# GCE

# Geology

Advanced GCE **A2 H487**

Advanced Subsidiary GCE **AS H087**

# OCR Report to Centres June 2015

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This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

OCR will not enter into any discussion or correspondence in connection with this report.

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**OCR REPORT TO CENTRES**

# F791 Global Tectonics

**General Comments:**

This paper was a similar standard to that of last summer. On every question at least some candidates scored full marks. Some questions proved to be very accessible, especially those with tables linking definitions to terms and those involving completing missing terms in a paragraph. There was no evidence that candidates ran out of time, and the majority were able to attempt the extended prose question. There were very few questions with no response.

Candidates with poor handwriting must take care when spelling is being assessed, as the words need to be completely legible. Candidates should be advised to slow down or write in capitals on such occasions, e.g. q4c.

The quality of candidates' diagrams for cleavage formation and fold structures was variable but the best were well annotated. The fold structure diagrams in particular were generally well drawn and labelled, and some cleavage formation diagrams had such detailed labels that text marks could be given.

There was a great deal of evidence that candidates were familiar with the relevant technical terms and could use them in an appropriate manner throughout the paper. Candidates showed a sound knowledge of planets and their formation, often with very detailed explanations. They also had a good understanding of the use of the Mercalli scale and seismometers. Candidates were clear about the value of specific fossils in providing evidence for continental drift, but were less secure in their knowledge of the relevance of mountain chains and polar wandering curves. Knowledge of the features to be found at convergent plate margins varied considerably. Candidates often struggle with concepts of stress/strain and with competent/incompetent, and this was again the case in this paper. Candidates are improving in their ability at linking brittle or ductile/plastic deformation with competent and incompetent rocks. Many knew the difference between anticlines and synclines and also symmetrical and asymmetrical, although some diagrams did not receive sufficient care and so were not as symmetrical as they should have been. Nappes and recumbent folds were less well known, as the diagrams showed. The extended prose question, on evidence for the composition of the crust and mantle, received answers with varying degrees of detail and knowledge. Often answers were unbalanced, showing a good knowledge of mines and ophiolites but not of volcanic activity.

Candidates generally understood the requirements of the questions and there was little evidence of misinterpretation. It was often the lack of detail that stopped a candidate gaining the second or third mark that was available.

Extra space had been used by many candidates for more extended answers, especially if the candidate's handwriting was large. It was most helpful when candidates pointed out the continuation in the original answer space (e.g.. 'answer continued at back of book' or similar). Very often the more extended answer contained material worthy of credit. Candidates should be aware, however, of the extra time it takes to write longer than expected answers.

**Comments on Individual Questions:**

**Question No. 1**

1a Most candidates had a good understanding of the solar nebula theory. The better answers were wide ranging, considering several aspects, e.g. spinning dust clouds, accretion, gravity,

separation into gas giants, terrestrial planets and the asteroid belt. For two marks there needed to be at least two correct descriptions.

1bi The vast majority of candidates knew the terrestrial planets.
1bii Most candidates knew how to work out the averages. However, candidates should be aware that if the data given for a calculation is accurate to 2 dp, then the answer should be given to no more than 2 dp. To express the answer to extra dp is misleading (and not acceptable) in relation to the accuracy of the original data.

1c The question stated that the answer should be related to 'density' and NOT to other indirect methods of inferring the structure of the core and mantle. Credit was given for recall of information such as the density of the crustal rocks. Many candidates knew the average density of crustal rocks and could explain that taking this value from the average Earth density could give an estimate of the core/mantle density. Few candidates concluded that the core/mantle density must therefore be greater than the average Earth density. Fewer still gave an appropriate density for the mantle or core.

1di Many candidates knew that rock and soil samples had been collected from the Moon's surface (and returned to earth to be analysed). A minority mentioned direct observations by astronauts on the Moon. One-word answers are not acceptable when the question asks for the candidate to 'describe'.

1dii Most candidates were familiar with Olympus Mons and knew that it is a huge volcano. Many talked about large scale explosive volcanism with stratovolcanoes, when in fact the volcanoes are now extinct, being effusive only when active, forming mafic shield volcanoes.

**Question No. 2**

2ai Many candidates misread the question and described what an isoseismal line ***is***, rather than how it may be ***'constructed'***. Two succinct statements were required for one mark. Most candidates knew that isoseismal lines joined up points of equal earthquake intensity, but very few mentioned any of the steps leading up to that knowledge, such as observing damage and plotting intensity on a map.

2aii It is clear that candidates know that variations in rock type can affect intensity, and some linked this to liquefaction. The expected correct answer refers to ***rock*** conditions and NOT to people's unreliability in reporting damage.

2bi Candidates should be made aware that isoseismal lines go around the intensity readings on a map and so the R should be marked clearly between the VII and VIII lines, and not straddling either.

2bii The isoseismal line was correctly drawn in by many, but the word ***'moderate damage to buildings'*** was not always picked out from the list of descriptions, even though that had been specifically asked for.

2c Candidates generally did well with this cloze question. The most common errors involved reversing focus and epicentre and also giving L waves a high frequency, rather than high amplitude. Almost all candidates knew the range of shallow focus earthquakes.

2 d Whilst there are many ways of designing and building a seismometer, the two basics were not always included, i.e. i) ***ground movements*** are detected, ii) those movements are ***recorded/plotted.*** The simplest answers discussed the seismometer detecting vibrations/ground movement and then recording them. Better answers described the heavy

mass which stays still as the ground moves, allowing a graph (seismogram) to be drawn or digital value to be gained.

2ei ***Conservative*** was usually spelt correctly but the description given was often too general and could have applied to other types of plate margin. Most candidates did know that California is a conservative plate margin. 'Transform' or 'passive' are not acceptable as plate margin types. Candidates should make sure that they know what is happening at a conservative plate margin just as they would with a convergent or divergent plate margin. Therefore candidates should be aware that the movement is horizontal or shear or in the same direction at different rates. Alternative answers could mention that the movement is along transform or strike slip faults.

2eii ***'No subduction'*** was the most popular correct answer but there were many other options. Most candidates knew that intermediate and deep focus earthquakes are linked to subduction.

**Question No. 3**

3ai Many candidates scored both marks for this part question. The most popular answers described the matching outcrops between both continents, as well as matching rock types, and the rocks being the same age in both continents. When answering questions like this, candidates must give detailed, clear answers. Stating, "they match up" is too vague. It must be clear that the outcrops of the shield areas match up when the continents are joined together. Otherwise the answers are ambiguous - examiners should not be expected to read between the lines. Candidates could also mention that the shields have the same (not similar) rocks and they are of the same (Precambrian) age.

3aii The majority of the answers were poorly expressed, and very poorly drawn on the map. It is well worth looking in more detail at the present-day map of those continental shields and fold mountain chains. Very few candidates knew where to draw joining fold mountain chains, often drawing them through the shield areas. Just stating that the fold mountain chains match up is not sufficient; candidates are expected to describe the alignment or trend of structures such as folds and faults which extend across both continents.

3b 'Erosion causing gaps and deposition overlaps at the coasts' were the most common answers. Some candidates did not link their answers to gaps and overlaps so only gained one mark. Others mentioned changing sea levels. If describing the continental shelf, candidates should mention that the edge of the continental shelf is closer to the edge of the continents. The better answers indicated that the best fit is about 500m/1000m below sea level.

3c Mesosaurus and Glossopteris were recalled accurately by many candidates. However, there were quite a few erroneous dinosaurs, birds, mammals, flowering plants and crocodiles. Many candidates, stating that many of these animals were not able to swim, generally had the right idea about fossils matching up across the join of the continents (and gained 1 of the 2 possible marks), even if their knowledge of the actual fossils was patchy.

3di Describing how the curves are constructed was tricky, and very few candidates scored high marks on this question. Very few had a clear, detailed understanding of how polar wandering curves are constructed. Many, though, did discuss palaeomagnetism and the alignment/inclinations of magnetic minerals in igneous rocks. Extra detail was expected, such as the inclination's link to palaeolatitude, the age of the rock also needing to be ascertained, and then the points at different ages joining to make a curve.

3dii There were some jumbled answers in respect of the given polar wandering curves which clearly showed quite a lot of misunderstanding of this topic. Candidates often find

palaeomagnetism difficult, and the the polar wandering curves particularly so. The more concise answers mentioned that the continents were once together and then split. Better answers linked the continents being joined to the time that the curves are parallel with the continents splitting and diverging when the two curves separate at 100 Ma.

3e There was a wide spread of marks on the plate margin question, with most candidates scoring at least 1 or 2. Generally, answers had fewer ticks than was required. The table of features did prove difficult, although very few scored 0. Candidates must ensure that they are very familiar with the features that form at all types of plate margins. Most candidates knew about the two margins that had Benioff zones (clearly linking this to subduction) and also the oceanic trench and the one margin with the island arc. Fewer candidates knew where the granite batholiths and fold mountains formed. The reverse-fault location was least well understood, being something found in all three margins due to compressive stress.

**Question No. 4**

4ai Questions related to stress and strain often prove difficult for candidates. Candidates firstly must be clear about the difference between stress and strain. They should then be clear how competent and incompetent rocks behave in terms of brittle/ductile behaviour, and which rock types are competent/incompetent. The best answers related directly to the graph and used accepted technical terms such as strain, elastic limit, fracture, competent, plastic, ductile and brittle.

Candidates should have pointed out that a large amount of stress applied to sandstone produces relatively little strain but also that it fractures after relatively small amounts of strain. This can then be linked to sandstone being an incompetent and brittle rock.

