WELSH JOINT EDUCATION COMMITTEE
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General Certificate of Education **Tystysgrif Addysg Gyffredinol**
General Certificate of Secondary Education **Tystysgrif Gyffredinol Addysg Uwchradd**

EXAMINERS' REPORTS

SUMMER 2006

GEOLOGY

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WJEC
CBAC

Statistical Information

GCE (AS/Advanced)

This booklet contains summary details for each unit: number entered; maximum mark available; mean mark achieved; grade ranges. *N.B. These refer to 'raw marks' used in the initial assessment, rather than to the uniform marks reported when results are issued.*

GCSE

The Examiners' Report may refer in general terms to statistical outcomes. Statistical information on candidates' performances in all examination components (whether internally or externally assessed) is provided when results are issued. As well as the marks achieved by individual candidates, the following information can be obtained from these printouts:

For each component: the maximum mark, aggregation factor, mean mark and standard deviation of marks obtained by *all* candidates entered for the examination.

For the subject or option: the total entry and the lowest mark needed for the award of each grade.

Annual Statistical Report

Other information on a centre basis is provided when results are issued. The annual *Statistical Report* (issued in the second half of the Autumn Term) gives overall outcomes of all examinations administered by WJEC.

GEOLOGY

General Certificate of Education 2006

Advanced Subsidiary/Advanced

Chief Examiner: Mr. Peter Loader, St. Bede's College, Manchester

Principal Examiners:

GL1	Mr. Dave Evans, King-George V College, Southport
GL2a	Mr. I.C. Wall, Bolton Sixth Form College
GL3	Mr. Peter Loader, St Bede's College, Manchester
GL4	Miss Jo Conway, Yale College, Wrexham
GL5	Mr Elliott Hughes

Chief Coursework Moderators:

GL2b	Dr. Alan Seago, Open University
GL6	Mr. Ian Kenyon, Truro School

GEOLOGY

General Certificate of Education 2006

Advanced Subsidiary/Advanced

GL1 Foundation Geology

Principal Examiner: David Evans, King George V College, Southport

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an AS award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this paper and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
GL1	1477	60	35.7

Grade Ranges

A	45
B	39
C	33
D	27
E	22

N.B. The marks given above are raw marks and not uniform marks.

UNIT GL1 FOUNDATION GEOLOGY

This proved to be quite a varied paper with a range of stimulus material, consisting of maps, cross-sections and photographs. Students were faced with straight-forward knowledge and recall questions, and with questions demanding a higher level of problem-solving and deduction style responses. The paper allowed the full range of abilities to be shown. Many marks were lost through not reading the questions properly and by failing to answer fully. The number of marks available is a good guide to the number of points to be made.

Q.1 (a) Most candidates correctly identified this as a destructive plate boundary or a collision zone.

(b) (i) Most candidates correctly used the information in Figure 1b to describe the processes of collision and uplift.

(ii) This proved to be a good discriminator between those students who recognised the continued uplift, those who recognised the effects of erosion, those who considered both and those who considered neither.

(c) (i) The majority of correct answers located the foci along the leading edge of the subducting plate. Other correct answers included their location within the rising magma plume. A significant number of candidates incorrectly located the foci on the map Figure 1a, or as a horizontal line above the land surface on Figure 1c. These latter candidates obviously confused the terms focus and epicentre.

(ii) Most candidates were able to explain the distribution of the foci in terms of friction and stress release where the two plates were moving against each other along the subduction zone.

(d) (i) Surprisingly few candidates were able to correctly name andesite.

(ii) Few candidates were able to correctly identify the role of partial melting of the subducting lithosphere.

Most candidates were able to comment, with varying degrees of detail, on the nature of the Carlsberg Ridge as a constructive plate boundary and the movement of oceanic plate northwards from it. However, few candidates could explain that this motion provides the driving force for the subduction or collision along the plate boundary X-Y.

Q.2 (a) Somewhat disappointingly, fewer than half of the candidates were able to correctly identify the evaporite as the deposit of the exposed lake bed (A), the conglomerate as the river deposit (D), the breccia as the deposit of the scree slope (C) and the well sorted sandstone as the deposit of the desert sand dunes (B). The majority of candidates achieved only one or two correct answers

(b) Most candidates correctly identified the grains as having a rounded shape and many were able to explain this in terms of attrition in air/wind.

(c) The correct identification of desiccation cracks in Figure 2b was common, together with accurate comments regarding the drying out and shrinkage of fine grained sediments.

(d) (i) Most candidates correctly identified a brachiopod, although the most common incorrect answer was "bivalve". The presence of a foramen and the inequivalve nature of the specimen should have triggered the correct response of brachiopod.

(ii) Examiners were after evidence that the candidates recognised that the fossil had come from the limestone and had been eroded out to accumulate in the scree. The terms "derived fossil" and "included fragment" were welcomed. Integral to the question was the recognition that a former sea level had been higher prior to uplift or sea level fall. Few candidates worked out the full sequence of events.

(e) As in previous years, this style of question was answered with a mixed response. The best answers included a quality scaled diagram of a relevant sedimentary structure, with a brief written description, and a written explanation of how it can be used to indicate a former current direction. Many good answers added a field location for such features, for which credit was given, although this was not necessary to gain full marks.

Common errors included a lack of detail about how the current direction could be determined and asymmetrical ripple marks with overturned down-current faces. Excessively steep current bedding was another popular mistake. Other errors included sedimentary structures, such as graded bedding, which cannot be used to show a former direction of current, and features which show current direction but are not sedimentary structures, such as glacial striations.

Q.3 (a) Many candidates identified igneous body A as a sill, and cited the two baked margins, the medium crystal size and the concordant nature of the body to back up the identification.

(b) Most students were able to note the effect of chilling close to the top and bottom edges of igneous body A and explain the fining crystal size in terms of more rapid cooling of the magma. Weaker candidates simply noted that more rapid cooling would cause finer crystal size, without locating where this would occur in body A. The weakest answers simply noted that crystal size is dependant upon cooling rate, for which no credit could be given.

(c) (i) It was disappointing to note how many candidates confused erosional process with those of weathering. The best answers noted the oxidation of iron in forming the reddened surface, and the most likely role of freeze-thaw in the opening up of the joint to form the loosened block. As a minimum, chemical and physical weathering should have been noted as the two processes respectively. A few students were incorrectly keen to develop the role of acid rain in the formation of the reddened surface.

(ii) Most students were able to complete the table correctly but fewer were able to justify the age order. Candidates were expected to note that igneous body B is a lava flow and therefore must have occurred earlier than the features above it, given that the eroded surface proves the geology to be the correct way up. The reddened surface, being obviously derived from the lava flow when originally exposed, should have indicated that it was younger than igneous body B. Finally the intrusive nature of igneous body A should have been used to indicate its relatively young age. No marks were given for the common, simplistic explanations involving superposition.

Q4. This proved to be the question which triggered the lowest mean mark, suggesting that either metamorphism is less well understood, or that students were not working quickly enough in earlier parts of the paper, or both.

(a) Virtually all candidates successfully used the mineral data sheet to identify the mineral chlorite.

(b) The majority of candidates noted the crystalline nature of the rock, but fewer gave precise measurements of the coarser garnets and finer quartz and mica as expected. The foliated nature of the specimen was also noted. Many candidates incorrectly used igneous terminology such as "phenocryst" and sedimentary terminology such as "matrix".

(c) Only the better candidates managed to score both marks on this question. The coarse, non-foliated and equigranular nature of granite was recalled by all too few students. Many students incorrectly commented on the contrasting mineral content of the two rocks rather than on textural features.

(d) It was hoped that students would do more than simply explain how schist formed, but rather would do as the question asked and relate this to the evidence from Figure 4b. The foliated texture of the schist provides evidence of regional metamorphism under directed pressure, and the presence of garnet suggests evidence of medium grade metamorphism of a rock of fine grained sedimentary origin. The weakest candidates referred to processes involved in contact metamorphism, or in variation in cooling rate of magma!

(e) (i) The majority of students correctly suggested that metamorphic grade would increase towards the pluton in the aureole and explained this in terms of the pluton being the heat source for the metamorphism.

(ii) Disappointingly few students seemed aware that slate is a lower grade metamorphic rock than the schist, and consequently few arrows were drawn correctly from the slate towards the schist.

(f) This question proved to be an excellent discriminator at the upper end of the ability range. The better candidates suggested that the conglomerate may be younger than the metamorphism, using the downthrow side of the fault as the trigger for the age relationship. Others indicated that it existed outside the area being metamorphosed by either regional or contact processes. The best candidates also suggested that it may have been displaced into the region by the fault, thereby bringing non-metamorphic rocks into a region of metamorphic rocks. It was encouraging to see answers covering a range of common sense options.

GEOLOGY

General Certificate of Education 2006

Advanced Subsidiary/Advanced

GL2a Investigative Geology

Principal Examiner: I.C. Wall, Bolton Sixth Form College

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an AS award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this paper and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
GL2a	1470	60	36.7

Grade Ranges

A	45
B	40
C	35
D	30
E	26

N.B. The marks given above are raw marks and not uniform marks.

UNIT GL2a INVESTIGATIVE GEOLOGY

The paper was similar to previous examinations in that it contained questions testing the range of skills and techniques flagged up in Unit GL1 of the specification. The demands made by the paper on candidates were broadly comparable with previous years, although the mean mark was up compared with 2005, reaching a very similar mark to that recorded in 2004. By and large, the questions produced a range of responses that allowed for differentiation.

Q.1 Many candidates failed to read the question stem and consequently wrote about the texture of Specimen A in part (a)(i); the better answers referred to the essential mineralogy, the colour index or to the relative density of the specimen. In part (ii), most candidates linked the coarse texture with slow cooling, but a large number also suggested a two-stage cooling history because the specimen was "porphyritic" – it clearly wasn't. Only the better scripts commented on the intergrowth of poorly shaped crystals which suggested that the minerals were forming at the same time. Candidates were expected to evaluate each statement in (b)(i) and to justify their choice of true or false by using the results of tests or observations on Specimen J. The hardness required both the use of a fingernail and a copper coin, the mineral clearly left a white powder on the streak plate, and a simple "hefting" test was required for the relative density. Some candidates attempted to use the data sheet only and so got hopelessly confused. Some candidates mis-read "strike" for "streak" in part (b)(ii), and credit was given to those who read the prompt in the stem and noted the proximity of a pluton or to the position on the hinge of a fold.

Q.2 Part (a) allowed candidates to gain credit provided they followed the rubric – *a scaled, labelled diagram representative of part* of Specimen B1. Drawing marks were allocated to reproduction of the basic polygonal walls, and then for detail of the septa and columella. There was a wide variety in quality. Some candidates drew external views or sections revealing detail of the inside of the animal. The scale line was frequently ignored. Cephalopod, bivalve, brachiopod and trilobite all appeared as the answer to the name. Although some marks were awarded for texture (crystalline or non-fossiliferous) and/or composition (carbonate) in (b)(i), a surprising number of candidates failed to identify Specimen B2 as a marble, with "calcite" being the commonest wrong answer. In part (b)(ii), the map showed a concordant igneous body and was usually correctly identified as a sill rather than a dyke, but only the best candidates realised that the baked margin was on the upper surface of the body and so it couldn't have been a lava flow.

