Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1214/01

GEOLOGY – GL4
Interpreting The Geological Record

A.M. MONDAY, 3 June 2013

2 hours

			Examiner only
Section A	1.	15	
	2.	15	
	3.	15	
	4.	15	
Section B	5.	7	
	6.	16	
	7.	7	
	8.	10	
Total		100	

1214
010001

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:
- the Geological Map Extract (Usk-Cwmbran);
- a hand-lens or magnifier to study the map (optional);
- a calculator;
- a protractor.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

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.

Candidates are reminded that marking will take into account the quality of communication used in their answers.

Examiner only

SECTION A

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

This section should take approximately 1 hour to complete.

1. Two samples of river sediment (**A** and **B**) were obtained from localities **A** and **B** on the geological map (**Figure 1a**). Sediments **A** and **B** were sieved and the results plotted in **Figures 1b** and **1c** respectively.

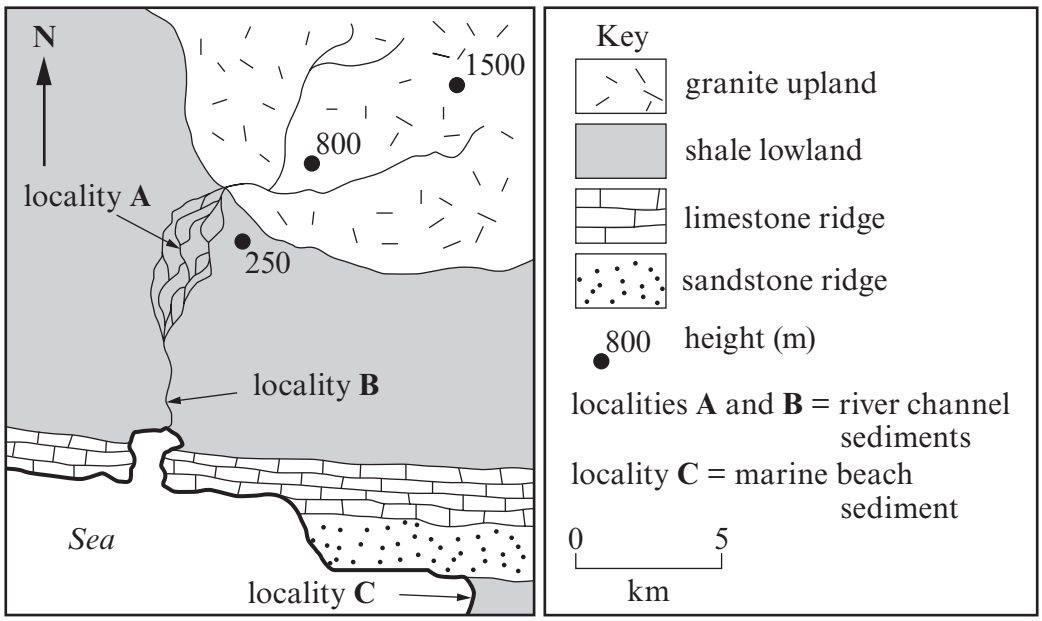


Figure 1a

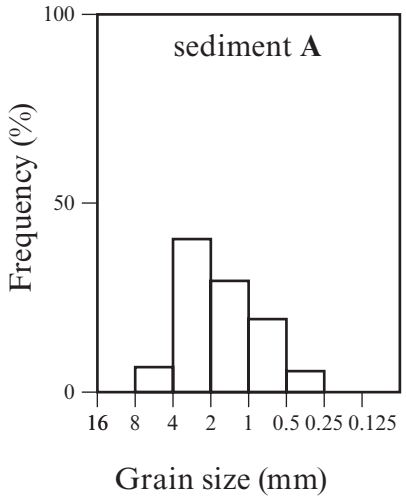


Figure 1b

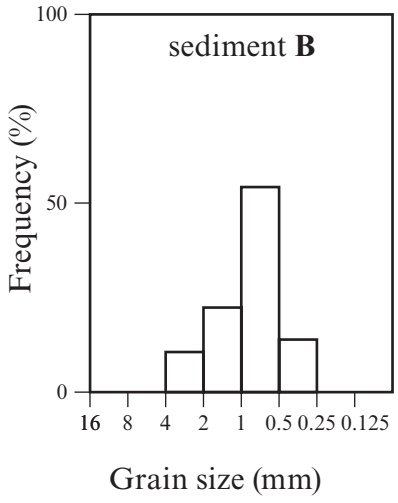


Figure 1c

Examiner only

Refer to **Figures 1a**, **1b** and **1c**.

(a) (i) Describe the sorting of sediment **A**. [2]

.....

.....

.....

(ii) **Account** for the difference in sorting between sediments **A** and **B**. [2]

.....

.....

.....

(b) Describe, **with reasons**, the **mineral composition** of the sedimentary grains you might expect to find in sediments **A** and **B**. [4]

Sediment **A** .....

Sediment **B** .....

Reasons .....

.....

.....

.....

1214 010003

Examiner only

(c) A sample of beach sediment **C** was obtained from locality **C** on **Figure 1a**. **Table 1** outlines details of a chemical experiment on sediments **A**, **B** and **C**.

Table 1

20 gram samples of sediments **A**, **B** and **C** were placed in hydrochloric acid (HCl) until any reaction was complete. The results of weighing the dried residues were as follows.