4aii Candidates should have pointed out that a relatively small amount of stress causes a high amount of strain in a shale, and that the shale fails after a high amount of strain. This can be linked to shale being incompetent and behaving in a plastic/ductile manner. Candidates should also be clear about how increased temperature may affect the behaviour of rocks under stress.

4bi ***Tensional*** stress and ***where*** on the fold the joints form were the two factors needed for one mark. Many candidates knew that joints are linked to tensional forces which make the rock fracture. However, relatively few explained that it occurs at the hinge/crest/trough of a fold.

4bii A ***fully labelled diagram*** requires at least two labels, though it is better to have more rather than too few. Many students omitted to mention the ***platy/clay/muscovite*** minerals. Many showed an impressive knowledge of how cleavage formed, often producing multi-stage diagrams to show this. The only weakness was that many candidates did not know that it was clay minerals or micas or flat minerals that were being aligned.

4ciThe majority of candidates knew that the type of force required to fold rocks is compressive/compression.

4ciiMost candidates drew accurate symmetrical anticlines, although they are advised to ensure that the two limbs do have a symmetrical dip. The asymmetrical syncline was less well drawn, with a significant number of candidates drawing an overfold with an inverted limb, which gained no marks. Some of the best diagrams had the limbs drawn with a ruler, which made recognising the symmetry/asymmetry much easier.

Labels were generally good, with the most common being axial plane, fold axis, limbs and hinge. If candidates are to give the ages as indicated by the anticline and syncline terms, then the oldest should be in the core if the fold is an anticline and the youngest in the core for a syncline.

4d Drawing and labelling ***nappes*** and ***recumbent folds*** was a problem for quite a number of candidates. Their diagrams showed that a minority seemed to not understand how a nappe formed. They were not very confident about drawing and labelling a nappe, and some diagrams represented improbable or impossible situations. Candidates should remember that the limbs of recumbent folds will be at an angle lower than $30^{o}$. Common errors were to have a fault plane at too steep an angle, the maximum being 45°, but ideally less. Often the recumbent fold was not shown as being displaced. Ideal labels would be '(thrust) fault plane', 'fold axis', half arrows to show relative movement.

The recumbent fold was better known, with many keeping the fold axial plane below 30°. Better labels included 'fold axis', 'limb' and 'inverted limb'.

4e ***Slickensides*** and ***Fault Breccia*** were described in detail by many, with a good number scoring full marks. Again, descriptions need to be full, at least two descriptions for each feature, to gain both marks. Candidates sometimes linked the slickenside grooves to the direction of movement and with the fault breccias mentioned a mineral cement binding it together.

**Question No.5**

Boreholes and deep mines gained most marks, although some students claimed depths far too deep, even suggesting that it has been possible to drill through to the mantle. Volcanic activity was described too vaguely by some, without creditworthy details such as 'xenoliths from the upper mantle', 'kimberlite pipes may include diamonds formed at 250km' , 'basalt from the crust'. Ophiolites and how they were brought to the surface was often described in rather loose language, without proper reference to ***'ocean crust breaking at subduction zones'***, and ***'obduction on to continental crust '***. Some students either ran out of energy or ran out of time on this question.

There was a wide distribution of marks for this question, with the average being 4/8. Strong candidates scored full marks. Out of the three sections, candidates were generally good at the mines and boreholes and ophiolites, but less certain about volcanic evidence.

Most candidates knew the maximum depth of mines and boreholes and that these features bring up samples that allow the composition of the crust to be examined. A significant number mentioned that the mantle had been reached. This is not yet the case. Very few gave an example of a typical crustal rock, as requested in the question. Where an example was given, it was typically granite.
Many candidates did mention mantle xenoliths in relation to volcanic activity, and the best answers linked this to peridotite. Other good answers discussed kimberlites and that they can contain diamonds that form at high pressures. Few candidates discussed what it is that melts to produce the magma, such as the upper mantle or crustal rocks. Many did mention the mantle but were not precise enough. Sometimes xenoliths, kimberlite and ophiolite were confused interchangeably.

Candidates showed confidence with ophiolites, knowing how they formed from obduction/thrusting and that they show a section through oceanic crust. Many also produced accurate and clear cross-sections of an ophiolite, showing four or more layers.

Occasionally parts of one section were mingled with others and proved difficult to interpret. The best answers were clearly structured (some with headings) and did make the link to rock types.

# F792 Rocks – Processes and Products

**General Comments:**

This paper was a similar standard to that of last summer. On every question at least some candidates scored full marks. There were a number of very accessible questions, using tables and diagrams, where candidates often gained high marks. Although the paper is long, few candidates did not attempt all questions, and many of the answers for Q7 were lengthy, giving no indication that candidates were not able to complete the paper in the time available.

The quality of candidates' diagrams of sedimentary rocks and volcanoes ranged from the very detailed and fully labelled to a few that lacked all labels and were very difficult to identify. The quality of some annotations and/or labels on the ooliths diagram was sufficiently high to earn text marks. Interpreting diagrams, photomicrographs and graphs is a key skill, and scale is an important factor. In this paper the majority of candidates ignored the scale that was part of the diagram and so wrongly identified a conglomerate as a sandstone.

The specification for this unit requires the use of technical terminology. Where candidates have a good grasp of technical terms and can use them in the correct way, then marks can be gained for the more straightforward descriptive questions. Confusion between mineral names and rock names continues to be a real problem, with a question that requires a rock name commonly having a mineral as its answer. Similarly, there is confusion between the two types of metamorphism - contact and regional - and their different index minerals. Limestones were generally an area of weak knowledge.

A growing number of candidates underline the command words on the examination paper to help them focus on giving a relevant answer. This is good practice, as many questions ask candidates to both describe and explain, and full marks cannot be gained without both parts of the answer being addressed. A few candidates even wrote the letter 'D' next to their description and 'E' next to their explanation, which illustrated their thought processes and helped them secure both the marks for the question. In the longer questions, 6 and 7, candidates are given useful additional guidance next to the pencil icon; for example in Q6 they were told to use examples of named rocks in the classification and in Q7 they were told to refer to rock characteristics, bed features and sedimentary structures. Full marks could not be gained without describing these.

A number of candidates had used the spare pages at the back of the answer booklet to continue answers or to replace crossed out answers. When candidates do this, it is very helpful if they clearly indicate where to find additional parts of answers. Candidate must not write on the sides and bottom of the answer pages, when they can't fit their answer in the space given.

**Comments on Individual Questions:**

**Question 1**

**Q1** This question was generally very well done with the highest marks on the paper. Knowledge of the sediments and processes was good.

**a) (i)** This was a well answered question, with the vast majority of candidates clearly identifying the correct areas of the rock cycle. Because diagenesis takes place just below the surface down to well below, it was accepted in both columns, but was essential for below the surface.

**(ii)** Candidates' knowledge of the three rock groups in relation to the rock cycle was very good.

**b) (i)** Abrasion is often confused with attrition and some candidates wrote the same thing for both processes. Good answers clearly described grains impacting on a rock face or any hard surface. A very wide range of terms was used to describe the impact - from 'hitting', 'smashing' and 'hurling' to the gentler 'dragging' and 'bouncing', and all were acceptable.

**(ii)** 'Attrition' was better answered, with most candidates having the concept of grains colliding with each other. Again, a large number of acceptable terms were used to describe the collisions, but more candidates used the common definition. Some failed to fully explain their answers, stating that grains collided but without explaining what with, and could not gain the mark as this could also take in abrasion.

**(iii)** The diagrams were generally very clear, with grains showing rounding and/or a reduction in size. The statements could be very brief, e.g. 'more rounded', as descriptions were not required. Nevertheless, many candidates wrote excellent descriptions, perhaps not having noted that the command word was state. Fewer candidates stated that the grain size decreased or that the grains became frosted.

**(iv)** Saltation was often described very well, with clear answers involving bouncing grains. However, a small number of candidates did not name any method of transportation and wrote about aeolian conditions in general terms. It should be noted that sand sized grains are normally moved by saltation, while finer material is carried in suspension and larger material by traction. 'Suspension' was the most common incorrect answer.

**c) (i)** There were many excellent answers, using the exact textbook definitions. Some candidates did not gain credit because they confused 'matrix' with 'groundmass' and stated that it was found in igneous rocks. 'Cement' had to include the concept of a mineral holding the grains together, compared to 'matrix', where between the clasts it could be clay or a mixture of rock fragments and/or clay. Few answers gave the difference, as the matrix is a primary deposit formed at the same time as the grains are deposited, while the cement is a secondary feature formed when minerals are deposited between grains after deposition by later ground-waters.

**(ii)** Knowledge of quartz as hard, stable and chemically inert was very good. This question asked for explanation, so stating a single property was insufficient because an explanation that weathering and/or erosion did not have an effect was also needed. Many candidates gave answers with good explanations, although some gave general answers, such as 'because they are common in sedimentary rock'.

**d) (i)** There were many high-quality answers with good accurate graphs. The cumulative frequency calculation was incorrect in some answers, but marks could still be obtained for plotting all the values that had been calculated correctly. A few candidates plotted the mass (%) instead of the cumulative frequency but could nevertheless score a mark. Cumulative frequency is a basic graphical technique that is regularly used when sediments are sieved, and candidates should know this. Many centres carry out this exercise as a practical activity.

**(ii)** The calculation was successfully completed by the majority of candidates. The calculation of the co-efficient of sorting from the graph was based on the sediment graph completed for candidates, and so did not depend on previous answers.

**(iii)** The majority of diagrams were very clear, with different sizes of grains in sediment B compared to the same size in A. The descriptions were unfortunately sometimes just a statement of sorting rather the detail of the sediment sizes. There was some confusion amongst those who thought that sorting refers to grain shape. It is acceptable to mark the descriptions on the diagrams.