Q.3 Part (a)(i) required candidates to study Photographs 1 and 2 and simply to measure and describe the labeled clasts; the commonest error was usually in using the respective scale bars. The name "conglomerate" rather than "breccia" was required in part (ii), but in addition to the latter, the following were all wrongly suggested as the rock name: granite, greywacke, sandstone and shale. Although many recognized dune bedding on Photograph 3 and/or a trace fossil on Photograph 4 (part (b)(i)), candidates were not credited for ripple marks in the former or load casts, flute casts or desiccation cracks in the latter. Credit was given in (ii) to scripts which suggested either a change in energy levels or to a change in the palaeo-geography (e.g. alluvial fan/river channel – dunes – playa), with clues to the latter being contained in what was a terrestrial red-bed sequence. Weaker candidates often suggested glacial or marine environments, and these answers were not credited.

Q.4 Part (a)(i) is still being answered incorrectly by many candidates despite this becoming somewhat of a feature of this paper. The innovation in (ii) was that it allowed knowledge of faults to be tested in a data response manner using terminology that may not be in common use in some centres. Those who were able to link the data on the diagram and the map often gained full credit here. Part (b) tested candidates' ability to place rock units and geological events in their relative age order. Unlike previous years, when the construction of a cross-section may have assisted, this was done using only a 2-D map; the response in many cases was very good, and it is possibly one of the reasons as to why the mean mark rose compared to 2005. Weaker students tried to "hedge their bets" by suggesting several positions for the fault, unconformity or folding, but to no avail as they gained no credit for these answers. Others used rock units from the east of the fault.

Q.5 The very flexible mark scheme traditionally used in questions of this type continues to allow credit to be given for any good interpretation of the information given on Map 1. There are some centres who obviously spend considerable time and effort on mapwork and here, candidates' scores on this question are of a much higher standard than the others; some students even produced tabulated geological histories on the continuation page, and although these were invariably correct, no extra credit was allocated! In many centres, however, this question continues to differentiate very well.

GEOLOGY

General Certificate of Education 2006

Advanced Subsidiary/Advanced

GL2b Internal Assessment

Principal Examiner: Dr. Alan Seago, Open University

Unit Statistics

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Unit	Entry	Max Mark	Mean Mark
GL2b	187	60	36.4

Grade Ranges

A	44
B	39
C	34
D	29
E	24

N.B. The marks given above are raw marks and not uniform marks.

UNIT GL2b INTERNAL ASSESSMENT

Sixteen centres submitted field investigations for moderation. It is pleasing to report that centres are taking note of comments made in individual centre reports in previous years so that there is a continuing improvement in the suitability of tasks being undertaken and the quality of candidates' work. There has been a reduction in the number of centres where scaling is required and the amount of scaling that has to be applied. For some centres, scaling had to be applied to raise the marks of their candidates. There are four main reasons why scaling has to be applied;

- awarding of marks on inappropriate tasks
- reliable rank order but marks generous or, very rarely, severe
- failure to recognise that candidates have not met some aspect of the specification e.g. not including skills specified in GL1 or original field notes
- failure to show how criteria have been achieved by annotation of candidates' work

Very few centres are now creating difficulties for themselves and for the moderators by submitting field investigations from outside the context of GL1 skills. Centres should be aware of the required context of the investigation at all times as described in the specifications.

The centres are to be congratulated on

- the standard of work produced by the candidates
- the opportunities given to the candidates to study geology in such suitable areas
- and in most cases the accuracy of the assessment.

The better investigations include the demonstration of basic field skills, such as rock identification and textures, identification of field structures using dip and strike/field sketches, sedimentary logging and fossil identification. The data collected can be manipulated and presented in cartographical or graphical form. Some excellent field investigations are now being seen which are well suited to the assessment framework. It is good to see geological field skills being demonstrated with a high degree of competence. There were, however, a minority of investigations which would have been more suited to GCSE, lacking, as they did, any scope for advanced analytical skills and any degree of complexity.

A problem in some cases was a lack of focus for the investigation. If clearly focused, for example, on 'the effects of the Armorican Orogeny at Broad Haven, Pembrokeshire' (analysis mainly of folding including crustal shortening), candidates can concentrate collecting appropriate data such as dip and strike of bedding, folding styles, drawing cross sections and analysing the amount of crustal shortening. On the other hand 'the geology of West Cornwall' is much too wide a brief and needs to be focussed down. With a lack of focus and definition of aims, candidates may collect irrelevant data. This sort of investigation, where the candidates are taken from locality to locality, collecting observations at the direction of the leader, results in very poor planning and evaluation, although the observations and the analysis may very well be of a high standard. This approach commonly results in every candidate having the same plan, method of recording data and analytical techniques. This makes differentiation between candidates very difficult. It also often results in 'planning' in the past tense.

Even if all of the candidates undertake the same field investigation, it is important that they have the opportunity to come up with their own ideas for data collection and presentation. This type of work may be valid in terms of a teaching exercise but not suited to the internal assessment component. Centres should appreciate the effect of unsuitable investigations on candidates' marks and advise candidates accordingly.

In some cases, there was no risk assessment, although the number of instances is decreasing. It was pleasing to see the extensive use of the Planning Tracking sheet. Some thought has to be given at the planning stage as to whether the data being collected is suitable for processing and analysis, e.g., histograms, cross-sections, logs, rose diagrams maps and geological histories. A number of centres are now making preliminary visits to sites in order to allow some forward planning by candidates, which often results in better Planning marks. Some candidates devoted insufficient time on the retrieval and evaluation of relevant material from different sources.

Some field notes consisted entirely of tables of data and it would be an improvement to see a variety of data collection including field sketches and rock descriptions, etc. In a number of cases, opportunities for the collection of basic field data have been missed. Observations such as rock identification, grain size, sorting, direction of cross-bedding, clast roundness/ orientation, field sketches, dip and strike measurements, should normally be part of every investigation where appropriate. There is no need for candidates to repeat observations made in the field notebook within a report unless it contributes significantly to the analysis. It is more advantageous for candidates to concentrate their efforts on the analysis and evaluation.

A mixture of tasks was undertaken, with a rough break down being investigations into:

interpretation of sedimentary environments (sedimentary logs, fossils and rock description)
mapping exercises (leading to drawing up of geological sections and history)
origin of granite plutons (rock textures, jointing and structural analysis)
joint orientation related to faulting (rose diagrams and stereonets)
structural analysis (faulting and folding styles related to compression or tension)
textures of recent coarse grained sediment
Centres are to be congratulated on the variety of opportunities given to candidates in areas of outstanding geology such as, North Wales, Isle of Arran, Pembrokeshire, Ogmore, Yorkshire coast, Alderley Edge Dorset, Devon and Cornwall. Other centres made good use of suitable local geological locations.

Centres should be aware that there is help available from the WJEC. Published exemplars of coursework investigations can be obtained from the WJEC offices and INSET activities are provided. Moderators' reports on the current moderation process are sent out to centres. Centres are urged to act on any recommendations in the Moderators' Reports. The Moderators do not enjoy moderating work which achieves low marks as this is going to be disappointing for the centre and the candidates, especially when there is often so much suitable geology on the centre's doorstep which, with a little help and guidance, can result in a successful submission. There are guidelines in the specification such as Planning Aid p62 and suggested investigations p22. Alternatively, the centre could discuss suitable investigations with myself thorough email/ telephone, as several centres do. This can include advice on the suitability of coursework investigations prior to carrying them out and examination of candidate's draft field investigations. My contact details can be obtained from the WJEC Geology officer in Cardiff. Any centre having a problem with applying the assessment framework should contact the WJEC well in advance of the submission date.

GEOLOGY

General Certificate of Education 2006

Advanced Subsidiary/Advanced

GL3 Geology and the Human Environment

Principal Examiner: Peter Loader, St. Bede's College, Manchester

Unit Statistics

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Unit	Entry	Max Mark	Mean Mark
GL3	1320	50	28.6

Grade Ranges

A	34
B	29
C	25
D	21
E	17

N.B. The marks given above are raw marks and not uniform marks.

GL3 – GEOLOGY AND THE HUMAN ENVIRONMENT

General

The overall quality of the responses for the data response questions was similar to previous years and both were accessible to weaker candidates but discriminated well. The quality of the essays was variable with full marks given for each of the essay questions. The most popular question (question 4) was best answered by candidates who knew their case studies and were able to directly answer the question set. Little credit was given for those that showed insufficient detail and accuracy.

Q.1 A very accessible question which discriminated well.

(a) (i) This was generally well answered, although vague statements such as "might affect the environment" or "destroy the ecosystem" were not credited. Repetition of a response was not credited, e.g. pollution of the pond, pollution of the ditch.. The most popular correct responses were groundwater pollution and acidity.

(ii) Most candidates correctly cited methane and, though other landfill gases were accepted (e.g. CO_2), an appropriate control had to be given to gain full marks. Some candidates found it difficult to explain how methane might be controlled (e.g. "use pipes") and only a small percentage suggested it might be used as a fuel.

(b) "Impermeable" was a very common response for one mark, though many candidates found it difficult to suggest another correct property.

(c) (i) This provided a mixed response but proved to be a good discriminator.

Many candidates ignored the fissures and sand lenses or deliberately avoided them, drawing the line (often straight) directly from the waste to the aquifer.

(ii) This question also discriminated well. Most candidates realised that leachate might flow freely along the fissures. Fewer were able to explain the significance of the sand lenses. Fewer still suggested the effects of acid on the limestone clasts.

(d) Though most knew that such waste would have to be stored more securely, usually citing burial at depth or the possible carcinogenic effects of surface deposits, few candidates mentioned the importance of time in radioactive decay (long half-lives) which would outlive the life expectancy of the landfill. Some candidates suggested that radioactive waste is explosive and others expressed their concern for terrorist action.

Q.2 A very accessible question.

(a) (i) Though few stated that the correlation was "(very) good" or "positive", most were able to describe the correlation qualitatively (though a number claimed that "as the earthquake frequency increased so did the injection of waste water"). As there was a general reluctance to quote quantitative evidence from the graph, many candidates only scored one mark.

(ii) A very mixed response. A significant number did not read the question properly and some anticipated the answer to (b)(ii). "Lubrication" was by far the most common accepted response, although examiners were hoping (after previous questions, mark schemes and examiners' reports) that a larger number might have mentioned increased **water / pore pressure** as a means of reducing **friction** and hence causing a quake. Many vague statements suggesting an "increase in pressure on the fault" or "extra weight" were given little credit unless developed.

(b) (i) Correctly answered by about two thirds of the candidates.

(ii) Most correct responses simply stated that "a large number of small quakes would release the stress a little at a time so there would not be a big earthquake", with only the more able candidates mentioning the gradual or controlled reduction in stress/strain.

(c) Most candidates quoted seismographs, radon gas and, in particular, animal behaviour. A disappointing number were unable to explain how their chosen method might be used and secure three marks. Very few cited the seismic gap method, though some made vague statements about measuring the location of epicentres along the San Andreas Fault.

(d) Many stated that earthquakes are very difficult / impossible to predict with any degree of accuracy but found it difficult to explain convincingly why good building practice might be a more effective way to reduce risk.

Q.3 This was not a popular choice and generally not well answered as the question was either misread or misunderstood.

(a) Many candidates described the **results** of the techniques rather than the techniques themselves. In these cases, candidates usually obtained their marks by inference and often there was considerable repetition in (b).

It was disappointing that a significant number were unable to identify two separate techniques but, where they could, the most popular were seismic and boreholes. Many responses were very vague and woolly and confined to a general survey which, though not stated as such, was either a desk study of geological maps or a preliminary field study. Both tended to be very superficial, e.g. "look for faults" or "check the rock types."

(b) This was generally better done. Most candidates cited the Vaiont Dam and there were some excellent and detailed accounts which compensated for the poor response in (a).

Q.4 This proved to be by far the most popular and well answered essay. Mount St Helen's was usually quoted as a case study but where a case study was not used, candidates were penalised. There was significant overlap between sections (a) and (b) to the extent that many candidates did not attempt to divide their essays into sections.