	Sediment **A**	Sediment **B**	Sediment **C**
Mass of original sample (g)	20	20	20
Mass of sample after treatment with HCl (g)	20	20	15

Refer to **Table 1** and **Figure 1a**.

(i) Suggest what conclusions can be drawn about the composition of sediment **C** from the results of this experiment. [2]

.....

.....

.....

(ii) Suggest why the beach at locality **C** has the composition shown by sediment **C** in **Table 1**. [2]

.....

.....

.....

Examiner only

(d) **Figure 1d** is a photograph of an exposure of sedimentary rock.

Figure 1d

A student concluded that the original sedimentary environment in which the beds in **Figure 1d** were deposited was similar to the depositional conditions found at locality **A** on **Figure 1a**. Evaluate this statement with reference to the evidence in **Figures 1a**, **1b** and **1d**. [3]

.....

.....

.....

.....

.....

1214 010005

15

Turn over.

Examiner only

2. **Figure 2a** illustrates four fossil trilobites (**A-D**). **Figure 2b** and **Table 2** describe the origin and diversity of the group during Palaeozoic times.

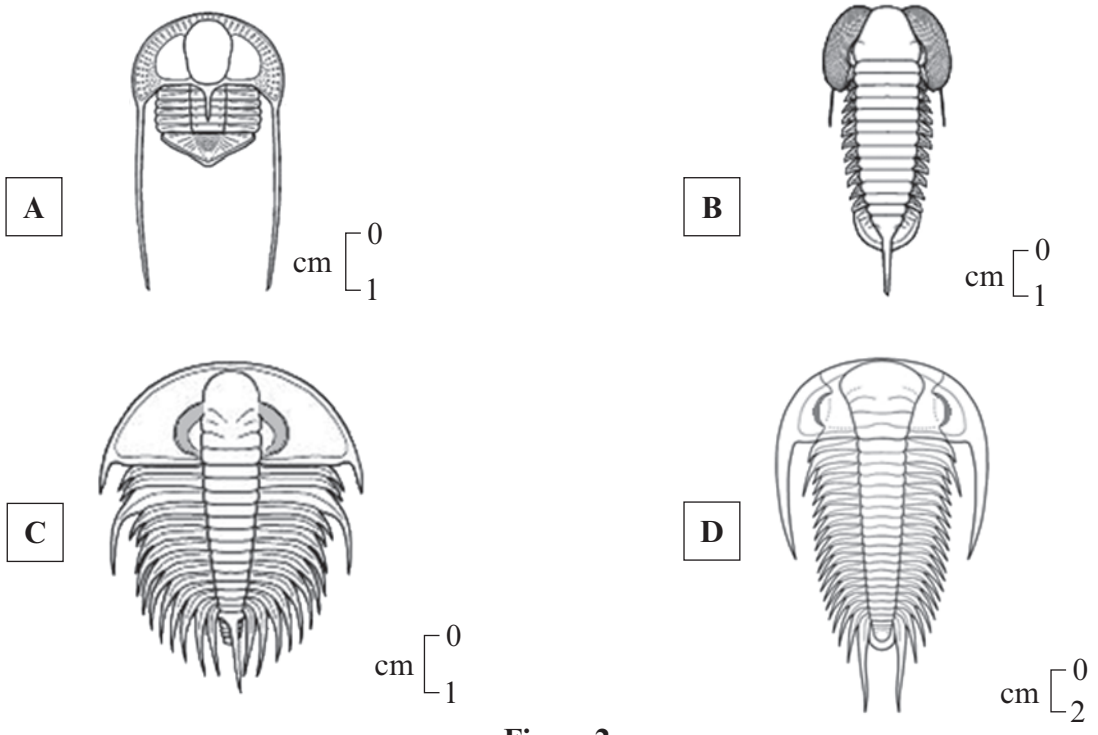


Figure 2a

Source – www.trilobites.info

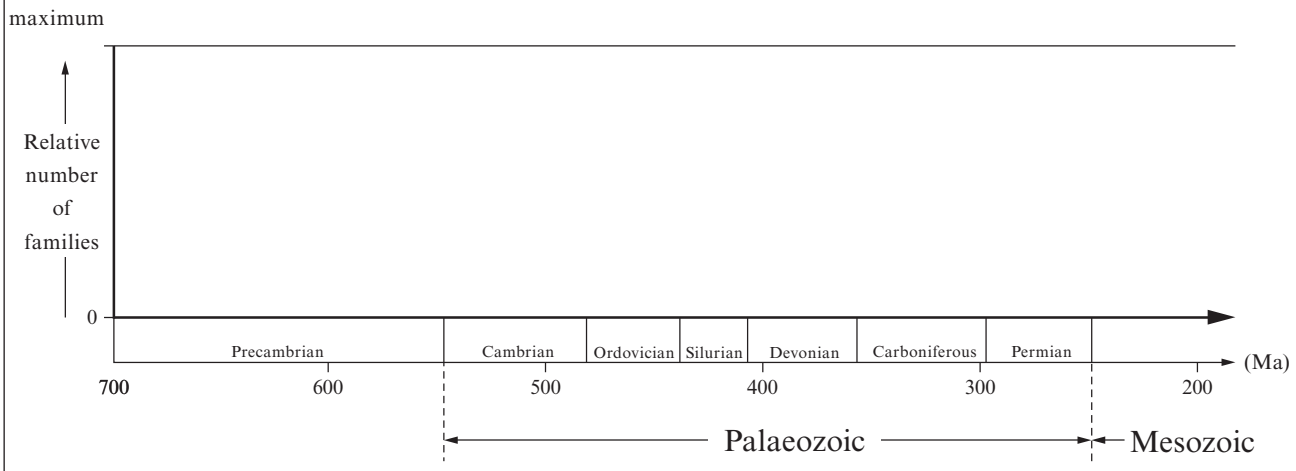


Figure 2b

Table 2

Trilobites suddenly appear in considerable numbers in the early Cambrian rocks. Their numbers had reached a maximum by the early Ordovician and gradually declined during the Silurian and Devonian. They were uncommon in the Carboniferous and finally became extinct in the Permian.

The genus *Olenellus* is an early trilobite with two large crescent-shaped eyes that are joined to the glabella. The thorax has many spines and the pygidium is relatively small.

Paradoxides has a large semi-circular cephalon, long genal spines and narrow crescent-shaped eyes. The thorax shows 16-21 segments each ending in a spine.

Examiner only