**(iv)** Most answers gave the environment as glacial, with a smaller number stating 'wadi'. The description was sometimes very general and not clearly related to the environment chosen. The explanations were not always clear, especially regarding the importance of the rapid deposition of sediment.

**Question 2**

**Q2** This question on igneous intrusions and metamorphic rocks was well answered, with candidates illustrating good knowledge of metamorphism. There was some confusion between contact and regional metamorphism, but fewer candidates made this error than on previous papers. However, confusion between the terms rock and mineral continue to be a major problem.

**a) (i)** Most answers were accurate and drawn parallel to the edge of the intrusion. Where a vertical line is drawn, then only one area will be at the correct distance from the intrusion. A few candidates incorrectly drew the line curving towards the granite at depth.

**(ii)** The labelling of the xenolith was excellent.

**b)** Generally there was good knowledge of the contact metamorphic rocks and their index minerals, with some candidates gaining full marks. A minority suggested the regional metamorphic rocks of slate, schist and gneiss and their index minerals. A few candidates confused rocks and minerals, or used sedimentary or igneous rocks.

**c) (i)** This was a well known topic with many very good answers correctly identifying the metaquartzite. The weakest part was the correct term for the granoblastic texture.

**(ii)** Similarly, marble was well understood and explanations were clear, though a number of candidates failed to name marble as the rock formed. The destruction of the fossils was sometimes described in vague terms without the idea of recrystallization.

**d) (i)** A minority of candidates knew that the metamorphic zones shown were Barrovian zones.

**(ii)** Garnet as the index mineral was also not well known. The most common incorrect answer was andalusite, but igneous and sedimentary minerals were also named incorrectly. Some candidates confused andalusite and andesite**.** It was clear that many candidates had not used the fact that all the other index minerals were listed in the key of the map.

**(iii)** Where candidates understood regional metamorphism, the answers were excellent with plenty of descriptive detail of slate, schist and gneiss. A large group of candidates knew the rock types but did not provide enough descriptive detail to gain full marks. The texture was well known but the characteristics of grain size and mineral composition were less commonly used.

**Question 3**

**Q3** This igneous question was well done by many candidates with clear answers.

**a)** **(i)** Amongst many good answers the common mistake was incorrectly ticking plagioclase feldspar as a mafic mineral. Candidates should have used the density data to separate the denser mafic minerals from the silicic minerals.

**(ii)** Many candidates correctly stated that a specific mineral such as quartz is only found in silicic rocks, though few managed to give two minerals to classify two different rocks. Incorrect responses included giving all the silica percentages for each of the igneous rock groups or listing all the minerals in the table by rock group, thereby simply repeating the table. Classification requires a unique mineral rather than a vague description, so stating that augite is found in mafic rocks is not helpful for classification, as it is also found in ultramafic and intermediate rocks. A few candidates used colour linked to composition without naming minerals.

**(iii)** The colour difference between basalt and diorite was well known and usually correct. The silica content was often not given using numbers for the silica percentage or else it was sometimes given using incorrect values.

**(iv)** There were some excellent answers by a minority of candidates. This question asked for the difference between silicic and ultramafic rocks, but many candidates wrote about mafic rocks instead. In this comparison question both rock groups are needed in the answer. Some answers incorrectly referred to Bowen's Reaction Series or to temperature. A common mistake was to write about the minerals rather than the rocks.

**b)** The true/false statements produced many correct responses.

**c)** **(i)** Most candidates correctly identified the rocks from the drawings. The most common error was confusing igneous and metamorphic rocks.

**(ii)** This was generally well answered, although some candidates did not fully appreciate the uniqueness of augite to igneous rocks. Incorrect responses gave answers of colour or density or general statements that did not relate to the question.

**(iii)** Almost all candidates gave incorrect answers, with the most common being desert sandstone. The scale on the diagram shows clearly that all the rounded grains are greater than 2mm in size, so this rock must be a conglomerate. The fact that so few candidates used the scale is a problem that needs to be addressed by centres when preparing candidates for rock identification questions

**Question 4**

**Q4** Knowledge of limestones was generally weak, making this question the most difficult on the paper. Only types of of limestones are named on the specification and three were used in this question. Ooliths are not animals! The stem of the question contained important information about the environment, including the fact that there is no clastic sediment, and this should have ruled out answers that were not limestones.

**a)** **(i)** This straightforward question was rarely well done, with few candidates giving the correct response: micrite. The stem of the question stated that "there is no clastic sediment", but incorrect answers contained clastic rocks such as sandstone and clay. ‘Limestone’ was a common answer.

**(ii)** Low energy was very well known and many good explanations using the diagram were seen. The most common error was a lack of explanation of the reef protecting a lagoon. Weaker answers did not refer to the diagram but assumed that it was low energy because it is a lagoon.

**(iii)** Some candidates knew the details of this bioclastic limestone very well. This area near the reef cannot have clastic rocks, and the stem clearly stated as much. However, many incorrect answers featured clastic rocks, such as conglomerate or sandstone.

**(iv)** Naming the fossil that forms reefs as corals was surprisingly difficult. The most common incorrect responses were ooliths (as many candidates believe that they are organisms), coccoliths and bioclastic limestone.

**(v)** This question was answered better than the previous one, with some very good explanations of the ideas of the coral growing upwards and the lack of sediment deposition which might form beds.

**b)** Answers produced the full range of marks with some very well labelled diagrams and detailed descriptions. The question required labelled diagrams and 1 mark was awarded for this, but a number of diagrams had no labels. Some candidates gave just one diagram of an oolith, others two diagrams showing ooliths rolling and many used three diagrams to show cementation as well. The incorrect concept of ooliths dying and sinking to the sea floor appeared in a minority of answers.

**c)** **(i)** Most candidates correctly named at least one of the evaporite minerals, particularly halite. Where gypsum was not given, calcite was the most common incorrect response. A few candidates gave silicate minerals as the answer and others rocks.

**(ii)** Some very good answers ranged from the formation of evaporite minerals from the conditions in a warm, barred basin to the order of solubility and the deposition of the minerals from dense brines. Other very general answers lacked the required detail, making it difficult to gain marks. Some candidates repeated the question as an answer, stating that evaporation takes place in shallow seas.

## Question 5

**Q5** Volcanoes is a popular topic and there were many excellent high-scoring responses to this question.

**a)** **(i)** Many very clear answers showed a high level of understanding of the subduction processes at this convergent plate boundary.

**(ii)** The rock type andesite was identified correctly by a minority of candidates. Many incorrect answers gave ‘intermediate’, which is not a rock but a compositional group.

**(iii)** The increase in silica content over time was given by most candidates. The explanation was rather more challenging, as the idea of fractional crystallisation / magmatic differentiation was needed. Few candidates offered the alternative idea of assimilation or mixing of the partially melted continental crust adding silica to the magma.

**b)** **(i)** Although this topic is generally well known, this question was different from previous examples, as the distribution of ash was nearly concentric around the cone. Some candidates clearly understood that the ash was deposited close to the centre due to the energy diminishing as the distance from the volcano increased. Many linked the small extension in ash to the North West to wind direction. A number wrote about coarse deposits of agglomerate and blocks, which were not part of the question. Some explanations involved the wind, or that deposition depended on the size of the particles. Some failed to note the data supplied and gave answers from previous questions about different volcanoes.

**(ii)** Many good diagrams to show cross-sections of a strato-volcano gained full marks. A few candidates missed the most straightforward mark by omitting either the crater or the vent labels. Some did not draw the alternating layers of ash and lava for the internal structure or failed to label them, and sometimes the layers were drawn horizontally, rather than parallel with the sides. The angle of the volcano sides drawn was variable but a wide range was accepted.

**c)** Most candidates knew that the temperature of the Earth decreases globally as ash reflects or 'blocks out' the sun. Some answers tended to be very general and missed the idea of a global change, but wrote instead about local change and plants dying. Some candidates wrote excellent responses about sulfur dioxide aerosols and their impact on global cooling.

**d)** Geysers were well understood, with many excellent responses that fully described the idea of groundwater being heated by magma and erupting under pressure at regular intervals. A few candidates had a rather exaggerated idea of scale, having geysers erupting miles high.

**e)** There were many very good answers to this straightforward question about benefits of volcanic activity. Fertile soils and geothermal activity were the most common responses.

**f)** The concept of hazard maps was well understood, but many answers lacked evidence. Where candidates provided specific evidence, such as plotting the extent of previous lava flows or the routes followed by lahars and pyroclastic flows in valleys, marks were high. Often a general statement was made to refer to past eruptions but without detail. This is not evidence so could not score. A few answers were actually on prediction.

## Question 6

**Q6** Many excellent answers comparing extrusive and intrusive igneous rocks gained full marks. Nearly all candidates addressed all three sections of the question with good use of clear headings; and the mark scheme allowed flexibility of marks across the sections. The question allowed the best candidates to give well-structured answers which differentiated from the weaker answers. The better answers explained the evidence; the weaker answers just listed the characteristics. The question asked for examples, and the majority of candidates included suitable examples of igneous rocks. It was clear that candidates understand the ideas of the different rates of crystallisation and many of the features used to distinguish between lava flows and sills. There were some good diagrams showing lava flows and sills but few of the diagrams added additional points to the text. Some of the spellings of the igneous textures were problematic.

The only major problem was a tendency for candidates to write about intrusive and extrusive as separate ideas so that the comparison was not always clear. The disadvantage to candidates of this approach was inconsistency between separate paragraphs, whereby they

gave the crystal size for intrusive, but not extrusive, and gave the rate of cooling for one and not the other. The best answers contained a sentence that compared intrusive and extrusive. A small number of responses had mixed up the terms completely, while some candidates used metamorphic textural terms instead of igneous.