(a) It appeared that a large number of candidates did not appreciate that the question asked for "the effects of" gas emissions and seismicity. There was much irrelevant material produced, most being more relevant to (b).

(i) Some good accounts, although many cited sulphur as the most common gas to be emitted. Radon and carbon monoxide were also very popular to the exclusion of sulphur dioxide and carbon dioxide. Methane was also regularly considered and some claimed that this gas was a cause of explosions. The more able candidates referred to pyroclastic flows, the effect on vegetation, the limited effect on buildings (accept in the case of pyroclastic flows) and on global warming. By far the most common correct case study was of the Lake Nyos overturn, which was frequently quoted.

(ii) This was usually poorly done, with many misconceptions apparent. Many responses were more relevant to (b). Others preferred to twist the question to write about plate movement, giving details of tectonic earthquakes rather than those associated with the movement of magma. Very few referred to harmonic tremors and the consequences of constant shaking.

(b) Responses to this section were generally better with some excellent accounts of the use of variations in gas emissions and seismicity as a means predicting eruptions. Only the more able candidates mentioned the use of COSPEC to measure gas variations. Having set a data question recently and despite candidates mentioning Mt. St Helen's, few referred to the seismic fingerprint beneath the volcano marking the distribution of the epicentres of harmonic tremors.

(c) This was generally well answered, though some responses were vague in their detail and often confused. Few used case studies to good effect.

Q.5 Not a popular choice, with few high quality responses.

(a) Candidates responses were very varied, many being too superficial. An often quite lengthy account could be summarised as " minerals will be dissolved and go into the water table." A small percentage of candidates went into some detail concerning acid mine drainage and the oxidation of pyrite and few mentioned the polluting effect of mine waste.

(b) (i) A disappointing response. In particular, there was a significant number of candidates who made it clear that they thought that ground water occupies large voids (caves or caverns) in the ground and once the water has been removed, these voids are no longer supported, so will collapse and cause subsidence at the surface. There were very few convincing accounts of reduction in pore pressure, packing, cones of depression and the effect of vegetation in dewatering.

(ii) The majority of candidates were familiar with the basic mechanism for salt water incursion. Many drew annotated diagrams, although not all of these added to the script. Cones of exhaustion were again rarely considered, although the importance of the density difference of sea and fresh water was usually discussed.

GEOLOGY

General Certificate of Education 2006

Advanced

GL4 Interpreting the Geological Record

Principal Examiner: J. Conway, Yale College, Wrexham

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an AS award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this paper and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
GL4	819	96	60.1

Grade Ranges

A	71
B	64
C	57
D	50
E	44

N.B. The marks given above are raw marks and not uniform marks.

GL4 INTERPRETING THE GEOLOGICAL RECORD

The paper worked well this year, and the mean mark rose by nearly 10 marks, although candidates still get some basic questions wrong (eg. Q2 a ii). Questions discriminated between candidates, and a wide range of marks was seen. Section B showed a continuing improvement on previous years.

Section A

Q.1 The question focussed on sedimentary rocks.

Candidates scored well on this question, with few candidates gaining less than half the available marks.

(a) Candidates were able to identify the appropriate environments and describe evidence for way up.

(b) The majority of candidates were able to fully explain the term (discussing angularity, poor sorting and high proportions of matrix), with good answers leading into a short distance/time of transportation history of the particles.

(c) Again, candidates observed the data well, and commented on well sorted and rounded grains, and were able to give very good outlines of the processes leading to these characteristics. Part (iii) proved a good discriminator for many candidates, with the weakest candidates not being able to correctly determine wind direction and internal structure from the asymmetric shape of the structure drawn.

(d) The majority of students correctly identified the unconsolidated boulder clay as a drift deposit, although the examiners found it disappointing that the same candidates could not state diagenetic changes to sediments. Good answers included reduction in porosity due to compaction, dewatering, cementation and grain welding. The majority of candidates were able to suggest reasons for the lack of fossil evidence in the sequence.

Q.2 The question examined fossils.

The question was well answered and many candidates gained very high marks.

(a) Examiners were disappointed that a few candidates only drew lines of symmetry on either specimen A or B, and also that there are still many candidates who were not able to identify the fossil groups. Notable howlers included Ammonite and Tripod.

(b) Candidates made excellent reference to the data given and gave very full answers to (i) and (ii).

(c) This part proved more challenging for the candidates, and some chose to focus on adaptations which could not be deduced from the data given in the question (e.g., shell thickness and internal structure and morphology such as pallial sinus). Good answers focussed on Bivalve X attaching itself to rocky surfaces with the byssus and the streamlined air-tight shell tolerating wave action, and Bivalve Y having a ribbed shell for strength to survive in the inter-tidal zone and the compact nature of the shell meaning a small foot shows a shallow burrower. A small number of candidates confused Bivalve Y with Pecten.

Q.3 This question examined rocks and metamorphism.

Candidates accessed the range of marks well.

(a) Well answered by most.

(b) Candidates found this more challenging, and the better candidates gave full explanations of regional metamorphism for the origin of the schistose texture in the figure. Surprisingly, many candidates found part (iii) challenging. Many candidates gave one word to describe the simple test and did not clarify to which specimen the result was attached. Good answers included placing drops of dilute hydrochloric acid onto the specimens with marble showing effervescence and scratching both specimens with steel, the metaquartzite not being scratched.

(c) Usually OK, although some candidates were unable to describe the geological situations and conditions under which dynamic metamorphism occurs.

Q.4 The question examined aspects of deformation and examiners saw a good spread of marks.

(a) Only a few candidates did not label the marks they placed onto the figure. The majority of candidates were able to gain credit for the axial plane and interlimb angle (although a few candidates only drew in half of the interlimb angle), many candidates found it more challenging to identify the cleavage/bedding intersection and an overturned limb. And, as last year, many candidates were unclear about where the overturned limb was. The majority of candidates were able to correctly measure the wavelength between two crests, but as in previous years, a significant number of candidates incorrectly measured the amplitude as being the distance between the crest and trough rather than half of it. Part (iii) was a simple calculation with which candidates coped well.

(b) This part of the question accessed higher levels of candidates' performance, asking for critical evaluations. It was marked holistically so that the examiners could assess the evaluative skills of the candidates. The best candidates pulled the statement into small pieces and compared to the evidence presented in the figure, then concluded with a reflection on the whole statement. Many candidates confused the terms competent and incompetent.

Section B:

The map extract of Alloa was clearly reproduced, although unfortunately without a key to the symbols. There was a slight difference in the colours of the map and the generalised vertical column. It was a little difficult to see the metamorphic aureole, but once candidates looked at the igneous intrusion it was straightforward. Candidates did not seem to be disadvantaged by this.

Q.5 This question was generally well done, with many candidates scoring full marks.

(a) Generally OK. In order to help candidates realise that two directions were required for the strike credit, examiners had put a small hyphen in the response box, a very small number of candidates may have interpreted this as a signal to leave the box blank.

(b) Well answered, indicating sound knowledge.

Q.6 This question discriminated well, and examiners saw the whole mark range of candidates.

(a) and (b) Generally well done.

(b) Examiners appreciate that the size of the boxes restricted candidates from giving fully detailed reasons. An extremely small number of candidates mistakenly reasoned the relative age of the three boxes rather than each of the pairs in turn.

Q.7 Candidates performed well on this question and examiners saw the whole mark range being used, with the majority of candidates scoring over half the available marks.

(a) Generally well done. The better candidates drew very clear sections to explain how the angle of the contact affected the width of metamorphic aureole.

(b) It was surprising to the examining team than a few candidates left this completely blank. Better annotations included the cross cutting relationship of the igneous body to the bedding, and detail of the baked and chilled margins.

Q.8. Although the question discriminated well, only the highest level candidates accessed the top marks of the question.

A minority of candidates are still giving non-geological factors within their answers to which little credit could be given, for example, noise, aesthetics, visual reasons and also rats. A few candidates chose to focus their answers on opening up the quarry sites for further extraction, rather than the new landfill purpose. Good candidates ensured they focussed on the map location and the surrounding features and gave arguments for and against the sites. Good discussion of geological factors included, for example, rock permeability, structures, mining history leading to subsidence potential and proximity to faults. Candidates should be aware that all sites have the potential to be a landfill site if there is sufficient engineering employed (e.g. use of liner materials).

GEOLOGY

General Certificate of Education 2006

Advanced

GL5 Geological Themes

Principal Examiner: Elliot Hughes

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an AS award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this paper and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	**Entry**	**Max Mark**
GL5 (all options)	816	100

Grade Ranges

Option	**01**	**02**	**03**	**04**	**05**	**06**
A	68	69	69	67	67	68
B	62	62	63	60	61	62
C	56	56	57	54	55	56
D	50	50	52	48	50	50
E	44	44	47	42	45	45
Mean Mark						

N.B. The marks given above are raw marks and not uniform marks.

GL5 GEOLOGICAL THEMES

General

There is continued improvement in candidates' ability to respond to questions which ask them to "evaluate". Examiners are at pains to reward good geological reasoning even if it might be at variance with the mark scheme and / or opinions of the examiner. An example of this was Unit 1 Q.2(c), where candidates were asked to assess the usefulness of pollen to indicate past climatic conditions. The most common response to be awarded full marks was something along the lines of "pollen is a good indicator because it is widely distributed by the wind, preserves well and identifies plants which lived in particular conditions." At least one candidate suggested that; "pollen is a poor indicator because it is very small, so hard to find and is widely distributed by wind so can end up in places far from where the plant grew." This was also awarded full marks. There are limits to this approach such that in Unit 1 Q.2.(b) where "plants had not yet evolved" was not accepted. The only evaluation question that was consistently poorly done was Unit 3 Q.2.(b)(iii). Few full marks were awarded.

There were several cases where candidates covered the principles well but made fundamental mistakes with terminology. Two examples are 1. Unit 1 Q.5., where some candidates clearly distinguished world-wide changes in sea-level from localised apparent changes but called the former isostatic and the latter eustatic and, 2. Unit 4 Q.5., where the terms "normal" and "reverse" faulting were occasionally confused but the importance of the orientation of the principal stresses well understood. Such errors did not prevent candidates from obtaining high marks.

There is considerable trade-off in many essays between breadth and depth. For example, Unit 4 Q.5. Here, candidates were asked to consider the factors which might lead to fault or fold production. Some of the highest scoring candidates discussed one factor, e.g. temperature, in great detail. Others preferred to consider temperature, time and pore pressure in lesser detail. Both approaches are eligible for full marks, so long as the candidate can demonstrate real insight.

The question of the state of the upper mantle arose in questions Unit 1 Q.5. ,Unit 3 Q.5. and Unit 4 Q.3. A large number of candidates stated that the mantle was partially molten. This, as a general rule, is incorrect. The mantle is solid and becomes molten by excess heating (at hotspots), marked decompression (at mid-ocean ridges) or additions of volatiles to lower the solidus (subduction zones). Apart from these occurrences, the mantle is solid.

Quoting relevant figures from graphs was readily credited.

Students should be encouraged to include more diagrams in general. It is clearly evident that those who employ well-labelled diagrams consistently score higher marks than those who do not include diagrams.

Unit 1 - Quaternary

Q.1 (a) (i) A minority of candidates plotted the correct petals but also the reflection of these petals.

(ii) Generally a well-answered question, although a significant number found it difficult to describe directions. The easiest way for candidates to obtain the marks was to quote figures.