(a) With reference to **Table 2**, draw a graph on **Figure 2b** to illustrate the diversity (relative numbers) of trilobites during the Palaeozoic. [3]

(b) (i) In the appropriate box below, state which of the trilobites (**A-D**) in **Figure 2a** represent the genera *Olenellus* and *Paradoxides*, outlined in **Table 2**. [2]

Olenellus = (**A, B, C** or **D**) ☐ *Paradoxides* = (**A, B, C** or **D**) ☐

(ii) State **two** morphological differences between trilobite **A** and the other trilobites (**B, C** and **D**) shown in **Figure 2a**. [2]

1. .....

2. .....

(c) Suggest a possible mode of life for EITHER trilobite **A** OR trilobite **B**.
Explain **two** pieces of evidence from the morphology of the fossil. [3]

Chosen trilobite (**A** or **B**) ☐

Mode of Life .....

Evidence .....

.....

Evidence .....

.....

1214 010007

Examiner only

(d) "The *Ediacaran fauna* represent the oldest, most diverse set of multicellular, soft-bodied organisms with a possible link to the early appearance of trilobites as a complex and diversified group."

(i) Explain why the fossil record does not contain evidence of trilobites before the Cambrian. [2]

.....

.....

.....

(ii) On **Figure 2b** on page 6, clearly mark with an arrow (labelled **E**) a geological time when the *Ediacaran fauna* flourished. [1]

(iii) Suggest a possible reason for the sudden development and diversification of the *Ediacaran fauna* during this time. [2]

.....

.....

.....

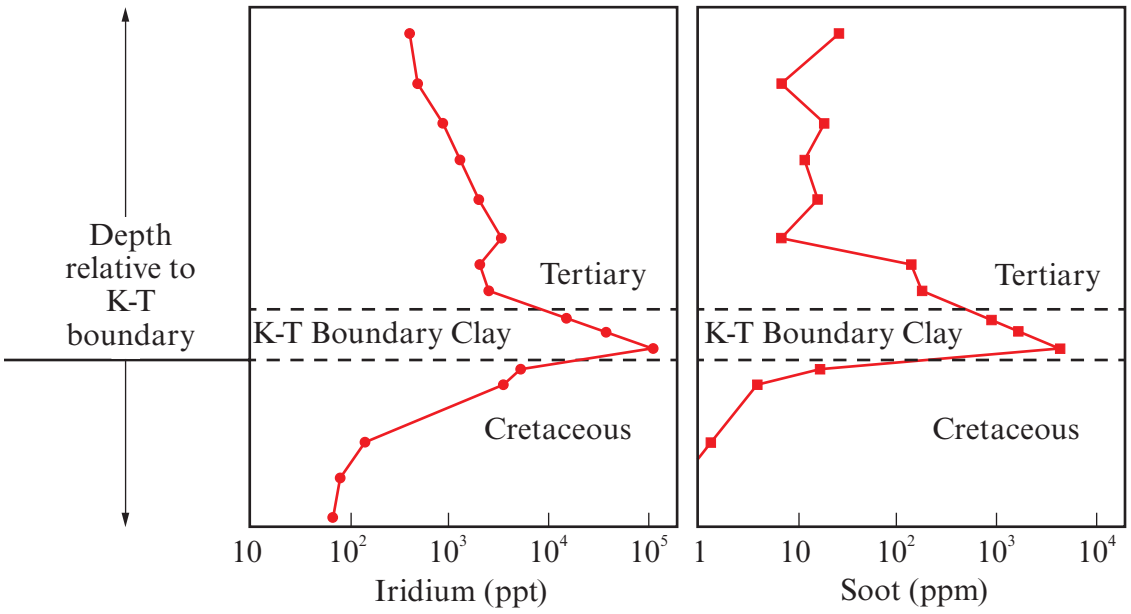
15

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

Examiner only

3. **Figure 3a** shows data obtained at the K-T boundary in New Zealand. **Figure 3b** and **Table 3** show data linking the K-T boundary and Chicxulub impact crater, considered to be the site of an asteroid impact which caused the Cretaceous-Tertiary (K-T) boundary mass extinction.