**Question 7**

**Q7** There were some excellent answers but this was a more challenging question than some candidates realised. The question asked for characteristics, sedimentary structures and bed features of deposition in three different fluvial environments. Many addressed the characteristics in one section but ignored bed features; others addressed sedimentary structures in another but ignored characteristics. This made it difficult for these candidates to gain high marks. There are a large number of marking points and so there are many ways to achieve full marks, even omitting some areas from each section.

There were a number of common errors (in particular the inclusion of flute casts and turbidity currents, which occur only in a marine environment). Another was the idea that channel sandstones were very well sorted and well rounded when in fact they usually display a range of grain sizes and shapes. Cross-bedding and ripples cannot occur in clays, as they do not contain grains that can accumulate in this way because clay minerals are platy. Knowledge of flood plains was very limited. A number of candidates incorrectly described clay minerals as well rounded. There was also a tendency to list sedimentary structures without giving a description. Bed features were largely omitted.

# F794 Environmental Geology

**General Comments:**

Most candidates were able to demonstrate sound knowledge and understanding of the key ideas and concepts of the Environmental Geology unit. Although there were some "no responses", the majority of candidates completed the question paper in the allotted time and the standard of responses to the 8 mark extended question on methods used to prevent coastal erosion was high.

Candidates with good synoptic knowledge scored highly, as did those who gave carefully considered and appropriate answers to the questions on less examined areas of the specification. Some candidates could improve their responses by ensuring they take note of all the information and prompts given in questions and carefully study any accompanying diagrams. Incorrect answers seemed to take two forms – those who didn't know the answer or those who knew the answer but did not use precise enough terminology to achieve the mark. Candidates didn't always fulfil all the requirements of a question to get the marks – they shouldn't assume one point made equals one mark. For example, fully describe in Q2d(i) needed two descriptors to get the characteristics mark.

Candidates who had a good grasp of the methodology used to analyse and interpret metallic mineral exploration data were able to tackle question 4 about geochemical surveys with confidence. Other candidates would benefit from more practice of techniques such as plotting isolines, which have many different applications in geology (e.g. isoseismal lines for earthquake epicentre location, isopachytes for thickness of pyroclastic material, isograds for mapping metamorphic grade) as well as in geophysical (e.g. gravity surveys) and geochemical (e.g. soil surveys) exploration.

Some scripts were difficult to read due to poor handwriting. In some cases, e.g. in the question that tested the quality of written communication, it was impossible to decipher whether the spellings of porous and permeable were correct. In these cases benefit of the doubt was not given. Responses to the questions requiring mathematical calculations were variable in quality and a significant number of candidates did not attempt any of the calculations on the question paper.

**Comments on Individual Questions:**

**Question No. 1**

Water supply proved to be a well known area of the specification but some candidates were challenged by the parts of the question that required application of knowledge and understanding to the unfamiliar situation of Mono Lake.

**(a) (i)** Most candidates were able to correctly describe the difference between the terms *surface water* and *groundwater*, but not all included correct definitions in their answers and thus lost marks. Stating that surface water needs treating and groundwater doesn't was not enough, as this is not always the case and doesn't describe the two sources. A common error was to say surface water was above the ground level, but these candidates could still score the mark if they stated in rivers, lakes or reservoirs.

**(ii)** This question asking for an advantage and a disadvantage of using groundwater for drinking water supply was done very well. A minority of candidates could have improved their answers by describing the difficulties in accessing groundwater (e.g. the requirement to drill boreholes or dig wells) or describing the costs involved (e.g. the cost of raising water vertically).

**(iii)** There were some excellent descriptions of how groundwater resources can be both renewable and sustainable, but not all candidates were able to show a clear understanding of the difference between the two terms.

**(b)**

**(i)** Candidates with sound mathematical skills were able to correctly calculate the percentage change in the surface area of Mono Lake. A significant number of candidates incorrectly calculated the surface area left (69%) rather than the change in surface area (31%).

**(ii)** Virtually all candidates were able to correctly describe the relationship between water level and salinity in Mono Lake. Not all were then able to go on to give a suitable explanation in terms of the decreasing volume of water due to evaporation causing the salt dissolved in the water to become more concentrated. Some candidates wrongly adduced the idea of salt water encroachment affecting groundwater in coastal aquifers. The map accompanying the question clearly showed that Mono Lake is inland and fed by streams.

**(iii)**

Candidates with good synoptic knowledge had no difficulty in naming desiccation cracks as the sedimentary structure that would form in the sediments around the lake as they dry out. The answer 'salt pseudomorphs' was also accepted. Although very few spelled desiccation correctly, this were not penalised, as quality of written communication was not tested in this question.

**Question No. 2**

The quality of responses to this question on oil and gas was variable. Candidates who read and carefully analysed the information and prompts given in the question were able to produce high level responses to the parts of the question requiring analysis and explanations in an unfamiliar context. Some candidates would benefit from more opportunities to deal with real situations rather than generic, idealised examples.

Candidates with good synoptic knowledge of rock classification also scored highly on the parts of the question requiring rock identification and description.

**(a)** **(i)** The term *reserves* was well known, with most candidates scoring the mark for providing a correct definition. A minority failed to give their definition in terms of the amount of the resource that can be extracted at a profit and mistakenly defined reserves as all of the resource left in the crust.

**(ii)** Candidates who understood that destruction or loss of oil from a trap would have occurred before the reserves were calculated were able to successfully access this stretch and challenge question. Some described the changes in reserves as oil is extracted, which wasn't relevant to the question. Only the best answers discussed the incomplete nature of exploration data or considered the variations in the reservoir rock which would affect the amount of oil that could be extracted and, thus, the reserves. Discussion of loss of oil was best reserved for question 2 b (iv.

**(iii)** The majority of candidates knew that the production rate would decline over time as oil was extracted from the reservoir rock, but answers could have been improved by citing reduction in hydrostatic pressure as the cause. Many candidates used the terms *reserves* and *reservoir rock* as if they were interchangeable, whereas in reality they are two very different things. In addition, a number of candidates ascribed the decrease in production rate to a drop in the price of oil.

**(iv)** The majority of candidates were able to attain 1 or 2 marks for general discussion of the role of faults in both the accumulation and loss of oil from traps. Many answers could have been improved by referring specifically to the two faults listed in the question and by responding to the prompt in the question by using information from the cross-section diagram of Wytch Farm. Very few distinguished between the Purbeck Fault Zone - responsible for loss of oil and the surface seeps - and fault F1 - responsible for trapping oil in the reservoir rocks. Some candidates contradicted themselves by stating that fault F1 was a trap and oil was migrating up it to form seeps at the surface.

**(b)** **(i)** Those with good synoptic knowledge of sedimentary rock classification were able to successfully name the three reservoir rocks from the written descriptions, though very few candidates got all three correct. Although many identified the Sherwood and Bridport reservoir rocks as sandstones, many were unable to name the specific type of sandstone correctly. Granite was a common incorrect answer for the Sherwood arkose. In the case of the Frome limestone, many did not give a correct full rock name, and oolitic limestone was a common incorrect answer.

**(ii)** The terms porosity and permeability were well known and most gave a correct explanation of the property to match the word used. Legibility of handwriting was an issue in many responses; in some the benefit of doubt could not be given and no marks were awarded.

**(c)** The reason why extended drilling technology was used to extract oil from beneath the sea was poorly understood. The most successful answers were given by candidates who understood how production wells are established and had carefully read the information given about Wytch Farm. Many were then able to give good explanations as to why it was advantageous for either economic or environmental reasons to have one onshore wellhead. Many candidates did not appreciate that the extended reach production wells were horizontal, even though this information was given to them in the question. The most common incorrect answers were that the sea was too deep, and some said it was harder to drill vertical wells.

**(d)** **(i)** The majority of candidates gained one mark for giving a correct description of the composition of an oil shale, but a significant number described a source rock containing plankton. Few were confident in their synoptic knowledge of rock characteristics (plural), and as a result not many attained the second mark.

**(ii)** Good answers were produced by candidates who correctly applied their knowledge of the environmental consequences of exploiting unconventional petroleum to the context of hydraulic fracturing of oil shale. A large number suggested that subsidence might be an issue but this was not credited as, unlike mining for coal or metallic minerals, fracking for shale gas does not remove large quantities of rock from underground and, to date, there are no documented cases of fracking operations causing subsidence.

**(iii)** Most candidates scored one mark for suggesting that, because reserves of conventional oil and gas are decreasing, the extraction of petroleum from unconventional sources is likely to increase. Explaining the economic argument in detail was insufficient to get more than one mark. To get the second mark candidates needed to develop their answers further and discuss either the non-renewable nature of oil and gas, or the fact there are vast reserves of unconventional petroleum, or the improvements in technology which will allow exploitation of unconventional resources, or the reasons why renewable energy resources are unlikely to be able to make up any shortfall in petroleum production.

**Question No. 3**

There were some excellent answers to this question on mineral deposits, displaying in-depth knowledge of the formation of hydrothermal, secondary enrichment and placer ore deposits. Some candidates could improve their answers by ensuring they apply their knowledge to the specific situation given in the question.

**(a)** **(i)** The majority of candidates correctly answered this synoptic question on the type of plate margin at the western side of South America. Although 'destructive' was allowed, *convergent* is the term used in the specification.

**(ii)** Candidates who used their synoptic knowledge of processes at convergent plate margins to explain the source of hydrothermal fluids were the most successful, and produced excellent answers that scored the maximum 3 marks. Those that ignored the context of the question and wrote generically about the formation of hydrothermal ore deposits scored less highly.