(iii) A full range of responses. The full-marks answers tended to be of drumlins, where many candidates clearly explained how the direction might be obtained. However, a significant number of candidates discussed striations or the orientation of clasts in till and could not explain how a direction rather than a trend would be obtained. A few candidates explained how the hand might be used in the case of striations. Examiners would have looked very favourably on candidates who might have made the point that it might not be possible in certain cases to obtain a direction rather than a trend, but none did.

(b) (i) Reasonably well-answered. A significant number did not make reference to the direction of the sun.

(ii) Many candidates mentioned freeze thaw, but often the description of the process was not detailed enough to secure full marks.

Q.2 (a) (i) Generally well answered, although many candidates found it difficult to use the scale, often using the enlarged scale for plotting on the figure. Particularly at 11,000y, many candidates took 11% from the enlarged scale to plot on the figure. Also, many did not realise that the line dividing Zones I and II was older than 11,500y and marked the 32% peak ON the line. However, no-one was penalised for the latter error.

(ii) Generally well answered, except some candidates described the trend in reverse chronological order.

(iii) Generally well answered, some candidates lost marks for giving descriptions which were much too general (e.g., use of terms such as 'trees' with no qualification).

(b) Not particularly well-answered. Answers ranged from 'plants had not yet evolved' or 'there was a mass extinction' to 'there was a desert and not many plants grew'. The most common accepted answers were "the lake did not exist at that time", "the lake deposits have been eroded away", or "the area was covered with ice".

(c) A reasonably well-answered question, except that many candidates ignored the request to "evaluate" the use of pollen, thus forfeiting one mark.

Q.3 A generally well-answered question, but many candidates did not obtain as many marks as they might have by not including labelled diagrams. Answers on folds and igneous bodies were generally much better than those on faults, joints or dipping strata. There was sometimes considerable overlap between igneous bodies and joints when tors were discussed. This was credited if in context.

Q.4 The full range of answers. In contrast to Q.3, diagrams were more common. Bouma sequences were often mentioned and there were some excellent descriptions. However, many candidates did not mention the density of the turbidite flows and only talked in vague terms about their speed. Discussion of graded bedding, (a popular choice for part b) was generally relatively basic and was not adequately developed. Tool marks were quite popular but, again, many descriptions were very basic. Flute casts tended to be selected by the better candidates and there were some excellent accounts.

Q.5 A generally well answered question which discriminated very well. Many candidates did not adequately draw the distinction between eustatic and isostatic processes, with the description of one process tending to merge into the other. On the other hand, there were some very impressive, concise accounts.

Again, answers generally did not contain enough diagrams.

Only the better candidates mentioned the crustal bulge which occurs around the margin of a large thick glacier.

A small number of candidates devoted considerable time to the discussion of Milankovitch Cycles, for which they received no credit.

Unit 2 - Natural Resources

Q.1 (a) (i) Generally well answered question

(ii) Some candidates clearly pointed their arrow to the fault which is not correct.

A small number of candidates missed the question altogether.

(b) Moderately well answered. It is clear that many candidates do not realise the importance of units in calculations.

(c) (i) Moderately well answered. Most candidates got at least 1 mark. Marks were usually lost for **only** drawing arrows along the fault or omitting to put arrows on the fault.

(ii) Generally well answered. Most candidates got 3-4. The importance of rock type, porosity and permeability was well demonstrated. However, few candidates made the connection between depth – geothermal gradient – and hot water being brought up along the fault, so few got 5 marks.

(d) Reasonably well answered, but relatively few mentioned oxidation and reduction.

The most common correct response was "iron was dissolved from the sandstone, rose up the fault and was precipitated at the surface.

Q.2 (a) (i) Most got this correct, although some clearly either do not know what a chemical element is or, more likely, did not read the question properly.

(ii) Most candidates put the arrow in the correct direction and gave an acceptable answer for the explanation. However, few of those who put the arrow in the wrong direction wrote anything sensible which was worthy of credit in the explanation.

(b) (i) (ii) A significant minority of candidates described the difference between peat/lignite AND bituminous coal/anthracite and not the differences between peat and lignite or bituminous coal and anthracite. In part (i), many candidates got 2 marks, however (ii) was not as well answered and very few got the reserve mark for saying that bituminous coal was layered whereas anthracite was not. A significant number of candidates used the word "lighter" without making it clear whether they meant lighter colour or lighter weight.

(c) This question proved to be very demanding. It could be answered in two ways: gas from coal, or gas from marine organisms whereas coal is derived from plants. Either of these approaches could obtain full marks. Relatively few mentioned that they were both hydrocarbons.

Section B

Q.3 A very popular question but not generally well-answered – most candidates seem to have learned a pre-prepared answer which did not address certain parts of this question (namely 'how the environment can be protected'.) Very few mentioned planning regulations and legislation relating to environmental matters. The candidates who secured top marks in this section discussed these points.

There were a lot of relatively bland answers to this question which waffled on at great length about washing wheels of trucks, and flooding old quarries to make lakes, etc. Relatively few mentioned acid mine drainage.

Q.4 Not a popular choice.

(a) A significant number of candidates do not understand what is meant by a 'bulk' mineral deposit. Many discussed copper (a few candidates tried to justify why they regarded Cu as a bulk deposit and some credit was given for this). This section was generally not well answered – the discussion of economic importance was often omitted or only given cursory mention.

(b) Generally answered much better than part a) copper was a common answer and the better candidates included diagrams (aluminium was also discussed as well).

Some candidates used Cu for both parts of the question

Q.5 Generally a reasonably well answered question – although the evaluation asked for in the question was often non existent or very poor.

There were more diagrams in this section but some candidates still think they can write an answer like this without diagrams – this invariably means that they are not getting as many marks as they might.

Each method was described as "cheap" by some candidates and "expensive" by others, with rarely any attempt to justify such claims. Such discussions would have enabled candidates to score highly on the "evaluate" element.

(i) Geological mapping was generally well answered, although sometimes seen as a lab-based exercise which involved only the study of maps and the drawing of cross-sections.

(ii) Geochemical prospecting yielded some good answers. Some candidates did not make it clear what is done with water or sediment samples once they have been collected.

(iii) Remote sensing was not a popular choice but was particularly poorly answered.

(iv) Seismic reflection showed that most candidates have only a limited grasp of the method or its limitations.

Unit 3 – Evolution of Britain

Q.1 (a) (i) Reasonably well answered

(b) (i) Answered reasonably well – some candidates had problems with the scaling.

(ii) Generally well answered.

(c) Many candidates cited oolites in their responses to (i) and/or (ii). Most qualified them with reference to energy required for formation or evaporation rate of the seas. However, a significant number claimed that oolites are formed due to rolling on beaches. Most used the information provided but some relied on their knowledge. An example of the latter was the presence of corals. Most claimed that this implied low energy as they were in their growth position. Some, however, claimed it was high energy as reefs form in high energy conditions. This is another example of where examiners give credit for different responses so long as the reasoning is sound.

(i) A well answered question, although some candidates did not cite characteristics of the environment .

(ii) Most candidates recognised the fact that one environment was more energetic than the other. However, few took their analysis beyond this to score full marks.

Q.2 (a) (i) Generally well answered. The date for the opening of the North Atlantic was obviously obtained from knowledge by some candidates. Examiners were expecting 220 to 100Ma but some gave answers down to 55Ma (the most recent estimate). All of these were accepted.

(ii) Only a very small minority got this correct – most did not appear to know what polar wandering curves were or how they were arrived at. Most stated that they were apparent because the data or evidence was not very reliable. Very few stated that it is the continents and not the poles that (significantly) wander and that this is just a convenient way of presenting the data.

(b) (i) Generally well answered

(ii) Quite a poorly answered question. Most candidates gave features which could be interpreted as fluvial, but made no attempt to explain why or justify their choice.

(iii) Comments like 'yes, the statement is correct' with little qualification or evaluation, were common. Few got full marks and most answers focussed on sedimentary rocks. Better candidates were able to evaluate the use of sedimentary rocks as indicators of palaeolatitude. Very few mentioned that the palaeomagnetism of a rock could be re-set by alteration/metamorphism. Many claimed that palaeomagnetism could not be found in sedimentary rocks.

Q.3 This question was quite popular. Diagrams were lacking in many of the answers. Many of the candidates only talked in vague terms about the differences between the two orogenic belts. Very few mentioned differences in the structural style of the two belts and differences in metamorphic grade were poorly addressed. The Caledonian orogeny was generally well known and understood. Not so the Variscan, which was sometimes confused with the Alpine Orogeny. Many candidates who satisfactorily discussed the effects of the Variscan Orogeny in Cornwall did not acknowledge any effects elsewhere in Britain.

Q.4 This was a popular choice and produced a wide spectrum of responses. It appears that some candidates read the first part of the question then stopped and did not notice that it specifically referred to the P-T and not the whole geological column. Such candidates answered the question very generally in terms of mineralogy, texture, sedimentary structures and fossil content, without specific reference to the P-T (credit was given where the features discussed could be observed in P-T rocks but nothing could be given for discussions of features such as coal swamps and glaciers). Part (b) was in many cases not attempted. Few candidates scored highly for this part of the essay, although a small minority competently evaluated the application of the Law of Uniformitarianism.

Q.5 This question was only answered by a few. A number of candidates did not know what Cenozoic meant and wrote essays which encompassed the Cambrian to the present day. Descriptions of the igneous features of the BTIP were generally good. Although candidates were not penalised for claiming that extension at the ridge (alone) was responsible for the excess volume of magmatism observed on the European and Greenland continental margins at this time, it should be noted that excess heat in the form of a mantle plume is required to generate such thickness of melt (cf the Iberian margin as the Central Atlantic opened, no large igneous province formed nor any significant excess melt).

Alpine structures were much less well described and most candidates appeared to know relatively little about this topic.

Unit 4 – Lithosphere

Q.1. (a) Reasonably well answered.

(b) (i) Generally well-answered. However, a significant number of candidates put the arrow in the wrong place.

(ii) Relatively poorly answered, with many candidates simply talked about increasing pressure with depth and could not account for the two opposing forces.

(c) (i) Generally well-answered. The most common mistake was putting 85 instead of 185 for the depth of Z.

(ii) Generally well answered – explanations generally good.

(iii) A relatively poorly answered question. Temperature was not mentioned as much as it could have been. It is pleasing to note that VERY few candidates now claim that the speed of seismic waves increases with density.

Q.2 (a) Reasonably well answered, but a significant minority of candidates failed to appreciate that the faults were **reverse** faults.

(b) Again reasonably well answered but some candidates failed to recognise that because this was an extensional environment that the faults were **normal** faults.

(c) A generally well answered question although few candidates actually evaluated the statement, and so, few obtained 3 marks.

(d) Generally a well answered question, although some candidates failed to recognise that the increased sediment mass would lead to accelerated basin subsidence and so more sediment deposition. On the other hand, a surprisingly large number suggested that fault reactivation might occur.

(e) A generally well answered question.

Q.3 This was a generally well answered question. However, many otherwise good answers were let down by either lack of diagrams or very poorly constructed diagrams. A surprising small number of candidates was able to produce a high quality description of how remanent magnetism is produced. The Curie Point was only occasionally considered. The affected minerals in the rock were usually just referred to as "iron" or "iron minerals". Very rarely was a suitable mineral (even magnetite) mentioned.

Few candidates mentioned dating of the basalts in order to confirm the ages. Also, few mentioned the evidence available from the continental margins which have separated. The role of transform faults in offsetting blocks of oceanic lithosphere was only mentioned by a few.

Q.4 This was generally a well answered question with some excellent essays. However, very few candidates mentioned hot-spots in their answer. The second part of the question was sometimes ignored, written about in a few cursory sentences or generally poorly completed, with the magmatic processes occurring at the various locations rarely discussed in detail – many candidates preferred to talk about convection of the mantle. Upwelling of hotter mantle is generally of secondary importance to the magmatism (or lack of it) in explaining heat flow. Some candidates did not include a diagram/graph which is essential to a question such as this.