Source: Modified after Wolbach et al., 1990

Figure 3a

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

(i) Describe the distribution of iridium in **Figure 3a**. [2]

.....

.....

.....

(ii) Describe the degree of correlation between iridium and soot in **Figure 3a**. [2]

.....

.....

.....

(iii) Account for the degree of correlation between iridium and soot at the K-T boundary in **Figure 3a**. [2]

.....

.....

.....

Examiner only

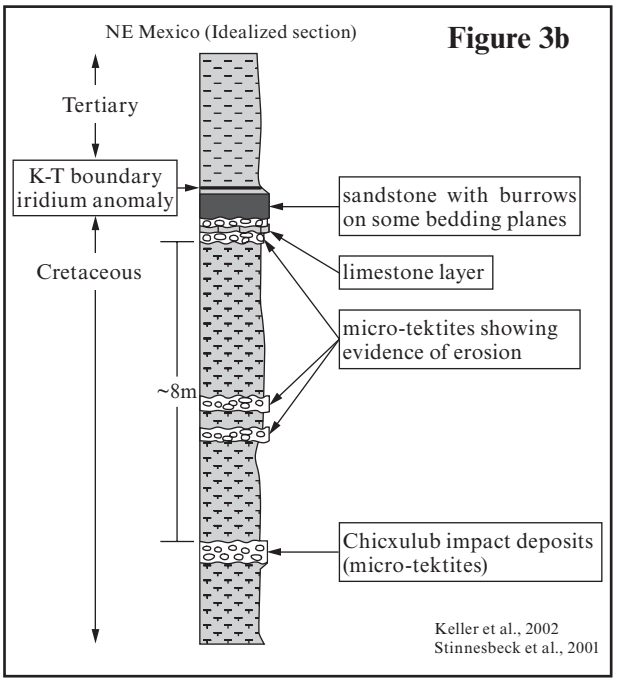


Figure 3b

Many K-T sites show layers of small, spherical, glassy grains known as **micro-tektites**, thought to represent droplets of vaporised rock following the impact.

Some researchers suggest that the iridium layer at the K-T boundary was deposited during the rapid deposition of impact debris following an asteroid impact at Chicxulub (Yucatán peninsula).

Others suggest evidence from NE Mexico (**Figure 3b**) indicates the iridium layer to have been deposited 300,000 years after the Chicxulub event in a separate unrelated impact event.

Table 3

(b) Refer to **Figure 3b** and **Table 3**.

(i) Explain why micro-tektites are *spherical* and *glassy*. [2]

.....

.....

(ii) Outline **two** pieces of evidence from **Figure 3b** that might suggest the iridium layer at the K-T boundary formed much later than the Chicxulub impact event. Explain your answer in **each** case. [4]

1. .....

.....

.....

2. .....

.....

.....

(c) From your knowledge, explain **one** alternative theory for the mass extinction at the K-T boundary. [3]

.....

.....

.....

.....

1214 010011

15

Examiner only

4. **Figure 4a** is a partially completed geological map. **Figures 4b** and **4c** show two rock specimens collected from different quarries on **Figure 4a**.