**(b)** **(i)** Most candidates were able to use the data given to correctly calculate the concentration factor for the primary copper ore and the zone of secondary enrichment. Also credited were answers that correctly calculated the concentration factor for the zone of secondary enrichment from either the % of copper in continental crust or from the % of copper in the primary ore. Some candidates lost the mark due to rounding errors.

**(ii)** The process of secondary enrichment of copper was well known by many candidates. There were many excellent answers that fully described and explained the changes in conditions from oxidising above to reducing below the water table. There was impressive knowledge of soluble "ates" above, and insoluble "ides" below, with only a minority getting them the wrong way round. Some candidates could improve their answers by ensuring they link their description to a correct explanation. The use of correct technical terms, such as solution and precipitation of copper, should be encouraged.

**(iii)** Candidates who used the term *grade* in their explanation as to why secondary enrichment is important to the economics of a copper mining operation had no problem with this question. Candidates who merely stated the zone of secondary enrichment contains a higher % of copper, or has a higher concentration of copper, were not awarded the mark, as this information was given in the question; they needed to show an understanding that secondary enrichment concentrates the copper into a <u>smaller volume</u>.

**(c)** There were many excellent well drawn and labelled diagrams showing a site of placer gold deposition in a river. Some candidates could have improved their diagram by adding an arrow to show the direction of river flow. Most candidates also showed a good understanding of the formation of placer deposits of gold but some lost marks because they did not note the command word *explain*.

**Question No. 4**

Answers to this question on geochemical surveys and the environmental consequences of metal mining were variable in quality and the question proved to be a good discriminator. Although virtually all candidates were able to show some relevant knowledge, only the strongest were able to gain most of the marks available.

**(a)** **(i)** Candidates who correctly completed all 3 isolines to gain both available marks were in the minority. However, some were able to gain one mark for drawing 3 concentric isolines, even though they didn't go through the 300, 500 or 1000 points or they went through points other than these.

**(ii)** The term 'dispersion' was not well known, and only the best answers described how it results from weathering or erosion which spreads out copper from an underlying ore body. Some candidates lost the mark because they discussed the transport of copper beyond the soil.

**(iii)** Many candidates were able to correctly describe the pattern of distribution of copper in the soil. Not all were then able to go on to give a suitable explanation as to what underlying geological structures may have controlled this pattern. Many failed to realise it was a flat area, even though this was given in the stem of the question.

**(iv)** This question was answered well. The majority of candidates shaded the area of highest copper values and correctly cited this as the reason why they would drill an exploration borehole there. A small number seemed confused with gravity surveys for oil exploration and shaded around the outside of the geochemical anomaly rather than in the centre. Others suggested drilling in the areas of low concentration to determine where the edges of the ore deposit might be, or drilling along a transect line to determine the extent of it. Such answers would have been appropriate if candidates had been asked to suggest how they would delineate the extent of the ore body.

**(b)** Some candidates knew that the results of soil geochemical surveys can be used to identify areas of soil contamination. These candidates often gave good descriptions of the identification of toxic heavy metals in soils. Others described how anomalous amounts of elements in soil can be identified. The best answers went on to describe how environmental agencies could use this data to monitor habitats or to assess the impacts of industrial activity. Other candidates could improve their answers by confining themselves to the question asked. For example, the results of a soil survey would not identify areas of groundwater pollution.

**(c)** There were some excellent, detailed answers to this question about the environmental consequences of the legacy of metal mining in the British Isles. Some used specific examples such as the Wheal Jane acid mine drainage water incident to good effect. Many candidates could have improved their answers by showing an understanding of the word legacy and confining their answers to the impacts of past metal mining, rather than discussing problems caused by current mining and mineral processing.

**Question No. 5**

This extended question on the methods used to prevent coastal erosion was answered well by the majority of candidates. Virtually all candidates gained some credit for their answers, and marks were skewed towards the higher end of the scale. The best answers gave concise descriptions and explanations of four contrasting sea defences, whereas others picked similar methods such as rip rap, gabions, offshore reefs or the various methods of cliff stabilisation. Others who did not score so well either did not describe the methods they had chosen or failed to give an appropriate explanation to accompany their description. Some candidates needed to take care not to repeat the question: “it would prevent coastal erosion” as an explanation. Others wrote overly long answers or described more than four methods, and that scored no extra marks.

# F795 Evolution of Life, Earth and Climate

**General Comments:**

In general this paper was very similar to the standard of last summer's paper. There were a number of very accessible questions diagrams and terms where candidates often gained high marks. A few candidates used the additional answer space at the end of the examination booklet for both the long answers and also for part questions. Most candidates used their answer booklet to clearly signpost these additional answers, which was helpful to the marker.

The quality of diagrams ranged from the very detailed and fully labelled to a few that lacked all labels and were very difficult to identify.

Interpretation of graphs and charts was generally well done. Candidates seem to be better at applying their known factual content or concepts to new situations or unseen 'case studies'. There has been an increasing proportion of open-response questions that enable the candidate to demonstrate a deeper understanding of the concepts. The quality of answers to these questions has increased over time. Synoptic content, such as knowledge of limestones, can be a problem if candidates have not revised their knowledge of relevant content from AS units.

There were lengthy answers in Q7 and Q8 which suggested that no candidates ran out of time. Useful additional guidance is given next to the pencil icon in these longer questions to help candidates structure their answers. In Q7 they were told to use diagrams, and full marks could not be scored without doing so. There were many excellent labelled diagrams by many candidates. In Q8 where candidates were told not to use diagrams, many drew trilobites of various guises, for which no credit was available.

**Comments on Individual Questions:**

**Question 1**

**Q1** This question was generally very well done and was accessible for all abilities. Candidates knew and understood the topic of 'preservation'.

**a)** **(i)** Most answered this initial section correctly. A few hedged their bets by providing general terms, such as cephalopod, which was unacceptable as there was more than one cephalopod in this part of the question. Some erroneously thought that the bivalve was a brachiopod. Candidates should be encouraged to use as much precision as possible; providing the phylum or class *as well* will not result in penalties. Some candidates gave generic names, which were also credited if correct.

**(ii)** This was well answered, with the majority of candidates providing an excellent diagram with a good selection of accurate labels. Candidates should be careful with those labels that do not refer to a particular point and which therefore require brackets, e.g. 'spire' or 'whorl'. Labels were generally well placed, but some candidates lost marks, as their label lines fell short of the structure they wished to indicate.

**(iii)** Candidates are to be reminded that one-word answers, e.g. 'nektonic', are not acceptable when the question asks them to 'describe' the mode of life. Many described the mode of life generally as a 'filter feeder' or 'benthonic' and gained no marks. This section proved more difficult than expected for many candidates.

**(iv)** This part question began with the instruction 'explain'. It was not acceptable to merely provide a list of what makes a good zone fossil, without explanation. Geology at this level is more than remembering and repeating lists, as questions require candidates to provide evidence of understanding of principles.

**b) (i)** This part question on geological terms was very accessible and almost all candidates gained full marks. A minority confused 'life' and 'death' assemblages.

**(ii)** Candidates often failed to properly answer the question by failing to explain, how the assemblage could be used to interpret the environment. This meant that candidates lost marks for material that they probably understood, but did not convey. The commonest issue involved the candidates repeating the term 'high energy' in the answer, without demonstrating an understanding of what this actually means.

**c) (i)** Most candidates knew something of this exceptional preservation process, and some provided rich detail. Greater precision in terminology would benefit a significant proportion of candidates. For example many used the word 'sap' rather than 'resin', and did so interchangeably without an understanding that they are different.

**(ii)** There were many excellent answers on the process of entombing animals in tar. The processes of preservation were also well understood and often included in the answer. A majority of candidates gained full marks for this part question.

**Question 2**

**Q2** This question on microfossils and their place in major Earth cycles was an attempt to allow candidates to apply their knowledge to an unknown set of circumstances. Most candidates scored well.

**a) (i)** The specification requires a reasonable familiarity with processes of graph plotting. This particular graph was an unusual one, requiring candidates to plot two sets of data. Most did this with great success, with only a minority of candidates attempting to use only the left hand Y axis, thus losing one of the plotting marks. Some candidates produced totally inappropriate bar charts and also lost marks. The quality of labelling was variable, with units often omitted.

**(ii)** The question required the exact temperature and latitude of the point at which the two graphs crossed. The temperature for 50% can be read from the two axes as $10^{o}$C and the % sinistral graph is sufficient to provide a latitude. Variation was allowed in the latitude to take into account variability in the plotting.

**(iii)** There were many excellent explanations of the two lines drawn on the graphs, demonstrating a thorough appreciation of the processes involved and even some speculation on reasons for the change in coiling direction. Some were confused by the fact that latitude increases towards the poles and, more understandably, mixing up right and left coiling data. The fact that left-coiling happened in colder waters and vice-versa was not credited in answers because it formed part of the question. Some ignored the latitude altogether in the answer, linking the changes only to temperature.

**b) (i)** Some candidates failed to convert cm to mm, and the commonest incorrect answers involved the decimal place being in the wrong place. The calculation was relatively simple but careless errors were made.

**(ii)** There was a huge variety of answers both sedimentary and igneous rocks. A minority of the candidates were able to name 'ooze' correctly.

**c)** **(i)** Most candidates correctly selected eccentricity.

**(ii)** The real data here provided number of fluctuations to choose from but the most obvious were those which approached 100% right coiling and occurred at roughly 100,000 year intervals, coincident with the Milankovitch eccentricity cycle. Good candidates linked the cycle to the changes in the Earth's orbit. Candidates were expected to link the mechanics of that cycle with higher temperatures and increased right-coiling, a link which was made well by those who were better prepared.