Q.5 Generally a poorly answered question. Again, a big problem was the lack of diagrams as candidates find it difficult to adequately describe fault mechanisms without the use of diagrams. Many candidates did not mention tear faults and some of the better candidates, who scored highly on normal and reverse, showed a distinct lack of understanding when it came to tear faults. In general, descriptions of the faults were poor. The better candidates provided examples of these faults.

The second part of the question produced a varied response. Here, the high scoring candidates drew stress-strain curves and discussed in full detail the factors which determine whether folding or faulting occurs.

GEOLOGY

General Certificate of Education 2006

Advanced

GL6 Geological Investigation

Principle Examiner: Ian Kenyon, Truro School, Cornwall

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an AS award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this paper and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
GL6	817	60	41.3

Grade Ranges

A	48
B	42
C	36
D	30
E	24

N.B. The marks given above are raw marks and not uniform marks.

GL6 – GEOLOGICAL INVESTIGATION

Administration

The administration and moderation of the coursework samples ran smoothly once again this year. The Principal Moderator is very grateful for the efficient organisation and punctuality of the majority of centres. Only a small number of centres submitted materials after the May 6th deadline.

Packaging Coursework

When packing the coursework samples, please try to reduce bulk and weight as far as possible. A4 hardback ringbinders should not be used. It is helpful (and cheaper for centres) to use slim plastic folders that can be packed efficiently. The use of large and heavy field notebooks containing only a few pages of assessed material is to be discouraged. Please consider detaching the relevant pages of field notes and inserting them in the front of the report with a paper clip. Alternatively photocopy the relevant pages and include in the front of the report. All materials for moderation should be included in just one modest sized package.

Fieldwork and Laboratory based Investigations

Please note that the requirements for GL6 are a minimum of two investigations. The assessment must be a minimum of 50% field based work and a minimum of 25% laboratory based work. Therefore only two possible combinations are available. Field 50%, Lab 50% or Field 75%, Lab 25%. Please state clearly on the GLF1 form whether Lab (L) or Field (F) is being assessed. It is not appropriate to write F/L.

GLF 1 Forms

A completed GLF 1 form should be included with the coursework sample. This is used by the moderator to make any recommendations for mark adjustments. Please note it is not necessary to write out the details of the investigations undertaken in the space allocated on the right hand side of the form. The GLF1 form should list **all** candidates and their marks from the centre, not just those selected as a sample for moderation. It is helpful to mark with an asterisk on the left hand side those which are included in the sample.

GLF 2 Forms – The Tracking/Planning Sheet

A completed GLF 2 form should be included for each investigation undertaken, i.e. two for each candidate in the sample. This is used primarily to assess the planning of the investigation. The quality of the planning sheets varied from exceptional, exhaustive and comprehensive to inadequate, inappropriate and shoddy. The best marks for planning were achieved where students carried out a pilot study to test their planning, then modified the original plan in the light of this. A significant number of centres were over-generous on awarding marks for planning. It is not possible to score full marks on this section when candidates have failed to make any predictions about possible outcomes and anticipated sources of error.

These sheets can be enlarged to A3 where space is insufficient. Additional planning information can be included at the beginning of the written report under a clear 'planning (GLF2) continued' heading.

Students should be encouraged to plan in detail and should be discouraged from using simplistic bullet point statements on the planning sheet.

GLF 3 Forms

A completed GLF 3 form should be submitted for each candidate in the sample. Please make full use of the opportunity to comment on the work of individual candidates on the GLF 3 form. Ideally, the use of 4 'post-it' notes should be used to locate within the work, where and why the marks have been awarded. A few centres still fail to comply with this request each year and possibly disadvantage their candidates as a result.

Downloads from WJEC

Copies of the forms GLF1, GLF2 and GLF3 can be downloaded directly from the WJEC website www.wjec.co.uk by following the Examinations, GCE(AS/Advanced) subjects and then Geology links from their home page.

C Forms

Please note that the C forms (red/pink) for recording candidates' marks should be sent directly to WJEC and not the moderator of coursework.

Implementation

In order to provide evidence for implementation, it is vital that the appropriate field and laboratory notes are included with the report.
A small number of centres failed to include the laboratory notes again this year.

It should also be noted that laboratory work must yield some raw data that could not be collected in the field. Bringing back rock samples then describing them as in a 'traditional' practical is not really in the spirit of the new assessment.

Good examples of lab work included:

- Making thin sections of rock samples followed by microscope analysis
- Sieving sediments and calculating sorting, skewness and kurtosis
- Establishing composition of sediment samples using point counts
- Testing rock samples for resistance to abrasion, impact and polishing
- Modelling rock deformation using plasticine and mars bars
- Simulating mass movements and tsunami generation in a wave tank
- Porosity and permeability of rocks related to their utilization potential
- Testing the resistance of various mollusc shells to abrasion/attrition and linking to preservation potential

The overall quality and quantity of the lab and field notes were a little disappointing again this year and could easily be improved upon. Field sketches were particularly poor.

Ideally, each field location should have a six-figure grid reference. If sites are close together, then the same reference should be given with '12 metres west of site 4'. It was pleasing to note some very accurate fieldwork locations were given by a few centres using GPS.

All field sketches should have grid reference, scale, compass orientation and detailed annotations. Simplistic labelling of sketches should be discouraged.

Information from secondary sources, such as bed ages or detailed palaeogeographies, should not appear in the field notes. Photographs are also inappropriate in the field notes. The field notes should be used to interpret the photographs in the report.

Field notes should consist of detailed observations, measurements and records made individually by each candidate. Identical notes, obviously dictated in the field, are to be strongly discouraged.

It is strongly recommended to practise field sketching from photographs or slides prior to fieldwork being carried out. The field and lab notes provide the basis for the report and should be considered the most important part of the investigation.

Analysis

This involves some synthesis and interpretation of the primary data collected in the lab or field. There must be some development from the field or lab notes, rather than simply copying out the same information in a neater form.

The use of photographs is to be strongly encouraged but these should be used selectively and integrated within the text. Transparent overlays or outline diagrams adjacent to photographs may be used to highlight important features or annotated digitally. Grid reference, compass orientation and scale should be included as a matter of course.

Please discourage the indiscriminate use of photographs, which lack location and annotations. Only include photographs, which are directly relevant to the investigation. As a general guide no more than 8 to 10 photographs should be included. Less than half the candidates included photographs this year and the majority were poorly annotated.

Statistical analysis is recommended if it is appropriate to the data collected. Excellent investigations on sedimentary environments included work on sorting, skewness and kurtosis. Particle size and shape was assessed using Zinng's, Krumbein's and Cailleux's indices. Spearman's Rank, Chi Square and Vector analysis were also used by some centres. Point counts were used to assess the mineralogical composition of rock and sediment samples.

Spreadsheets were used by a number of centres, but not always to the best effect. Printouts of cumulative frequency graphs, Zinng diagrams and histograms were rarely annotated to show evidence of thorough analysis and interpretation.

Evaluation

Evaluation must be included as a separate section within the report. It is an opportunity for students to reflect objectively on the work they have carried out. The quality of evaluations varied from sophisticated and thorough to simplistic and inappropriate. It may be worthwhile suggesting to students that they break up the evaluation into a number of distinct components:

Evaluating the planning sheet they completed. How appropriate were the techniques and methods they selected? This may refer to methods of sampling, sample size and sample number.

What problems or limitations were encountered during implementation? This could involve reference to confusion between true and apparent dip or problems between the base map geology and actual rock outcrops.

An outline of the way in which the investigation could be improved, given more time and/or resources and with the benefit of hindsight.

An overview of the investigation based on the likely reliability/validity of the data collected in the available time frame. Which part(s) of the investigation(s) yielded the most/least reliable data and why? Are the conclusions made concrete, tentative or partial? How do these findings compare with published work on the same area/topic. How do they compare with the results/conclusions of students from last year?

Evaluation is not a list of excuses. Naïve and simplistic statements regarding lack of time, bad weather and lack of familiarity with equipment do not form the basis of a mature evaluation. As a rough guide, one side of A4 word-processed text is a probable optimum length for evaluation.

The Report

It is now expected that students make use of IT and finish reports to a professional standard. It was encouraging to see so many centres making appropriate use of IT this year and just a few hand-written reports were submitted.

As a rough guide, the optimum length for each report should be between 1250 and 1750 words. This excludes maps, diagrams, photographs, graphic logs and statistics. Quality rather than quantity is to be encouraged. The reports should be concise, relevant and clearly focused.
Please dissuade students from including large amounts of photocopied material from secondary sources.

The report should be based on the primary data collected in the lab or field and there should be some cross-referencing between the two. Safety considerations should be briefly acknowledged and students should be encouraged to be aware of the importance of the need for conservation of geological sites. The report might include the following sections, though they may be subsumed under a smaller number of headings:

Contents Page
Location Map
Introduction
Aims/Hypotheses
Safety Aspects
Methods Of Data Collection
Data Presentation
Data Analysis
Statistical Analysis
Graphs/Printouts With Annotations
Photographs With Annotations
Conclusions
Evaluation
Bibliography
Acknowledgements

Standards

The standard of coursework submitted this year represents yet another improvement on last year as many centres have again clearly acted upon the advice given on moderator feedback forms. Teacher marking is now very close to that of the Principal Moderator on all four components of the assessment criteria. In 2006, two centres were adjusted downwards and seven were adjusted upwards.

Help and advice is available from the Principal Moderator at any time. Contact email address igk1527@aol.com
Telephone (01872) 554361 (Home) or (01872) 272763 (School)
(07971) 961365 (Mobile)

Coursework for 2007 can be submitted any time after 1st April 2007. The final deadline for coursework submission is May 4th 2007.

GEOLOGY

General Certificate of Secondary Education 2006

Chief Examiner: Dr Alan Seago, Open University

Principal Examiners:

Paper 1 Higher Tier	Dr Alan Seago
Paper 1 Foundation Tier	Dr Alan Seago
Paper 2 Foundation Tier	David Lomax
Paper 2 Higher Tier	David Lomax
Coursework	Dr Alan Seago

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	Entry	Max Mark	Mean Mark
Paper 1 Foundation	251	100	45.6
Paper 1 Higher	386	100	62.6
Paper 2 Foundation	249	90	44.2
Paper 2 Higher	387	90	51.4
Coursework	637	30	19.0

Paper 1

Foundation Tier

This was the second year of the new style of Paper 1. There was a decrease in the mean mark, which suggests that the candidates found the questions slightly more difficult than in 2005. The use of similar data for both papers with a greater overlap of questions increases comparability with the Higher paper. This provides a greater assurance that a Grade C achieved on the Foundation Paper is equivalent to a Grade C on the Higher Paper. It is pleasing to report another successful year for centres with some high quality candidates and all candidates able to gain significant marks on each question. There are, not surprisingly, a large number of weak candidates attempting this paper, which suggests that centres have their entry criteria largely correct. There are a small number of candidates performing exceptionally well on this paper and these would certainly gain a higher grade on the Higher Paper.

Q.1 The first part of this question was based upon an earthquake in North Wales, testing general principles about the measurement, causes and prediction of earthquakes. (2.1.3, 2.4). This was then broadened to include earthquakes worldwide. The question then tested the use of seismograms to determine Earth structure (2.2.2).

(a) Most candidates correctly estimated the scale of the earthquake and its location near the fault. Candidates found it difficult to explain clearly how animal behaviour can be used to predict earthquakes, when a simple explanation of how animal behaviour changes because they are more sensitive was all that was required.