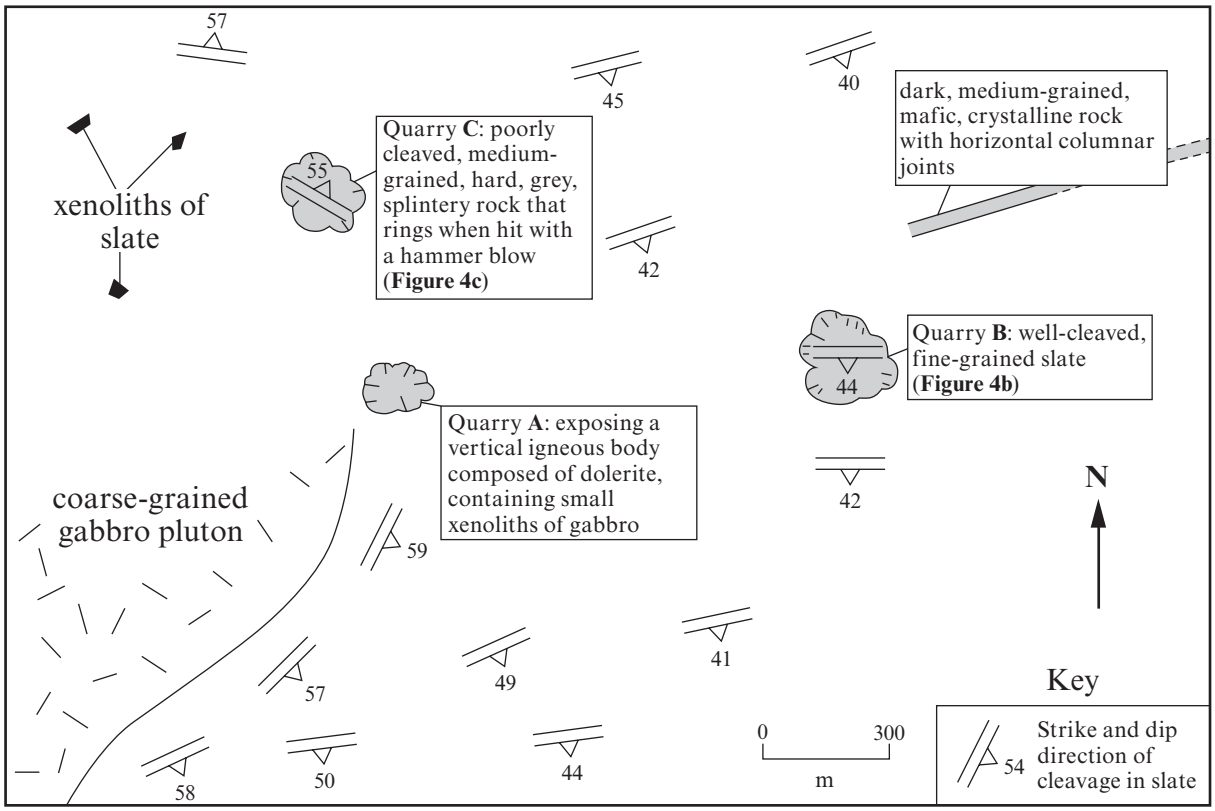


Figure 4a

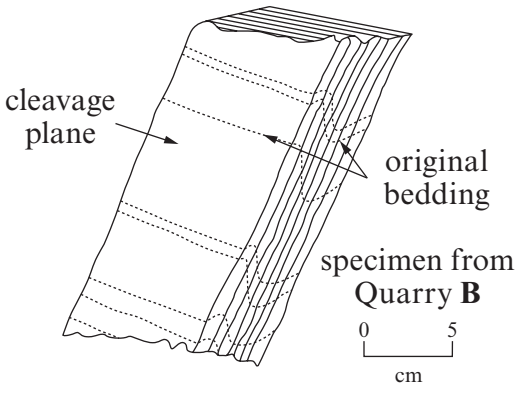


Figure 4b

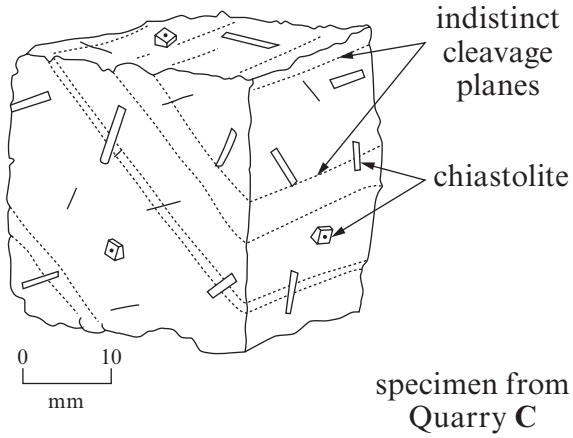


Figure 4c

Examiner only

(a) Using data from the map, complete the outcrop of the following on **Figure 4a**:

(i) the gabbro pluton; [1]

(ii) the extent of a dolerite dyke. [2]

(b) (i) State the maximum principal stress directions (σ *max*) that formed the slate in Quarry **B**, outlining the evidence for your conclusions from **Figure 4a** and **Figure 4b**. [3]

Direction .....

Evidence .....

.....

.....

(ii) Account for the difference in orientation and dip of the cleavage in the slate near to the gabbro pluton compared with the slate in Quarry **B**. [2]

.....

.....

.....

(c) A student **correctly** concluded that the cleavage in the specimen from Quarry **C** (**Figure 4c**), formed at the same time as that in **Figure 4b**, from Quarry **B**.

With reference to **Figure 4a**, account for the differences in the mineralogy and structures within the specimen from Quarry **C** (**Figure 4c**) compared with Quarry **B** (**Figure 4b**). **Explain** the evidence for your conclusions. [3]

.....

.....

.....

.....

Examiner only

(d) **Figure 4d** is a thin section through a zoned crystal of plagioclase feldspar from the gabbro pluton with a composition that varies between high temperature, Calcium (Ca)-rich plagioclase and lower temperature, Sodium (Na)-rich plagioclase.