**Question 3**

**Q3** Candidates, on the whole, showed a clear understanding of the morphology of corals.

**a)** **(i)** The structures present in the individual coral groups were not well understood.

**(ii)** Most candidates gained good marks for this part question. The most common labels used were columella, septa and dissepiments. Some unnecessary marks were lost due to careless use of label lines and of inappropriate labels, such as calice or tabulae, which could not be seen in the coral cross section.

**b)** Common sense answers to this unfamiliar question included the obvious structural support and 'strength in numbers' as protection from predators.

**c)** There were some excellent answers from some of the higher achieving candidates. Most gained one only mark out of the two for this part question due to making simple errors concerning the basics of plant and animal nutrition and respiration. Some gave the correct description of oxygenated high-energy waters, but then qualified this by saying that the corals needed oxygen to survive, without giving the reason. At this level such broad answers are insufficient. Many more failed to establish that it was the algae/zooxanthellae that would be photosynthesising in the sunlit waters, rather than the coral polyps. It must be emphasised that corals are animals and not plants.

**d)** **(i)** The synoptic content of this question proved difficult for many candidates. Although many knew of the disarticulation on death, there were few successful answers on how crinoid debris could be made into a limestone. Some followed the question by suggesting that it was formed from coral debris.

**(ii)** Candidates who understood that chalk is formed from many coccoliths often gained full marks for this part question. Some, however, thought that chalk was composed of ooliths or crushed coral debris. The lack of understanding of synoptic content was evident.

**Question 4**

**Q4** This was perhaps the most challenging question on the paper, involving the use of concepts from familiar content to evaluate unfamiliar material.

**a)** **(i)** The majority of candidates scored at least one mark for this part question. Many general answers, which were low on science content and terminology, made little reference to the Cambrian diversification in particular.

**(ii)** This was well answered, with clear explanations in respect of conditions for exceptional preservation. A minority of candidates modified this to suit the case study. Only a minority of candidates presented a list of conditions, which was not credited.

**(iii)** Surprisingly, given the information provided in the question, most of the methods of preservation were suggested: mould and cast, silicification, pyritisation, carbonisation etc. D.

**b)** **(i)** Most candidates were successful in suggesting arthropods or trilobites as being similar to the unknown fauna illustrated. Some candidates were able to describe trilobites as having three parts (cephalon, thorax and pygidium) but didn't mention jointed appendages or antennae. More candidates would have gained full marks if they had recalled what characteristics define the phylum. It is worth teaching the characteristics of each phylum when tackling this in class.

**(ii)** Some candidates gave full answers which linked well with the information in the case study from the Chengjiang Shales. Many candidates had not heard of the term 'problematic' and were unwilling to speculate on what it might mean. Some assumed it was synonymous with 'derived fossil', and their answers centred round this topic. There were many vague answers.

**c)** **(i)** Most correct answers linked the burrows to the ability of the organisms to survive in a burrow; many went on to link this to increased predation in the environment. Some were uncertain as to what this question was asking. There were some intelligent attempts to frame answers, for which many used most of the available space on the page. Candidates should be encouraged to extend answers on to additional pages, rather than inserted at the bottom of a page where it may overlooked by a marker.

**Question 5**

**Q5** Brachiopods and bivalves are well understood and there were many excellent responses to this high-scoring question.

**a)** **(i)** Most candidates correctly labelled the musculature and ligament on the diagram(s). Incorrect responses included labelling the adductor muscle in the bivalve as a ligament. A number of responses were not fully labelled, as required by the question.

**(ii)** Most candidates were successful in labelling the brachial valve. Some responses involved the labelling of the section of pedicle valve on the other side of the foramen or the foramen itself, which was not credited.

**b)** **(i)** Most candidates were able to describe this very well. Some responses not worthy of marks included stating that the adductor and diductor muscles were used to open and close the valves, without saying which contracted to open, which was the point of the question. There were also transpositions of 'brachiopod and bivalve', 'adductor and diductor', and even of 'open and close', in the answers and so it is worth training candidates to check their answers as they finished them.

**(ii)** This was in general well answered and high scoring, with much good use of technical vocabulary. Some marks were lost due to failing to be specific, e.g. in identifying the *inhalant* siphon as the provider of oxygenated water. There were excellent answers on the functions of the lophophore. .

**c)** Most candidates answered this question well, in particular with the discussions about the adaptations for turbulent water. Candidates lost marks by describing features that the fossil does *not* have. Many words were used to describe the lack of pedicle and pedicle foramen in free-lying brachiopods. Candidates are reminded once again to check the question stem which in this case was 'Describe and explain'. Description on its own is a simple technique unlikely to score high marks.

**d)** **(i)** This part question on drawing deep-burrowing bivalves was not answered very well. There were many unidentifiable diagrams, short of labels. Diagrams of soft parts were not credited. Some candidates transposed interior and exterior diagrams and labels.

**(ii)** In contrast, the explanation of deep-burrowing bivalves was high scoring. There is a clearer understanding of the fossil 'soft' parts than the 'hard' parts. There were some very good descriptions of siphons and their functions, though some erroneously named the siphons as the siphuncle.

**Question 6**

**Q6** This question produced a wide range of answers varying from excellent to weak.

**a)** **(i)** Almost every period and era was suggested for the one in which amphibians first appeared in the fossil record with only a minority giving the correct answer: Devonian or Carboniferous. Even fewer were able to pinpoint 'upper' or 'lower' in their answer.

**(ii)** Many answers, lacking in knowledge, re-used the phrases in the question to little effect. There are two parts to this question, describe and explain, and this was largely ignored by most candidates. The most common incorrect answer involved the swim bladder being used as a sac to carry water in so that the organisms could 'breathe' out of the water. The interchangeable use of the words 'breathe' and 'respire' was also evident. Animals respire in water as well as out of it. Terminological precision is required.

**(iii)** Some excellent adaptations were discussed by the higher achievers, including details about bone structures and the hinged nature of the ankles. The question was a 'describe and explain' format, but most candidates failed to 'explain'. Most candidates could not describe an adaptation in any detail to gain a second mark, and there was a general lack of detail in the answers for this part question.

**(iv)** This question was designed to stretch the most able candidates and did in fact cue a spread of marks. A failure to read the question carefully was illustrated by candidates describing differences, rather than the similarities, between the two groups.

**b)** **(i)** The illustration provided much useful inspiration for the candidates, but the difficulty was dividing the features into reptilian and avian. Many obvious answers, such as feathers, were not credited because they cannot be seen on the diagram supplied, plus the fact that it is now believed that dinosaurs did in fact have feathers, albeit not for flying.

**(ii)** The amniotic egg was well known, and most answers were good, despite a tendency to contain extra material about the eggs themselves, rather than the specified the properties of the *shell.*

**Question 7**

**Q7** This was answered moderately well, although it was the weaker of the long answer questions on this paper. Some candidates drew very well labelled diagrams, as required in the stem of this question. These diagrams were often linked with very good, often detailed, descriptions of their formation, often with good detail included. Candidates that failed to gain high marks tended to not give more than one example for each of the three methods discussed. Still more marks were lost by the confusing 'laid down first' with 'youngest', which led to some mixed up sentences. The 'law' of superposition was commonly described as the 'law of horizontality' and, while it is probable that dipping rocks are older than horizontal rocks, this assumption can depend on subsequent tilting. Many methods and their diagrams failed to show which rocks were the oldest and which the youngest rocks, despite the requirements of the question.
Some candidates scored no marks at all, because they misinterpreted the question completely and wrote essays on 'biostratigraphy or chronostratigraphy or radiometric dating.

**Question 8**

**Q8** This was a high scoring extended answer question, as the subject knowledge is interesting and exciting to most students. There was a lot of detail in the answers of many candidates with specific examples provided in their explanations. However, the instructions stated that no credit would be given to diagrams drawn, but many still drew these anyway, maybe to act as a prompt in writing the essay, or because they had forgotten the instruction. There were many part statements that were not very well explained, in particular 'swimming with pleura' by not linking the of pleura with the numbers of pairs of legs and then linking these to the mode of life.

A number of candidates answered for both planktonic and nektonic at the same time. Some incorrect answers used the generic names instead of planktonic or nektonic terms, but incorrectly thus losing marks.

# F796 Practical Skills in Geology 2

**General Comments**

In this sixth year of submission many very good tasks were submitted, and a large percentage of candidates demonstrated excellent subject knowledge. Many were able to express themselves clearly and concisely, using a sound range of geological terminology. There was no evidence of candidates struggling to complete the centre based and evaluative tasks within the suggested time of an hour. For the Evaluative Tasks most candidates submitted tasks for either EV 3 or the new EV1, with relatively few centres submitting for EV2. However, with the Centre Based Tasks, all three were regularly submitted.

As in previous years, many centres submitted their marks via interchange, often well before the deadline, and as a result could receive very prompt requests for their samples of work. The whole system seemed to work very efficiently this year, with most requests for candidate's work being received in only a few days at most. The moderating team had received the vast majority of their centres' work by the start of the half-term break.

Where centres are unable to submit their marks via interchange, it is important that they send the moderator a copy of the MS1 form, as well as the top copy to OCR, so that the moderator can then choose the sample.
This is especially relevant with centre consortia. It would be appreciated if the Geology teacher could contact exams offices in their consortia schools, as otherwise there can be cases of missing paperwork. Exams officers need to be alerted about submitting Geology MSI's even if they do not offer it as an exam in their centre, because otherwise they often did not send off this paperwork.

It is worth centres noting that, if they have only a small cohort of students - say 15 or less -, it may well be worth packaging up the whole sample and sending it off in time for the May 15th deadline. This can save a lot of time because, when the request does arrive, most of those 15 or so candidates will need to be sent to the moderator anyway.