(b) This question was correctly answered by the majority but many candidates repeated their part (i) answers in part (ii).

(c) Candidates were generally aware of the use of earthquakes to determine Earth structure. Many candidates erroneously thought the mantle was totally liquid, the outer core totally solid, that L waves pass through all of the Earth's layers and P waves have the lowest velocity.

Q.2 The initial part of the question involved evidence for the existence of Pangaea (2.3). The question went on to test constructive plate margins and the differences between continental and oceanic crust (2.2.2, 2.3). The extended prose section tested the candidates' knowledge of magnetic stripes with a diagram as a stimulus (2.2.2).

(a) Most candidates identified the age when continents were joined using the Data Sheet. Jigsaw fit of coastlines was the most common answer to part (iii). However, answers as to how the Great Ice Cap could be used as evidence for the continents being once joined were poor. Many seemed to think that the Ice Cap melting caused continental drift and allowed continents to separate.

(b) The abyssal plain was not identified correctly by many candidates, and the direction of plate movement was often incorrect. The suggested locations of oldest ocean crust, youngest ocean crust and molten magma tended to vary quite a lot, although some variability, within reason, was allowed for in the mark scheme. The age of the continental crust was more accurately stated than the thickness of the ocean crust.

(c) This was poorly answered. Credit was given for fairly simple statements which were relevant to magnetic stripe formation such as intrusion of magma and cooling. References to changes in polarity and symmetry were rare.

Q.3 The first task for candidates was to identify the mineral using the Data Sheet and compare the texture of schist and marble, thereby interpreting the conditions of metamorphism (2.1.4). Candidates were then tested on igneous textures including the interpretation of vesicular and porphyritic textures (1.2, 2.1.1).

(a) Most candidates identified the quartz correctly but the foliated texture of the schist proved to be quite a difficult difference between the two rocks for the candidates to appreciate. Few stated contact metamorphism for the origin of the marble.

(b) The crystalline nature of the crystals was expected for part (i) or the lack of fragmental (rounded) texture. Most candidates correctly measured the size of the crystals and interpreted the rate of cooling of the lava. Many could explain, in part, the presence of two crystal sizes in the porphyritic rock in terms of rate of cooling, but the suggestion of intrusion of the magma/crystal mixture at some stage in the history of the rock proved to be more elusive. The origin of the vesicles was well answered.

Q.4 This question involved interpreting a sedimentary log. The first part of the question involved identifying and labelling fossils and picking out the characteristics of a good dating fossil (5.1, 5.2). Interpreting the glacial nature of the till (2.1.3) from sedimentary evidence provided quite a challenge to candidates, although the oolitic limestone was easier, probably because of the different format of the question. The origin of columnar jointing proved less of a problem than its significance (2.1.1, 5.3).

The final part of the question tested the candidates' ability to interpret the evidence in order to suggest the direction of drift (5.3).

(a) A variety of incorrect fossil names and names for the suture were suggested. Most candidates could give at least one characteristic of a good dating fossil.

(b) Very few candidates identified the chalk, although limestone was accepted. Most candidates repeated the observations concerning the till from the field notes without any interpretation. Most candidates correctly completed the sentences describing the origin of the oolitic limestone.

(c) Many recognised that columnar jointing was the result of cooling and contraction. The volume of the lava flow was correctly calculated, although most found it difficult to give a reason for the large volume of lava in North West Britain, with most simply stating 'volcano'.

(d) All three alternatives were suggested for the direction of drift by significant numbers of candidates in each case.

Q.5 The first part of the question tested a popular branch of palaeontology, although not commonly asked at this level, and proved to be very successful in terms of candidates' responses. The second part of the question presented fossil data in a different way from the usual, asking candidates to interpret the environment of deposition applying the principle of uniformitarianism, but it proved to be challenging for candidates (5.1, 5.2).

(a) The dinosaur question was answered very well with some imaginative suggestions for the function of the bony plates.

(b) The calculation caused some candidates problems. Candidates found it difficult to clearly explain the use of the phrase *the present is the key to the past*. Many failed to recognise the significance of the percentage of broken fossils at locality R but could state two other features of the environment. 'Plants' was simply often stated as a feature of the environment at S with no explanation.

Q.6 Questions 6 and 7 tested economic geology, with Question 6 concentrating on oil traps and oil exploration (4.1)

(a) Most could identify the type of oil traps and the nature of the cap rock, although some thought that the halite cap rock meant that one was a salt dome trap. The high porosity of sandstone was more familiar to candidates than the low permeability of shale. The reasons for oil migration were poorly known.

(b) The diagram stimulus to this question worked well and candidates made good use of the information provided. When describing seismic survey, the most common mistake was to talk about ultra-sound – a reasonable analogy, useful in teaching but the differences in the nature of the waves needs to be noted. 'Reflection' was not a term that candidates used commonly.

Q.7 The first part of the question concentrated on faulting (3.2) and the geological factors affecting the mining of coal (4.1). The emphasis in the second part of the question was on the environmental aspects of opencast and deep mining (4.1).

(a) The downthrow side of the fault was identified by the majority of candidates but the angle of dip and type of fault resulted in many errors. How the dip affects the type of mining was not always clearly explained and many thought the washout was caused by folding.

(b) There were some interesting suggestions for the purpose of the borehole but many were incorrect and included letting gas out and providing access for miners. A number of candidates thought that the baffle bank was used to hold back the waste or prevent flooding. When explaining how the quarry is being restored, many candidates repeated information on the diagram or thought the soil was stored to sell it at a later date. The final part of the question demonstrated how candidates fail to read questions carefully despite 'deep mining' being in bold. A lot of answers related to opencast mining. If a problem was mentioned, there was often little description or solution to the problem. One of the most common correct responses was subsidence but the remedy was, almost without exception, filling in with concrete. A significant number of candidates described destruction of habitat but with no solution. Very few discussed water pollution or spoil tips. Is this a sign that the environmental effects of coal mining have been dealt with nationally and that coal extraction is no longer considered as an environmental problem in many parts of Britain (and therefore an outdated section of the specification)?

Paper 1

Higher Tier

This was the second year of the new style of Paper 1. There was an increase in the mean mark and the candidates seem to find that the different style of presentation has advantages over a separate book of data. It is pleasing to report another successful year for centres with some high quality candidates and all candidates able to gain significant marks on each question.

Q.1 The first part of this question was based upon an earthquake in North Wales, testing general principles about the measurement, causes and prediction of earthquakes. (2.1.3, 2.4). This was then broadened to include earthquakes worldwide. The question then tested the use of seismograms to determine Earth structure (2.2.2).

(a) Most candidates correctly estimated the scale of the earthquake and its location near the fault. A significant number of candidates only stated a second method of prediction rather than describing it. Some answers referred to using seismographs but did not explain the 'gap theory' or the increasing activity nearer to the earthquake.

(b) This question was correctly answered by the majority, but even some of the better candidates often failed to say which country had the higher population density, poorer engineering, etc.

(c) Candidates were generally aware of the use of earthquakes to determine Earth structure. A number of candidates failed to label the mantle and this was often the case in all of the questions where labelling of diagrams was asked. The iron-rich nature of the outer core was not often correctly stated.

Q.2 The initial part of the question involved evidence for the existence of Pangaea (2.3). The question went on to test constructive plate margins using heat flow and the differences between continental and oceanic crust (2.2.2, 2.3). The extended prose section offered candidates the choice between the evidence for sea floor spreading and the causes of plate motion (2.3).

(a) Most candidates identified the age when continents were joined using the Data Sheet. However, answers to how the Great Ice Cap could prove this were poor. Many seemed to think that the Ice Cap melting caused continental drift. Jigsaw fit of coastlines was the most common answer to part (iii).

(b) The abyssal plain was not identified correctly by many candidates and the direction of plate movement was often incorrect but most correctly showed increased heat flow over the ridge. The age of the continental crust was more accurately stated than the thickness of the ocean crust.

(c) For the evidence for sea floor spreading, most answers concentrated on the magnetic stripe evidence and most candidates could provide a good description. Most candidates concentrated on convection currents as causes of plate motion, illustrating their answers with relevant diagrams. Some candidates erroneously described and drew detailed diagrams of plate boundaries.

Q.3 The first task for candidates was to identify the mineral using the Data Sheet and compare the texture of schist and marble, thereby interpreting the conditions of metamorphism (2.1.4). Candidates were then tested on igneous textures including the interpretation of vesicular and porphyritic textures (1.2, 2.1.1).

(a) Most candidates identified the quartz correctly but the foliated texture of the schist proved to be quite a difficult difference between the two rocks for the candidates to appreciate. An alternative answer was the porphyroblastic texture of the schist (although not necessarily using the term). Few stated contact metamorphism for the origin of the marble.

(b) The random nature of the crystals was expected for part (i) rather than a repetition of crystalline, which was given in the question. Most candidates correctly measured the size of the crystals and could explain the difference in terms of rate of cooling. The origin of the vesicles and porphyritic texture was well answered.

Q.4 This question involved interpreting a sedimentary log. The first part of the question involved identifying and labelling fossils and describing the characteristics of a good dating fossil (5.1, 5.2). Interpreting the environment of deposition of the glacial till or oolitic limestone (2.1.3) from sedimentary evidence provided quite a challenge to candidates, as did the significance of the columnar jointing (2.1.1, 5.3). The final part of the question tested the candidates' ability to synthesise the evidence to interpret changes in climate and latitude (5.3).

(a) Most could name the fossil but the suture line was less well known. Most candidates could give at least one characteristic of a good dating fossil.

(b) Very few candidates identified the chalk. Most candidates chose to interpret the oolitic limestone rather than the till. Candidates failed to discuss the evidence available such as the brachiopods indicating marine, continental shelf conditions and simply stated shallow, warm sea. Of those who interpreted the till, many described it as part of a scree slope or flash flood deposit. These candidates recognised that the deposit had not travelled far but failed to understand the significance of the scratched boulders or clay matrix. Most candidates repeated the observations from the field notes without any interpretation.

(c) Most recognised that columnar jointing was the result of cooling and contraction. The volume of the lava flow was correctly calculated, although most found it difficult to give a reason for the large volume of lava in North West Britain with most stating 'volcano'.

(d) Some candidates were prepared for this question but wanted to use evidence they had been taught about rather than from the field sketch. Most could equate the oolitic limestone with warm tropical seas but as so many failed to recognise the origin of the till, they did not explain that this showed how far Britain had drifted north. Some candidates confused altitude with latitude, perhaps because the sketch showed a vertical cliff.

Q.5 The first part of the question tested a popular branch of palaeontology, although not commonly asked at this level, and proved to be very successful in terms of candidates' responses. The second part of the question presented fossil data in a different way from the usual, asking candidates to interpret the environment of deposition, but it proved to be challenging for candidates (5.2).

(a) The dinosaur question was answered very well with some imaginative suggestions for the function of the bony plates and the reason for it being a plant-eater.

(b) The calculation caused some candidates problems. Many failed to recognise the significance of the plants or the percentage of broken fossils in the table when describing differences between the two environments.

Q.6 Questions 6 and 7 tested economic geology, Question 6 concentrating on oil traps and oil exploration, with the option for candidates of describing halite extraction (4.1, 4.2).

(a) Most could identify the type of oil trap and locate it in the sandstone. The high porosity of sandstone was more familiar to candidates than the low permeability of shale.

(b) When describing seismic survey, the most common mistake was to talk about ultra-sound – a reasonable analogy, useful in teaching but the differences in the nature of the waves needs to be noted. Some candidates erroneously described boreholes. The extraction of halite was answered well with lots of detail and informative diagrams.

