 % ☐

approximately 40 % ☐

approximately 30 % ☐

approximately 70 % ☐

approximately 1.3 % ☐

Examiner only

**Table 3** shows the amount of carbon dioxide ($CO_2$) released from volcanoes compared to that produced by humans.

| Main carbon dioxide ($CO_2$) producers | Billion metric tons per year (Gt/y) |
|---|---|
| global volcanic emissions in 2010 | 0.35 |
| produced by humans in 2010 | 35.0 |
| **Carbon dioxide ($CO_2$) produced by volcanic events** | |
| Mount St Helens, 18 May 1980 | 0.01 |
| Mount Pinatubo, 15 June 1991 | 0.05 |

**Table 3**

**2.** Which of the following statements is **false**? Tick (✓) only **one** box. [1]

the amount of $CO_2$ produced globally by volcanoes in 2010 was less than that produced by humans ☐

humans produced 100 times more $CO_2$ than volcanoes in 2010 ☐

it would take 3500 volcanic eruptions of Mount St Helens to equal the human production of $CO_2$ in 2010 ☐

it would take 7 volcanic eruptions of Mount Pinatubo to equal the human production of $CO_2$ in 2010 ☐

the largest volcanic eruptions produced much less $CO_2$ than humans did in 2010 ☐

**3.** The amount of carbon dioxide in the atmosphere can be reduced by natural processes. State which of the following rock cycle processes **does not** reduce the amount of carbon dioxide in the atmosphere. Tick (✓) only **one** box. [1]

formation and burial of fossil shells ☐

deposition of organic shales ☐

deposition of limestones ☐

deposition of coal ☐

metamorphism of limestone ☐

Examiner only

**Figure 22** shows the change in the percentage of carbon dioxide ($CO_2$) in the atmosphere from 1700 to 1990 and the changes in global average temperature between 1870 and 1990.

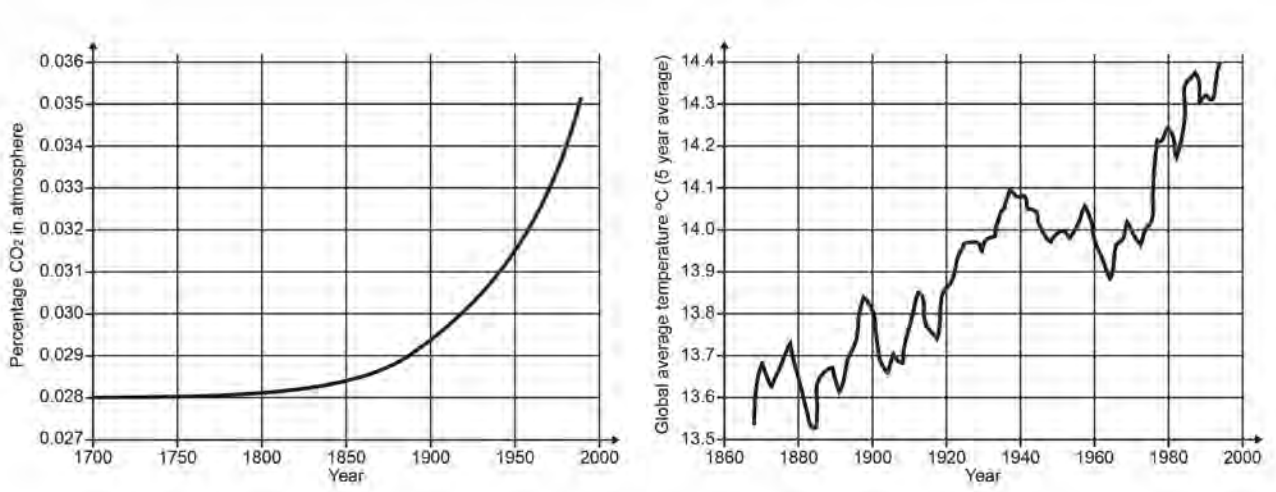


**Figure 22**

**4.** Describe the change in the percentage of carbon dioxide in the atmosphere between 1700 and 1990. [2]

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.....

.....

**5.** *'Increased amounts of carbon dioxide in the atmosphere cause the atmospheric temperature to rise.'*

State **one** way in which the graphs in **Figure 22** support this statement and **one** way in which they do not support this statement. [2]

Support

.....

.....

Do not support

.....

.....