Many centres had adapted copies of previous years' Excel spread sheets, and this proved very helpful in showing the range of tasks completed, as well as the marks awarded. The form should automatically calculate the totals using the best marks. However, there were still a notable number of clerical errors, some of which could be traced back to addition errors on this form. Centres who use the form are therefore advised to check it upon completion for any mathematical errors.

Only a few centres completed a single task for all candidates; most centres gave candidates two opportunities at Centre-based, Fieldwork and Evaluative Tasks. This year there appeared to be a slight drop in the number of centres offering all three Evaluative tasks.

There was also a significant drop in the number submitting fieldwork. This is extremely concerning, as fieldwork usually achieves good grades for many candidates and is excellent experience for candidates who may be continuing their geology in HE. It is to be hoped that this is a temporary situation which has most probably arisen due to the lack of fieldwork tasks being uploaded this year on interchange . Certainly a lot of fieldwork submissions have been scrutinised over the last two years and they have all been brought into a common format to make it easier for centres to carry out fieldwork.

Next year there should be a wide range of tasks across many regions of the UK, which will mean that centres do not have to go to the effort of creating their own tasks. New tasks and fieldwork sites are always welcome, and the new format, which will appear on Interchange, will help any teachers who wish to develop their own tasks, as the common framework will be available for guidance.

Centres are reminded that they should submit their details at least 6 weeks before the planned fieldwork departure date.

Administration

Administration this year was much less of a problem and centres are to be congratulated for completing all the necessary paperwork and including this with their sample. Of the few outstanding problems, the most notable were clerical errors.

A large number of these arose due to addition errors on the papers. In a large number of cases marks on the papers or fieldwork are added up wrongly; it is noted that this often occurs where sections are being subtotalled. Sometimes when actual marks and sub-totalled marks are present on the same page, both are then counted in the final addition, giving a wrong total. To aid accurate addition, it is only marks that should be placed in the right-hand margin next to the bracket which shows the marks available. Avoiding recording sub totals will mean that the only marks visible on the paper are those scored for the questions. Another common problem arises when more than one component is required for one mark; for example a candidate may have to mark something on a graph and then comment on this; a higher mark is then recorded because the graph is ticked and then the comment is as well.

Another cause of errors occurs when candidate's marks have been changed as a result of internal moderation. It is important to check that the right mark is clearly shown, is recognisable on the script and that the correct total is given. In a few cases marks had been changed on the script but totals had not been amended. Ideally all of the paperwork should be carefully checked for accuracy before submission.

Final problems occur when wrong marks are transferred on to cover sheets and from there on to the MS1 or equivalent.

Internal moderation is vital and centres sign the authentication sheet to state that this has indeed been carried out. Form CCS160 must be signed by all teachers involved in the marking and must be sent to the moderator.

The internally assessed work cover sheet is not compulsory, but can be very useful for summarising the candidate's performance and showing which tasks are being submitted. A copy of this sheet can be downloaded from interchange.

Some centres submitted work where marks were not visible and where moderators had to actually add up the marks themselves. Also, a small number of centres failed to securely fix together any of their candidates' work, which was then only available as a mass of loose sheets of paper. These two instances could disadvantage individual candidates and might lead to deferred results for the centre. If, for example, the coursework packaging were to be damaged or if the work were accidentally dropped upon opening, as it might take a very long time to determine which sheets belonged to which candidate so that moderation could begin.

Marking

In general marking was of a good standard. Where marks were on the generous side, it was usually a question of the interpretation of the mark scheme. Most centres are applying the mark scheme accurately. Most have read the additional guidance about specific requirements for marks to be given and use this to help with the marking. However, a small but significant number are ignoring this and are not applying the mark scheme correctly. For example, in some questions where three labels may be required, if only two are added, then marks cannot be awarded. Likewise, if a list of acceptable terms is provided, then these are the terms which can be credited. It should be noted that if a mark scheme lists some points, followed by the word "and", this means that the candidates MUST have points before **and** after the "and". Centres are also reminded that when a term is underlined, then it must be used in the candidate's answer if the mark is to be awarded.

A small but significant number of centres were crediting answers not on the mark scheme. In some cases, points which were definitely incorrect had been credited. This is unfair and is not acceptable. If centres feel strongly that a correct answer has been left off the mark scheme, they should contact OCR immediately so that their point can be considered. A response back to the teacher can usually be provided in a matter of days. Several mark schemes have been amended in this way.

All centres should make sure that they sign up for interchange updates .It is important for them to be using the most up to date mark schemes and papers. Whilst many centres regularly check on interchange for tasks, it is advisable to print material from interchange as close to the completion of the task as possible. In this way, centres will be aware of any additions to the mark schemes. Where questions require candidates to measure the size of a feature/displacement etc. the OCR mark scheme will provide an answer with an acceptable tolerance. However, in the past centres have sometimes found that that all their candidates were falling outside of the tolerance range. This was found to be because the act of photocopying photocopying sometimes changed the scale. Several centres helpfully informed the moderator of the values they had measured, and included an example to show how the photocopying had changed the scale. Where a task requires maps, graphs, cross sections to be marked to a degree of accuracy, teachers have found it helpful to create an accurate overlay, which speeds up the checking of that particular question and is of course available for future years.

Preparation of candidates

Centres should ensure that all candidates have a sound grasp of the main command words used by OCR, such as 'describe' and 'explain'. Frequently candidates only describe, and then fail to explain, and so lose valuable marks. Candidates should read all parts of the question, including the stem, which often contains valuable help.

Questions often require candidates to describe/explain what can be seen "in this photo/graph/fossil". In these cases candidates must focus their answer on the relevant image image and avoid writing generically. The same is true of sketches, where candidates are often required to draw what they appears on the page and so should not draw other different fossils from their own experience. Photos on the page are chosen carefully with specific features in mind, features whose relevance will be missed by a candidate drawing a generic textbook version which cannot be credited.

## Comments on the Centre Based Tasks

Centre-based tasks must always be accompanied by the trial results obtained by teachers in their trial run of the practical. These results should reflect the expected range of results. In experiments where the samples are destroyed, the data should show similar starting amounts so that the rates/trends of break-up can be compared. This helps moderators apply the tolerances quoted within the mark schemes. If a tolerance is stated it must be applied. When an experiment is involved where temperature may have an impact, teachers will find it worthwhile to carry out their trial in the same room in similar conditions to those in which candidates will carry out the task. Some chemicals may give different results if the teacher trial is done much later or earlier than the candidate task, so it is often advisable to keep a narrow time frame between the trial and the actual task.

## Comments on individual tasks

### Centre-based Tasks

CB1 In terms of the practical component, this task was not too dissimilar to one offered previously, which made it a popular choice, as centres clearly felt confident about it. Some moderators found it much more popular than the other two, which is unusual for a new task.

Question1a Centres are asked to ensure that they check the percentage calculations; in a few cases these answers were wrong and so the marks could not be allowed (N.B. One error was allowed)

Question 1c) 'Safety' as a topic finds many centres crediting answers not on the mark scheme.

Question 2ai) produced many good quality sketches. A significant number of candidates drew textbook versions of the fossil. As mentioned above, this should be discouraged, as the particular specimen had some important easily identifiable features which textbook drawings do not show.

Question 2aii) Many candidates failed to pick up the hint in the stem of this question, which refers to "this fossil". Again, many candidates made the mistake of writing in a generalised fashion rather than focussing on what they could see.

Question 3) This was a new style of question and produced some really excellent responses, with many candidates gaining full marks on this section. The mark scheme provided a wide range of marking options. A few centres failed to realise that two features were needed for each mark awarded.

Question4b) Geological histories were generally well done, but reference to two faults / or faults was needed. Tilting needed a value of tilt to be suggested.

CB2 This task was more popular this year. The experiment is more chemically based than ones used before and appeared to generate some good results. On the whole candidates did not appear to have any problems, and the precipitates formed usually showed the expected colours. A few centres commented that cost meant that they had used different iron compounds. This did not cause problems, as the colours generated were generally very similar to those on the mark scheme. The teacher trial data in these cases proved to be very useful in showing how marking had been applied. A few centres marked the first column harshly if candidates had not used the term "interface" in their answer. However, the instructions had asked for the interface colour, and therefore the mark could have been awarded.

Question1bii) did require some reference to both of the metal elements within the mineral to get the mark.

Most of the answers to this first section showed a sound understanding of metal deposits, and this was also true of question 2.

Question 1c) Answers need to match those on the mark scheme.

Question 2ai) In geological histories candidates should give more information that just "tilting". The mark scheme asks for specific degrees.
Question 3ai) The photograph question raised the usual issues because centres credited things that were not on the mark scheme or gave marks for insufficient features. Moderators are likely to adjust marks downwards if this very clear guidance is ignored, as the majority of centres are marking according to the scheme.

CB3 This was most popular this year. This reflects the recent pattern, as this will be the most familiar of the CB tasks.

Question 1b) This question is still causing some problems, as many candidates tend to just describe and not give a reason. The mark scheme clearly stipulates that no mark can be awarded unless both a description and a reason are provided.

Question 1c) still had many centres crediting answers not on the mark scheme. Consequently 'safety' questions have proven to be an area where many centres are adjusted down.

Question 2aiii) it was clearly stated that there was little variation in trilobite size. A small number of centres were found to be wrongly crediting quite the opposite. It was not a growth assemblage and there was no sign of ecdysis

Question 4c) For geological histories candidates need to make reference to uplift AND erosion. Many simply state that an unconformity has occurred without explaining how it formed.