Q.7 The first part of the question concentrated on faulting (3.2) and the geological factors affecting the mining of coal (4.1). The emphasis in the second part of the question was on the environmental aspects of opencast and deep mining (4.1).

(a) The downthrow side of the fault was identified by the majority of candidates as was the angle of dip and type of fault. Selecting the correct representation of throw proved to be more difficult. How the dip affects the type of mining was not always clearly explained or the impact of the washout. There were lots of responses about flooding and collapse of the roof.

(b) There were some interesting suggestions for the purpose of the borehole but many were incorrect and included letting gas out and providing access for miners. A number of candidates thought that the baffle bank was used to hold back the waste or prevent flooding. When explaining how the quarry is being restored, many candidates repeated information on the diagram with no explanation. The final part of the question demonstrated how candidates fail to read questions carefully despite 'deep mining' being in bold. A lot of answers related to opencast mining. If a problem was mentioned, there was often little description or solution to the problem. The most common correct problem discussed was subsidence (occasionally described as subduction) but the remedy was, almost without exception, filling in with concrete. Very few discussed water pollution or spoil tips. Is this a sign that the environmental effects of coal mining have been dealt with nationally and that coal extraction is no longer considered as an environmental problem in many parts of Britain (and therefore an outdated section of the specification)?

Paper 2

The questions for the Higher and Foundation Tiers were similar with differentiation provided by the levels of difficulty. Both tiers had the same photographs and specimens.

Foundation Tier

The paper included a geological map, five photographs and 4 specimens.

The paper achieved the full range of marks with a number of candidates performing very well. There were very few poor scripts this year. Last year it was reported that the overall performance on this paper was better than in previous years and this trend has continued. However, the trend of improved sketches has been reversed and, generally, sketching was disappointing. 10% of the marks for this paper are for sketching and therefore it is essential that candidates practise this skill. Generally, candidates performed well on all questions, with some part questions producing better responses than others. There is no evidence that any candidate did not finish in the time permitted.

Q.1 Map

As in previous years, a high proportion of the marks available for this paper were allotted to this question (37/90). Generally, all candidates achieved a degree of success on some parts of the question and the quality of mapwork had improved once again, continuing the trend of last year.

(a) The three part questions are straightforward and are intended to provide candidates with a good start. The majority of candidates answered well and showed a good understanding of the questions.

(b) The standard of cross-sections was impressive, with many candidates achieving very high marks. Candidates of all ability were able to draw-in the asymmetrical anticline. However, the vertical dyke and the batholith caused some problems. A number did not draw the metamorphic aureole parallel to the batholith. Labelling of the cross-section was very well done but labelling of the features was disappointing.

(c) Generally answered well. The true/false style of question works well on this paper.

(d) In order to achieve two marks for each part of the question, candidates needed to comment on the rock and its resistance to erosion. Most candidates were able to get the first mark but few went on to get the other. For example, candidates recognised that G was mudstone but did not relate this to the fact that the rock is soft and easily eroded.

(e) Once again, candidates found this question difficult and the comments from previous years' reports continue to apply. Credit will not be given when candidates give the reason for their selection as "is above" or "below" the other. More specific reasons are needed. The area where candidates have most difficulty is where they have to note the position in a fold.

Q.2 Breccia

The specimens were clearly breccia with angular and subangular grains forming the bulk of the grains. Generally, the question was well done by candidates of all ability.

(a) The quality of sketching was variable. Candidates who took a little time and included the detail of the grains and the surrounding matrix were able to gain maximum marks. Candidates used a variety of scales but some made errors in their use of ratio scales such as 1:2. Candidates are advised to use measurements in millimetres in order to ensure a correct scale is used. Labelling was generally poor and it was clear that most candidates did not know the difference between grains and matrix.

(b) Generally answered well. Candidates in previous years had found questions referring to texture quite difficult but asking for each aspect separately ensured good answers.

(c) A few candidates answered conglomerate but most answered correctly.

Q.3 Andesite

This is the first time that Andesite has been set for this paper. Centres will appreciate that the examiner can set any of the specimens named in the specification. The specimen was a typical porphyritic andesite. In order to answer the question well, correct identification was not required. However, the question was not very well done, largely because of poor answers to part (b).

(a) As in Q1, the use of true/false enabled students to achieve high marks.

(b) This question was done poorly by candidates of all ability. Many answered using minerals or colour for part (i), aspects that could not be determined from the sketch. Only a few discussed the size of crystals. There were two possible answers to part (ii), crystalline and porphyritic, but few candidates gained any credit.

(c) This part was answered quite well, with many candidates showing a good understanding of the concept of quick cooling occurring in a lava flow.

Q.4 Hematite.

The specimen was a typical piece of massive hematite. Along with Q1, this was the most well answered question on the paper. Candidates of all ability performed very well on all parts of the question. Candidates have a good understanding of the properties of minerals. However, there is still evidence, as in previous years, of insufficient use of the data sheet. Using the data sheet would have helped candidates with parts (c) and (d).

(a) Answered well by candidates of all ability. The tests were well performed by candidates and correct results given.

(b) As with part (a), this was well answered.

(c) This type of question has been set many times and it would not have been a surprise to candidates. Generally it was well answered by candidates of all ability. Although credit was given, the examiners would prefer candidates to answer "did not scratch" as opposed to "none". In this question candidates used the data sheet well.

(d) This question was not well done, with many candidates not making use of the data sheet. From part (c), the candidates would have been able to identify the mineral and from the data sheet, candidates could have answered "high density" and "a lack of cleavage". The examiners did not accept a lack of response to acid or a lack of salty taste. Candidates should be discouraged from tasting specimens which are unlikely to be halite.

(e) Correctly identified by most candidates.

Q.5 Bivalve.

The bivalve was a real specimen of Mya. In all specimens the internal features were very clear.

This question was identical to the fossil question on the Higher Tier paper. It produced quite good responses from candidates of all ability. Sketches for this question were generally impressive. Many candidates found interpreting the mode
of life somewhat difficult.

(a) The quality of sketching was much better than on other questions on the paper. Candidates were able to draw very clear sketches, including all the internal features. Many achieved maximum marks for the sketch. Only a few ignored the rubric and drew the external features of the shell. These candidates gained no credit. Adding a scale presented no problem and, in most cases, the labelling was well done. The only label which presented any problem was the pallial sinus where the label was often at the hinge line.

(b) The majority of candidates correctly identified the specimen, with only a few answering "brachiopod".

(c) Candidates had to choose one of four likely modes of life from a diagram and give a reason for their answer. Many answered "burrowing" but were unable to give a reason. The shape of the specimen and, in particular, the large pallial sinus identified the specimen as a burrower to the more able candidates.

Q.6 Photograph.

The photograph shows an unconformity which is clearly recognisable from both the photograph and the map. Centres should encourage candidates to look at the location on the map of all photographs and specimens. In this case, looking at the map could have proved very helpful to the candidates. Responses to this question were very disappointing.

(a) There were a few very good sketches but, generally, sketching was poor. Candidates should be aware that marks for the photograph sketch are awarded for the clarity and detail of the sketches. Examiners do not expect works of art but they will expect all the main features before awarding maximum marks. In this case, candidates needed to show the dipping beds below the unconformity, the horizontal beds above the unconformity and the joints in these beds.

(b) Candidates were provided with four labels to add to their sketch. Very few were able to label the unconformity. The other labels were generally well done but candidates must be more accurate with their labels. Arrows which fall well short of a feature can be misinterpreted.

Q.7 A series of four photographs.

The series of photographs showed a sequence on the map through sandstone and into a recent deposit. This question was poorly answered by candidates of all ability.

(a) Very few were able to recognise a clear photograph of cross bedding. Candidates may be used to seeing this structure in a red sandstone and the colour may have been confusing. Regrettably, an inability to answer part (i) meant that candidates were unable to answer part (ii).

(b) Responses to this question could have focused on the bed thicknesses or on the specific sedimentary structures. A few candidates noted the change in bed thickness but few mentioned the ripple marks.

(c) Photograph four is of a fluvial glacial deposit. The grains are rounded, quite well sorted and, in parts, layered. Most candidates noted the rounding as being due to water but few were able to give the required two pieces of evidence.

Paper 2

Higher Tier

The performance on this paper was similar to previous years, although the examiners consider that a number of candidates had been incorrectly entered at this level. Candidates of all ability scored quite well on most questions, with a number of part questions proving somewhat problematical. The quality of sketching was better than last year. There was no evidence of any candidate failing to finish in the time allotted for the paper.

Q.1 Map

It was mentioned in last year's report that there had been a decline in the standard of mapwork and it is pleasing to note that the quality was better this year. However, there are still some mapwork areas which even the more able are finding problematical. For example, very few understood the word "trend" and few were able to correctly draw in the axial plane trace of the fold.

(a) The angle of dip was well done but few answered correctly for the trend of the fault. Candidates lacked an understanding of the word "trend".

(b) The cross-sections were generally well done but even the most able made errors which prevented maximum marks being obtained. The horizontal and dipping beds were usually correctly drawn, although the close positioning of the major intrusion and the unconformity caused some confusion. Candidates must draw the metamorphic aureole parallel to the intrusion. Examiners will accept a major intrusion as vertical or steeply dipping but not going inwards as it goes down. The vertical fault was correctly drawn but the dyke, going under the unconformity, was frequently missed. Candidates should expect hidden features. Labelling was well done by candidates of all ability.

(c) Candidates generally had a poor understanding of the axial plane trace, with many drawing it vertical. Most candidates achieved some marks for the characteristics of the fold but few achieved maximum marks. Candidates must take account of the number of marks available for each part question. Those who correctly answered "asymmetrical anticline" achieved two of the four mark and were generally, in the examiners' opinions, capable of adding to their response.

(d) Some very good responses but, as with part (c), some candidates did not write enough for the marks available.

(e) The geological history followed the same format as in previous years and many candidates performed well. However, there was a tendency, as in previous years, to focus on the cross-section and not the whole map. As a result, the dyke and recent deposit were sometimes missing. Only the more able candidates noticed that the fault cuts the metamorphic aureole and is therefore younger. Centres should explain to candidates that detail regarding the environments of deposition of each sediment is not required.

Q.2 Breccia.

Candidates of all ability scored well on this question. The specimen was a typical breccia with the angular clasts clearly visible. As in the previous question, many candidates ignored the marks available for each part question, often answering with one word when two marks were available.

(a) This question required candidates to comment on four aspects of the rock. The grain size did not constitute a problem, although the examiners prefer candidates to use the word "coarse" as opposed to "large". Two marks were available for grain shape to take account of the angular-subangular mix but few expanded on their answer. This was also the case for the responses to grain sorting. The term "composition" was poorly understood, with many candidates simply giving a list of possible minerals.

(b) Very poorly done by all but the most able. Candidates were expected to comment on sedimentary processes generally and then specifically to breccia. This rock can be formed in a number of ways and those who achieved credit either concentrated on one process or listed a number. Either type of answer received high marks. Very few were able to do this and many discussed igneous processes.

(c) Generally a good response to naming the rock.

Q.3 Andesite

This is the first time that Andesite has been set in this examination and few candidates were able to give good reasons for their identification. Centres must ensure that candidates are prepared for any of the specimens named in the specification. This was the least well done of the questions on the paper.

(a) As in previous years, candidates showed a poor understanding of the word "texture". This has been referred to in a number of previous examiners' reports. Less able candidates simply described all aspects of the rock, including colour and hardness. Candidates should refrain from using mineralogical terms when describing a rock. However, more able candidates gave impressive answers detailing all aspects of texture.

(b) Very disappointing answers from candidates of all abilities. Many candidates answered the location correctly but were unable to relate cooling history to their answers. Better answers referred to major and minor intrusions, commenting on the fine grain size of the specimen.