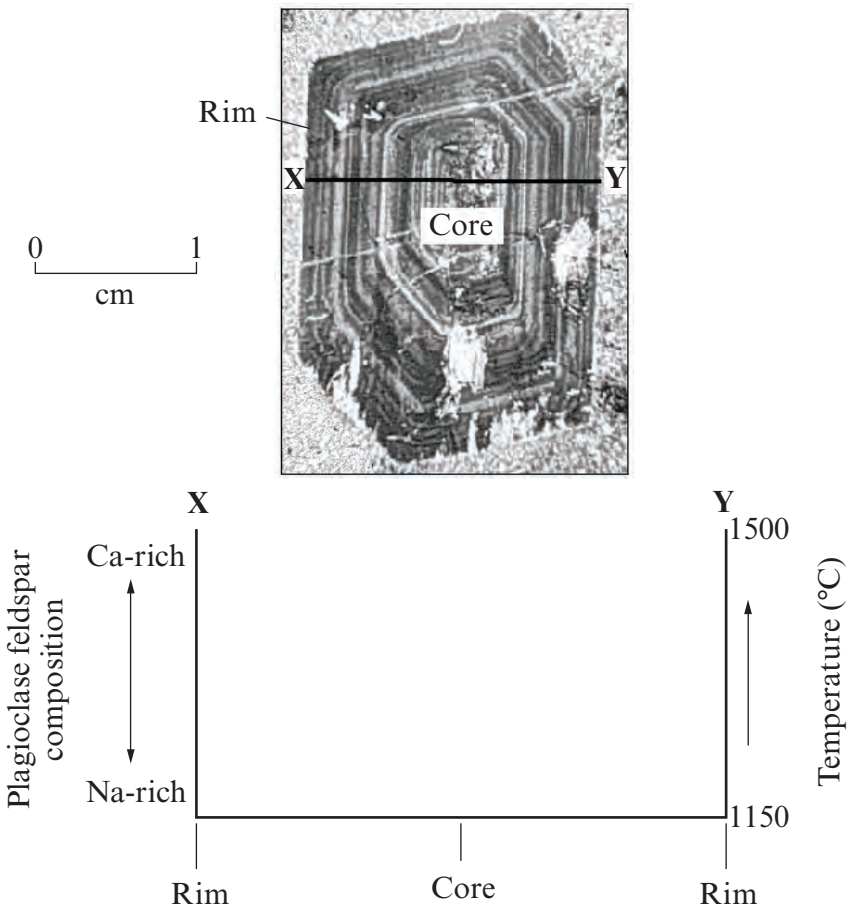


Figure 4d

(i) Using **Figure 4d**, draw a line graph to show how the composition of the plagioclase crystal is likely to change across the width of the crystal. [1]

(ii) Explain the reasoning for your answer to *(d)*(i). [3]

.....

.....

.....

.....

15

Examiner only

SECTION B

Questions **5-8** *relate to the* **British Geological Survey 1:25 000 geological map** *extract of* **Usk-Cwmbran**

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

This section should take approximately 1 hour to complete.

5. *(a)* Alluvium is the main type of superficial (drift) deposit on the **geological map**. Describe the outcrop **pattern** of this deposit. [2]

.....

.....

.....

(b) Account for the "v shape" in the outcrop pattern of the Upper Bringewood (limestone) beds (**b^{7b}**) in **grid square 3600**. [2]

.....

.....

.....

(c) **Figure 5** is a surface profile along the line **P-Q** in **grid square 3300**, showing the outcrop of the surface geology. A spring is associated with the Wenlock Limestone (**b^{6c}**).

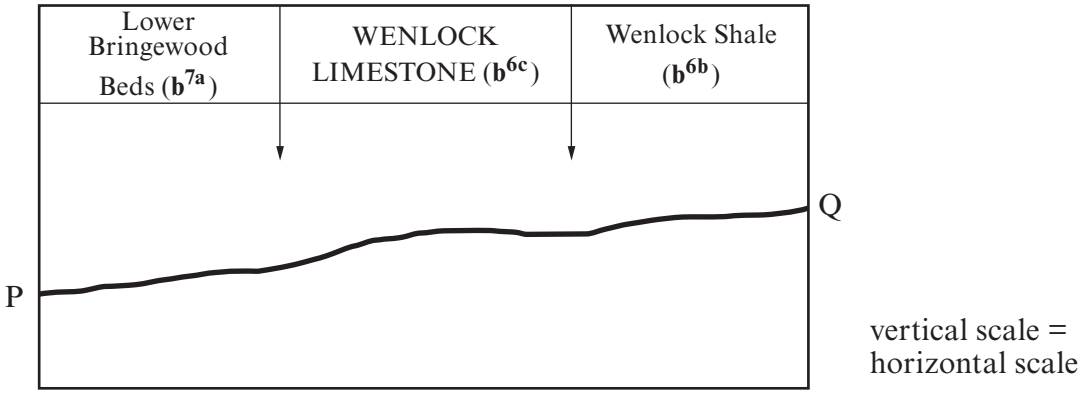


Figure 5

(i) Complete **Figure 5** by **sketching** in the upper and lower boundaries of the Wenlock Limestone (**b^{6c}**). [1]

(ii) Draw in the following on **Figure 5**:

1. an arrow (labelled **S**) to mark the most likely location of a spring;

2. the position of a water table associated with the spring. [2]

7

Examiner only

6. **Figure 6** is a simplified sketch of structural features on the **geological map**.

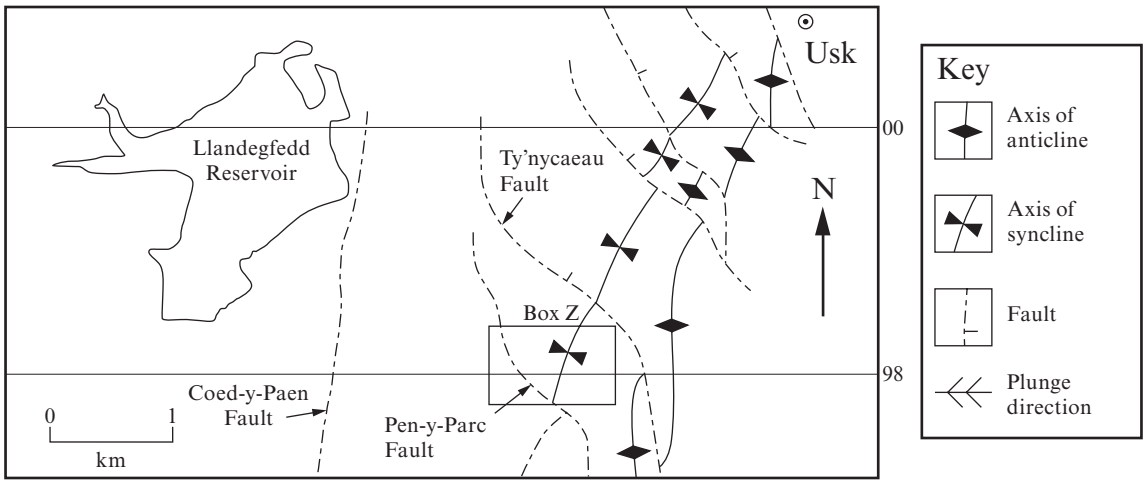


Figure 6

The axial plane traces of two plunging folds, offset by faults, are marked on **Figure 6**.