**Fieldwork Tasks**

Very few centres submitted fieldwork this year, which was a shame; many had commented that this was because many of the tasks had been removed from interchange. In fact a lot of tasks are ready to be uploaded for next year and Centres have been advised in their moderator's reports about the availability of new tasks.

There was a lot of good fieldwork. Many fieldwork tasks have now been brought into line with the marking of features, such as Graphic logs, which can also be encountered in centre-based and evaluative tasks. These should continue to be uploaded for use next year, and it should be noted that the format now is to award a maximum of 4 marks for logs: 1 mark being awarded to each of - grain size, thickness, appropriate shading and identification of a range of geological features. One error in plotting is allowed without penalisation. This will enable more comparability between centre-based and fieldwork tasks, as fieldwork outcomes have previously been higher than centre-based.

Centres offering fieldwork for 2016 must download new versions of the tasks, even ones they may have originally submitted. Tasks are available for all centres to use, even those who do not wish to put in an original submission, and centres are encouraged to inspect the tasks on interchange. They have all recently been overhauled to make sure that a minimum of 8 marks (ideally 10) are available for A2 work, and that there is a 50/50 balance of qualitative and quantitative. It should be noted that all fieldwork tasks must be submitted for OCR approval. An approved task will be clearly labelled with a "T" number at the top of the information sheet. Centres are asked to send written information about the rock types their candidates will be describing, as well as photographic evidence and copies of base maps etc. (This acts in a similar way to the teacher trial data in centre based tasks and will create a benchmark for comparison.) This information is very helpful to moderators and those few centres who do not send this information may seriously delay the work of moderators and may even cause delay in the publication of their results.. Please make sure this information is included for 2016.

Most centres had the required 50% of marks awarded for A2 tasks. One of the main weaknesses was the lack of detail in fossil work and rock descriptions. Centres who submit work with barely any detail to rock/fossil descriptions should marks such not expect their awards of 2 or 3 /20 to escape moderator adjustment. Candidates too must describe their fossils and rocks in a lot more detail and label their diagrams more clearly at this level. Centres and candidates will find it a useful comparator to aim for the type of detail required for a centre-based tasks. Centres who have never tried these tasks will find it worthwhile to look at the papers and mark schemes on interchange, as a guide to the amount of detail required. OCR is also willing to provide detailed feedback about pieces of work proposed by Centres.

The following advice about building up a detailed requirement should be helpful: bear in mind the requirements for a centre-based task - a mineral name with a reason for identification should earn 1 mark. If, for example, sandstone is described, it would be reasonable to expect a comment explaining the presence of quartz plus a reason to show how the quartz was identified, e.g. Hardness testing. A mention of grain/clast size (numeric for the quantitative component) shape

and sorting would then be a reasonable expectation, as would comments on colour, cement and composition of the whole rock. Many candidates are very familiar with the 3 S's and 3 C's, which is a good way to train candidates in detailed rock descriptions. Fossil descriptions need a similar amount of detail. Note that in the cases of Brachiopods and bivalves a clear description needs to be made to show how each was identified and distinguished, as they can have many similarities when viewed in a rock.

Fossils sketches should not be of textbook versions but should instead show what the candidates actually observed on the fieldwork.

Focusing on the economic uses of rocks traditionally earns good marks at this level. Candidates should be encouraged to identify properties of the rocks visible or testable in the field and link this to possible economic uses. Alternatively, if the site is on the coast, issues to do with coastal erosion could be explored. Field evidence for relative dating, using for example way up structures and cross cutting relationships, also provides sound fieldwork tasks. In general these sections were underrepresented when compared to fossils, but nevertheless do tend to score high marks

There were some excellent graphic logs, and most centres are now using acceptable versions. Centres should discourage candidates from drawing them as a simple diagram of 2 or 3 beds, not to scale and without clear grain sizes. It should also be remembered that if a sequence only contains, for example Limestone beds, a graphic log is not going to show any variation in the beds and as a result a different technique might be more suitable.

A few centres were still awarding up to 5 marks for marking rather basic points on to a log. Logs are fine up to a point, but as for centre-based papers, tasks will usually carry no more than 4 marks.

Field sketches for large areas in general were much improved this year, including some excellent ones with plenty of detailed labelling and good scales indicated.

Sometimes moderators have great difficulty matching the mark schemes to the different sections within the candidates' work. In a few cases where teachers wrote nothing onto the candidate work, it took a long time to work out where the marks fitted and to see how they were awarded. This slows up the work of the moderators and may in the end delay results. A good idea is to use task numbers on the mark schemes and on student work. Another system which works really well is to assign a number to a tick on the mark scheme and then to insert the number next to the relevant tick on the candidate's work. This helps the moderator to see how the two link up. The official task sheet with the OCR T-number on it must be sent to the moderator to prove that is it an approved task.

Very occasionally all the candidates in a centre wrote almost word for word the same for every site, suggesting that they had been taken around en masse and shown the same features. In one centre all the candidates came up with up "feldspathic sandstone". It is highly unlikely that every candidate in a centre would identify this rather unusual rock at the same point in their fieldwork. This is quite unacceptable, as fieldwork is meant to test independent field skills. Whilst it is perfectly acceptable to go over the general geology of the area to put the site into context, and whilst candidates can be asked to describe the different sedimentary rocks they will find at a site, the type of information given prior to and during the task should be consistent with the "grey box" information which is published on interchange for the Centre based tasks. Candidates MUST work independently. This part of fieldwork is not a teacher-led activity.

Candidates must therefore not be given too much guidance, e.g. telling them the names of rocks and structures they will see or providing guidance sheets, or booklets or paper with specific task boxes for candidates to sketch or write in. Moderators have even found cases where a structured work sheet has limited the freedom of potential top grade candidates. At best some of these practices are damaging, at worst they are unfair and unacceptable

**Evaluative tasks**

A similar trend was noticed here as with the centre-based tasks, the new EV1 task proving to be far more popular than in previous years. The outgoing EV3 task was also very popular. Very few centres submitted EV2, and centre spreadsheets showed that most centres offered two tasks - just EV1 and 3. Where all three tasks were offered, EV2 was rarely the candidates' highest marked task. It is a good idea to remind candidates of the importance of reading the questions carefully, paying special attention to any information in the stem, as it was noticed that the marking of EV tasks tended to be more frequently out of tolerance than centre-based tasks.

**Comments on individual tasks**

**EV1**

This new task proved to be very popular and some really good pieces of work were submitted where candidates had clearly taken on board the advice from the grey box and had studied this section of the course to a high standard. The main problems occurred when the mark scheme not been applied in sufficient detail.

Question 1ai) This question required a reference to depth of the overburden being measured from the graph.

Question 1aiii) The mark scheme provided clear tolerances for the angles of throw of the faults. These tolerances must be adhered to.

Question 1aiv) Terms underlined in the mark scheme must be in the candidate's answer in order for the mark to be awarded.

Question 1bii). A reason for the thinning of the coal was required; it was not enough to say it had thinned, as that is obvious from the diagram, and so this did not represent explanation.

Question 1biii) The question told candidates that the roof supports had been removed, therefore this was not an acceptable answer. A reference to the coal having been removed was required.

Question1ciii) This was a graph so should it not have been interpreted as an isoline map; this was a problem in several centres, although the question was usually very accurately marked.

Question 3ai) This question did cause a few marking discrepancies; the additional guidance column can help with marking here.

Question 3b. All of the terms shown in the diagram had to be used in the candidate's answer for the mark to be awarded. Many centres credited good detailed responses, which showed understanding but had not followed the guidance in the questions.

**EV2**

This continues to be the task that most candidates find the most difficult. Most often if marks are adjusted, this is due to misapplication of the mark scheme.

Question 1aii) Specific reference was required in candidates' answers to specific rocks and fossils found in the sequences. Response to the data presented, not generic geological knowledge, was being tested here.

Question1ci) This was completed to a much better standard this year, and centres applied the mark scheme very well,

Question 1cii) A couple of amendments to the mark scheme meant that most candidate scored on this question.

Question 1dii) Reference had to be made to the photo, which was suggestive of a current due to the presence of coarser material or by the fossil alignment.

Question1diii) Candidates must both measure the angle of the fossils and also plot them on to a rose diagram.

Question2aii) Most candidates failed to refer to a loss of energy.

Question 2bii) Candidates must explain why the coral has to be Rugose. To do this they must explain why it cannot be either of the other two groups.

Question 2ci) A reference to temperature of the seawater or colder water needs to be made, as the additional guidance column states that temperature alone is not enough.

**EV 3**

Only a small number of questions caused problems, and these were with the more interpretative questions. In general the mathematical operations were carried out correctly, although care should be taken over figures being rounded up correctly.

Question 1c) This did cause problems as many candidates were trying to link their answers to oil in the rocks rather than describing rock properties at points X and Y.

Question 1ei) Only 20.67 or 20.7Ma were acceptable answers, as shown in the mark scheme.

Question 2ai) continues to cause debate; the only acceptable answers were those shown in the mark scheme.

Question 2aii) which required the oil traps to be marked did cause issues. The acceptable answers were given in the mark scheme and additional guidance column.

Question 2aiii) was generally accomplished to a good standard.

Question 2b) The geological map in general was done in very good detail, although it should be noted that virtually no candidates identified the salt layer as occurring first. As a result, the first point on the mark scheme should not be awarded, as the sequence of sedimentary rocks was incorrect without the salt layer being identified as the oldest.

There were some cases with these EV tasks where incorrect responses or responses not on the mark scheme were credited. This is unacceptable and unfair. However, centres are reminded that OCR will be pleased to hear from centres who wish to discuss concerns over the range of acceptable answers in the mark scheme.

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