(c) The examiners recognised the difficulty candidates had in identifying this rock. Therefore they accepted either answer as long as the reason given was appropriate.

Q.4 Hematite.

The specimen was a typical piece of massive hematite. This question was very well done by candidates of all abilities.

(a) This consisted of three tests that candidates had to perform on the mineral. Most achieved full marks having successfully completed the tests.

(b) This consisted of two observations that candidates had to make on the mineral. Lustre is not well understood by less able candidates. Cleavage was well understood and full use was made of the data sheet. However, fracture was less well understood and Centres should make candidates aware of the phrases associated with fracture.

(c) A wide range of additional properties were available, including other aspects of hardness, and most candidates were able to answer correctly. Candidates should not copy straight from the data sheet, for example "density of 5.2", because this is not the result of testing or observation. Credit was not given for negative answers to taste or acid.

(d) Generally correct observations.

Q.5 Bivalve.

This was identical to question 5 on the Foundation Tier and, as expected, the responses on this tier were better. The bivalve was a real specimen of Mya in which the internal features were very clearly visible. Candidates of all ability performed well on this question.

(a) The quality of sketching was generally impressive with many candidates achieving maximum marks for their sketch. Very few drew an external view and these gained no credit. A few candidates did not include a sketch. Careful attention to the rubric is clearly essential throughout this examination. Labelling was well done in most cases, with the incorrect labelling of the sinus being the only common error.

(b) Generally correct identification with just a few incorrectly giving "brachiopod".

(c) Interpretation of the mode of life invoked a more mixed response but, nevertheless, most candidates gained some credit. More able candidates recognised the link between the shell shape and pallial sinus, allowing them to correctly identify the burrowing mode of life.

Q.6 Photograph.

The quality of sketching was generally satisfactory for part (a) but many candidates achieved little on part (b) because they did not relate the photograph to the map.

(a) This was a straightforward photograph in which the features are clear. Those candidates achieving maximum marks were able to sketch the dipping beds, the horizontal beds and detail such as jointing. Those candidates who achieved only one or two marks generally omitted the finer details.

(b) Very few candidates gained credit for part (b). Using the map, it is clear that the photograph is taken at an unconformity. However, presumably using only the photograph, the most common answer was that feature H-H was a sill. Those few who did correctly identify the feature were able to give very good reasons.

(c) This question required candidates to label two other geological features. Surprisingly, this was not well done and it may be that candidates were looking for something more complicated than the obvious. For example, "bed" and "bedding plane" would have been sufficient.

Q.7 A series of photographs.

This series of photographs showed a sequence on the map through sandstone into a recent deposit. Most candidates gained some credit from part (a) but showed a disappointing lack of understanding in part (b).

(a) Photograph four showed a fluvial glacial deposit in which three aspects; rounding of the clasts, sorting of the clasts and some indistinct layering were indicative of water deposition. Many candidates achieved maximum marks.

(b) This part question required candidates to look at the photographs, noting in particular the types of sedimentary structures and make deductions about the environments of deposition. For all but the most able, this proved to be very difficult despite the cross-bedding and ripple marks being very clear.

COURSEWORK

Fifty-five centres submitted coursework for moderation which is an increase on 2005. A small team of moderators undertake the moderating process, all of whom have considerable experience of teaching geology in schools and of moderating. There were some excellent field investigations seen which are being perfected by the centres and well suited to the specification. The best investigations allowed the candidates to demonstrate basic field skills and perform suitable analytical techniques on the data collected. It is good to see geological field skills being demonstrated with a high degree of competence. The work produced by the best candidates would be a credit to students at a higher level and centres are congratulated on the improving quality of work submitted by their candidates. Many centres are also to be congratulated on the accuracy of their assessment so that the need for scaling is progressively being reduced. For some centres scaling had to be applied to raise the marks of their candidates. There are four main reasons why scaling has to be applied;

- awarding of marks on inappropriate tasks e.g. very basic laboratory investigations
- reliable rank order but marks generous or severe
- failure to recognise that candidates have not met some aspect of the specification, e.g., include work based in the field. Planning, analysis and evaluation of field data are all carried out in the laboratory and therefore observation should be a field skill.
- failure to show how criteria have been achieved by annotation of candidates' work

The most successful investigations allowed the candidates to demonstrate essential field skills such as rock descriptions, field sketching, fossil identification, dip and strike, sedimentary logging. This was sometimes continued into the laboratory with sieving of collected samples with statistical analysis of grain size and sorting. Analyses made use of all of the available data. These investigations allowed the candidates to demonstrate essential field skills and perform suitable analytical techniques on the data collected. Candidates took the opportunity to demonstrate an extensive range of IT skills.

A mixture of field tasks were undertaken with a rough break down being investigations into;

interpretation of sedimentary environments
mapping exercises leading to geological sections and history
structural analysis such as assessment of the degree of crustal shortening and joint analysis
weathering of gravestones
fossil studies
clast analysis of pebble beds and interpretation of environment

Centres are to be congratulated on the variety of opportunities given to candidates in areas of outstanding geology such as the Dorset Coast, North Devon, Cornwall, Faringdon, Wren's Nest, Sedburgh, Gloucestershire, Berwick, Anglesey, Alderley Edge, Arran, Lake District, Yorkshire Coast, Peak District, Shropshire, the coast of Northern Ireland and the Isle of Man. Other centres used a variety of local geological locations.

Laboratory investigations included the effect of temperature on the speed of 'lava flows', effect of insulation on the rate of cooling, the effect of the size of a cooling body on country rock, effect of temperature on the behaviour of materials, density of various rock types and sieving exercises to determine grain size and sorting. Some of the laboratory investigations

have a number of well-documented shortcomings particularly the linking of the rather mechanical exercise to anything geological. The lab investigations when well-executed and analysed are good examples of **science** investigations but when there is little attempt to link it to geology it has little relevance to the specification. It also denies candidates the opportunity of demonstrating their skills at analysing geological data and presenting work in the usual geological format of maps, sections, sedimentary logs, rose diagrams etc.

The Principal Moderator saw the submission from approximately 25 centres and there were some common themes throughout the moderation, which can be addressed by centres prior to next year's submission.

- The spirit of the specification is now firmly towards fieldwork but making some provision for laboratory work particularly in difficult circumstances. There are however a variety of options which can be used to fit the specifications. A minority of centres still submit a substantial amount of laboratory work although centres are beginning to see the benefits of submitting a single piece of fieldwork which covers all of the skill areas. There are sometimes problems with centres which submit mostly laboratory work in terms of fulfilling the requirements of the specification which specifies the inclusion of 'work based in the field'. Some centres interpret this very loosely. The number of centres submitting work restricted to building stone or gravestone studies is also substantially reduced.

- A problem in some cases was a lack of focus for the investigation. If clearly focused, for example, on 'the environment of deposition of the Purbeck beds of Lulworth Cove' candidates can concentrate collecting data such as grain size, sorting, sedimentary logging and fossil content. With a lack of focus and definition of aims, candidates may collect irrelevant data such as fold shape and attitude and be distracted from the main investigation. An investigation entitled 'examine the geology of a section of the Pembrokeshire coast' is unlikely to be a success. This sort of investigation, where the candidates are taken from locality to locality collecting observations at the direction of the leader, results in very poor planning and evaluation although the observations and the analysis may very well be of a high standard. This approach commonly results in every candidate having the same plan, method of recording data and analytical techniques. This makes differentiation between candidates very difficult. It also often results in 'planning' in the past tense. Even if all of the candidates undertake the same field investigation it is important that they have the opportunity to come up with their own ideas for data collection and presentation. This type of work may be valid in terms of a teaching exercise but not suited to the internal assessment component. With slight modification, most of the field investigations submitted were suited to the criteria. In some cases instructions were included for each locality rather than allowing individuals to plan and develop their own method. The planning by some candidates was very brief e.g. no indication of sampling, no field procedure (roundness chart, how to measure orientation of clasts, dip and strike, or a pre-designed data collection table). Some candidates had little or no data in the field notes yet were able to produce the same in a report.

- The use of secondary sources at the planning stage needs further development by some centres and candidates need to demonstrate their detailed knowledge of geology to achieve the high mark range for Analysis and Planning. A number of centres are now making preliminary visits to sites in order to allow some forward planning by candidates, which often results in better Planning marks.

- In a number of cases, opportunities for the collection of basic field data have been missed. Observations such as rock identification, grain size, sorting, direction of cross-bedding, clast roundness/orientation, field sketches, dip and strike measurements and sedimentary logs should normally be part of every investigation where appropriate.

- Some thought has to be given at the data collection stage as to whether the form of the data being collected is suitable for processing and analysis, e.g., histograms, cross-sections, logs, rose diagrams maps and geological histories. There is no need for candidates to repeat observations made in the field notebook within a report unless it contributes significantly to the analysis. It is more advantageous for candidates to concentrate their efforts on the analysis and evaluation.

- Evaluation continues to be the problem skill for candidates. Very few candidates are able to discuss sources of errors in their measurements or describe detailed further work to provide additional evidence. Few candidates go beyond 'take more measurements and spend more time' at the field locations.

- Where candidates submitted laboratory work, there was sometimes no risk assessment which, taking the criteria literally, could mean that not even 2 marks are awarded for Planning.

- In some cases moderators were unsure as to whether maps showing the geology were actually completed in the field, and therefore an observational skill or whether they had been completed afterwards using the field data, and therefore part of analysis. Some annotation by centres would have helped with this. The same was true of sedimentary logs.

- In some cases, where a candidate achieved equal marks for a skill in the field and laboratory investigation there was no indication on the Gl2 form from which investigation the final mark was derived. Although there was no choice in some cases, in others it was left to the moderator who could have been moderating work which was not used in the final assessment by the centre. Circling of the marks on the Gl2 form used in the assessment would easily solve the problem.

- In some cases, the laboratory work is not of a complex enough nature to allow candidates to demonstrate higher levels of the skills no matter how well done. In the view of the moderation team, field observations are far superior to some of the basic recording in the laboratory under perfect conditions, and much more illustrative of the geological skills of the candidates. There is no requirement to submit any labwork.

Virtually all centres provide sufficient information to facilitate the moderation process and the annotation by teachers is much appreciated. Assessment was generally accurate but there were equal numbers of examples of generous and severe assessment indicating that the assessment criteria are being applied realistically. Clearer annotation by some centres may have resulted in higher marks for candidates by indicating where criteria have been achieved or clearer presentation of marks used in assessment on GL2 forms. There were rare errors in addition and discrepancies between marks on the candidates' work and on the Gl1 or Gl2 forms

The WJEC recognises the effort and enthusiasm that geology teachers invest in their candidates, which certainly shines through in the quality of work that they produce. The Moderators are always willing to provide as much support as is requested by the centre.

Centres should be aware that there is help available from the WJEC. Published exemplars of coursework investigations can be obtained from the WJEC offices. Moderators' reports on the current moderation process are sent out to centres. Centres are urged to act on any recommendations in the Moderators Reports. The Moderators do not enjoy moderating work which achieves low marks as this is going to be disappointing for the centre and the candidates, especially when there is often so much suitable geology on the centre's doorstep, which, with a little help and guidance can result in a successful submission. There are guidelines in the specification such as Annex 1. The scattered nature of centres makes INSET very difficult to target, particularly as there is quite a turn-over of new and old centres but centres can discuss suitable investigations with myself thorough email/ telephone as several centres do. This can include advice on the suitability of coursework investigations prior to carrying them out and examination of candidate's draft field investigations. My contact details can be obtained from the WJEC Geology officer in Cardiff.

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