(a) (i) Complete **Table 6** below by stating the **evidence** from the **geological map alone** that the Silurian strata in **Box Z** show the following fold characteristics:

1. a synform
2. a syncline
3. a plunge to the SSW. [3]

Fold in Box Z	Evidence
1. a synform	• .....
2. a syncline	• .....
3. a plunge to the SSW	• .....

Table 6

(ii) On **Figure 6**, draw in the axial plane trace of **another** major plunging anticline. Use the symbol in the key to indicate the direction of plunge of this fold. [2]

Examiner only

(b) The **geological map** and **cross section** show that the Ty'nycaeau Fault has been downthrown towards the east. Further research suggests that:

"..the faulting is complicated by reactivation. Initially it was probably a strike-slip fault with a later dip-slip movement".

(i) Give **two** pieces of evidence from the **geological map alone** to support the statement that the Ty'nycaeau Fault has been downthrown towards the east. [2]

1. .....

2. .....

(ii) The **cross section** shows the upper surface of the Wenlock Limestone (**b^{6c}**) on the west of the fault is approximately aligned with the base of the Downton Castle Sandstone (**c^{1}**) across the Ty'nycaeau Fault.

Using the generalised **geological column** only, calculate the throw (vertical displacement) of the Ty'nycaeau Fault. Show your working. [2]

Throw = ...m

(iii) Describe the evidence from **Figure 6** that the Ty'nycaeau Fault may have also been affected by strike-slip movement. [1]

.....

.....

(iv) A student suggested that *"..slickensides could be used as field evidence to confirm the initial strike-slip direction of movement of the Ty'nycaeau Fault".*
Critically evaluate this statement. [2]

.....

.....

.....

Examiner only

(c) Stating the **evidence** from the **geological map** and **cross section**, evaluate the following statement taken from a student's analysis of the map.

***Both** the Coed-y-paen and Ty'nycaeau faults are:*

1. normal faults
2. of similar throws
3. the result of the same principal stresses that formed the major folds. [4]

1. .....

.....

2. .....

.....

3. .....

.....

16

Examiner only

7. **Figure 7a** is a photograph of a true dip section of a typical exposure of Wenlock Limestone (**b^{6c}**) in the quarry at locality 24 (**grid square 3498**).

Figure 7a

(a) With reference to the **geological map** and **Figure 7a**, complete the table below. [2]

estimation of the exposed height of the section	• m
direction in which the camera was pointing	•

(b) Annotate **Figure 7a** to show **two** geological features. [2]

(c) With reference to **Figure 7a**, the **geological map** and **cross section**, assess the suitability of the Wenlock Limestone (**b^{6c}**) as an aquifer for the accumulation and storage of groundwater. In your assessment you should consider:

- rock characteristics (texture and structures)
- thickness and surface outcrop exposure
- fold structures [3]

.....

.....

.....

.....

.....

7

Examiner only

8. *(a)* The Darran Plantation (**grid reference 325980**) is situated on an ancient landslip which moved downhill to the north and west. With reference to the **evidence** from the **geological map**, evaluate the likelihood that the following factors were responsible for the landslip.

- Dip (angle and direction) of beds
- Fluvial processes
- Faulting [5]

(b) (i) Suggest a probable geological explanation for the choice of location of the Llandegfedd Reservoir (**GR 330995**). [2]

Examiner only

(ii) Explain **three** geological factors that may have limited the final size of the Llandegfedd Reservoir during its design stage. [3]

1. .....

.....

2. .....

.....

3. .....

.....

END OF PAPER

10

Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

Examiner only

Question number	Additional page, if required. Write the question numbers in the left-hand margin.