Examiner only

**Figure 23** shows one of the effects of an increasing atmospheric temperature.

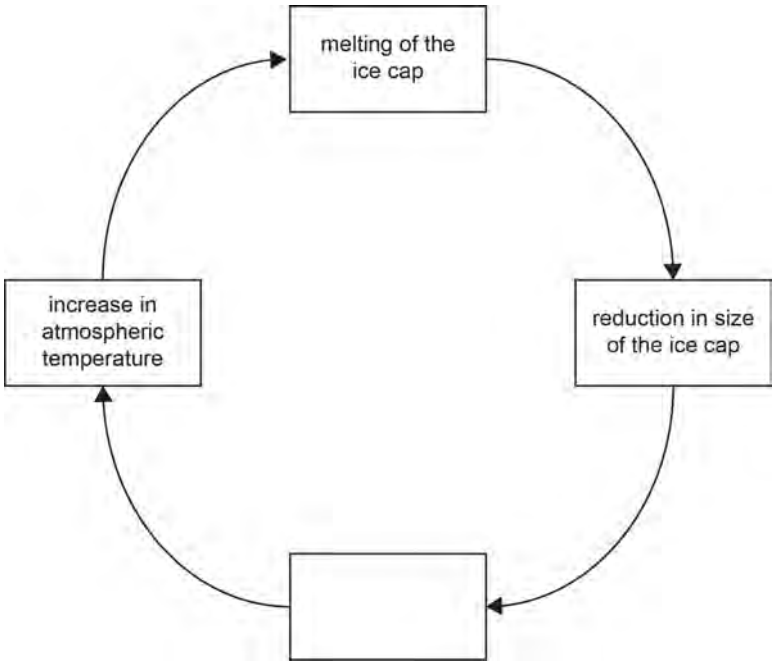


**Figure 23**

**6.** Select the most suitable process to complete the feedback mechanism shown in **Figure 23**. Tick (✓) only **one** box. [1]

increased albedo ☐

greenhouse effect ☐

lowering of sea level ☐

decreased albedo ☐

increase in carbon dioxide in the atmosphere ☐

**7.** State which of the following is **not** a potential effect of an increasing atmospheric temperature. Tick (✓) only **one** box. [1]

melting of polar ice caps ☐

more extreme weather ☐

sea level rise ☐

an increase in volcanic activity ☐

disruption of ocean currents ☐

Examiner only

**8.** Explain the meaning of the phrase *'enhanced greenhouse effect'*. [3]

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**END OF PAPER**

# GCSE

4250/01-A

# GEOLOGY
## DATA SHEET

A.M. WEDNESDAY, 21 May 2014

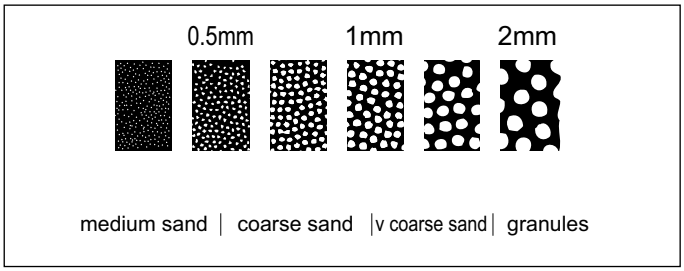
## Physical properties of minerals in hand specimen

| *Name* | *Hardness (Mohs' Scale)* | *Typical Colour* | *Streak* | *Lustre* | *Cleavage (number of directions)* |
|---|---|---|---|---|---|
| Quartz | 7 | colourless or white | scratches streak plate | glassy | none |
| Feldspar | 6 | white | scratches streak plate | pearly to glassy | 2 good |
| Mica | 2½ | silvery or brown | white | pearly to glassy | 1 good |
| Halite | 2½ | white | white | glassy | 3 good |
| Calcite | 3 | white | white | glassy | 3 good |
| Haematite | 5½ | black or red-brown | red-brown | metallic or dull | none |
| Galena | 2½ | grey | grey | metallic | 3 good |
| Garnet | 7 | red | white | glassy | none |

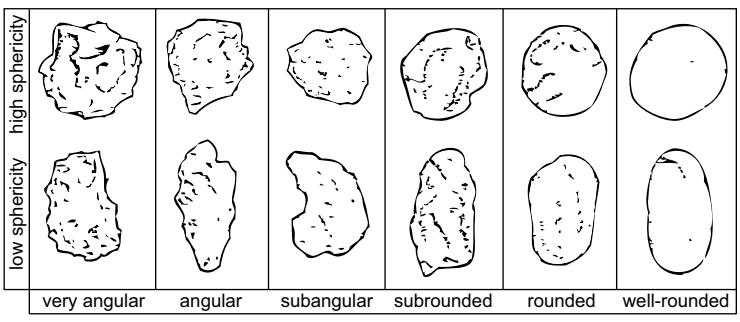
### Mohs' scale of hardness

| *Mineral/ hardness* | | *Common equivalent* |
|---|---|---|
| Diamond | 10 | |
| Corundum | 9 | |
| Topaz | 8 | |
| Quartz | 7 | |
| Orthoclase feldspar | 6 | ← steel pin |
| Apatite | 5 | |
| Fluorite | 4 | |
| Calcite | 3 | ← copper coin |
| Gypsum | 2 | ← finger nail |
| Talc | 1 | |

### Grain size scale




### Grain shape and sphericity scale



## Geological ranges of vertebrates