Examiner only

Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

Examiner only

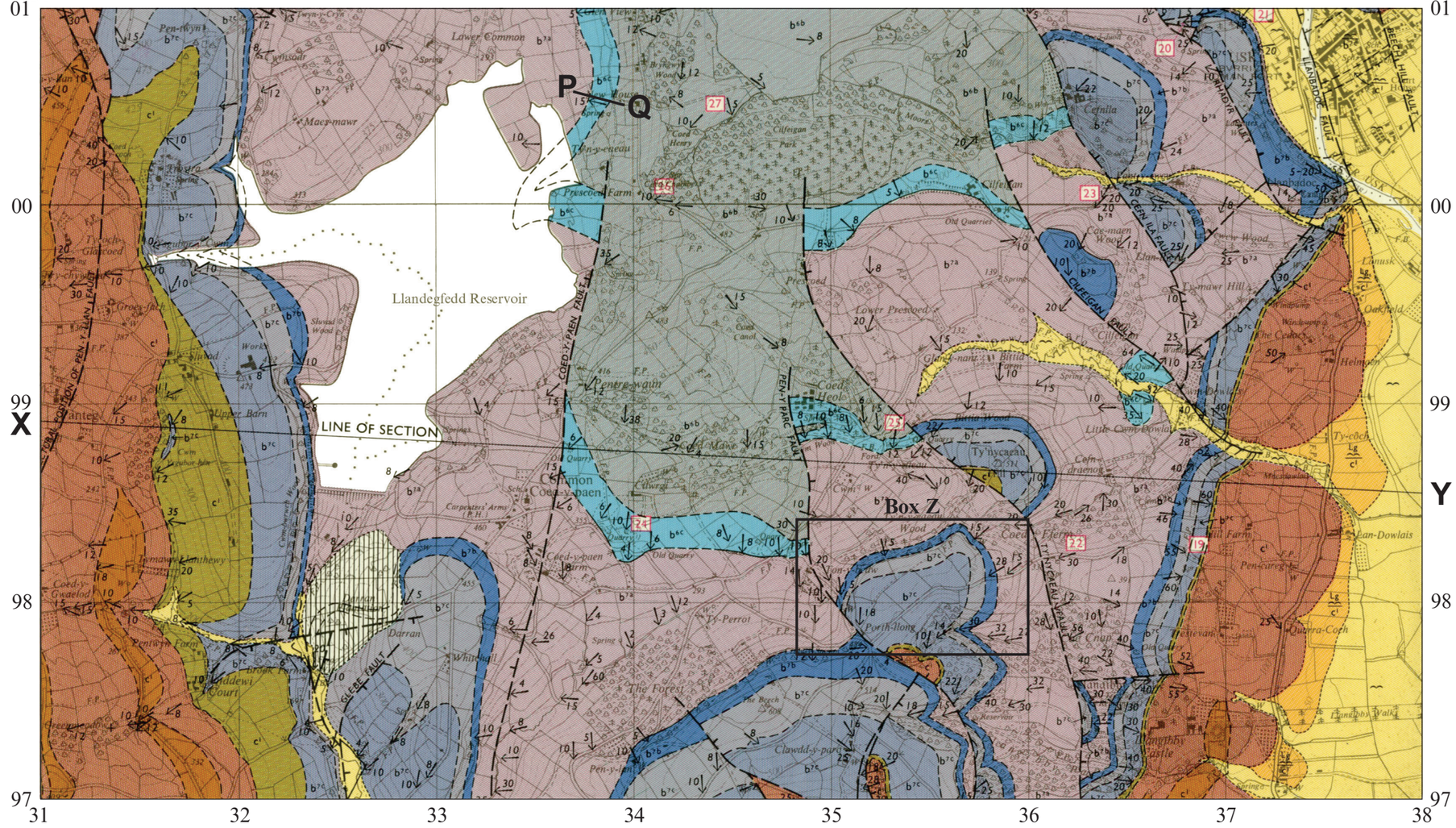
GCE A level

1214/01-A

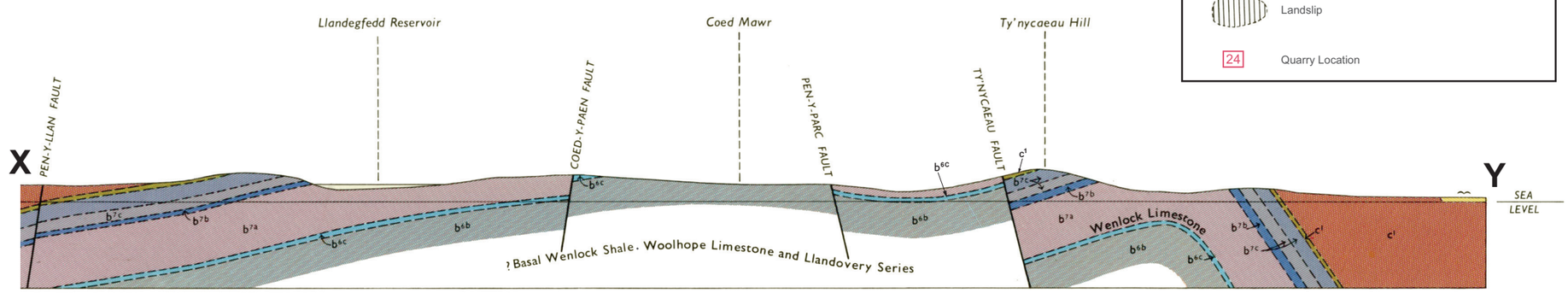
GEOLOGY – GL4
Geological Map Extract

A.M. MONDAY, 3 June 2013

WJEC 1214/01-A ADVANCED GEOLOGY GL4 JUNE 2013
Extract from Usk-Cwmbran (Solid & Drift) 1:25 000 (1 cm to 250 m)



CROSS SECTION SHOWING THE GENERAL RELATIONS OF ROCKS ALONG THE LINE X-Y



Key to symbols

- 10 ↙ Inclined strata, dip in degrees
- Geological boundary, Solid
- Fault at surface, crossmark indicates downthrow side
- Landslip
- 24 Quarry Location

Superficial (drift) Deposits

- Alluvium
- River Terrace Deposit (Lg)

GENERALISED GEOLOGICAL COLUMN
Scale 1:4200 (1 cm to 42 m)
Solid Geology