Edexcel GCE Geography from 2008
Unit 4 Geographical Research: exemplar responses

- This is an exemplar response from the **June 2013** examination series.
- It is an example of candidate work which has been word processed and adapted to make it more suitable as a teaching and learning aid.
- Errors, including QWC errors, have in most cases been kept. The aim of these exemplar reports is to highlight good practice and areas of potential improvement. The marking levels and examiners comments given are indicative and should be used as a basis for discussion in the classroom, rather than indicating a specific grade.
- Comments and indicative marks are provided at the end of the exemplar.

Pre-release research focus:
OPTION 2: Cold Environments – Landscapes and Change

• Explore the range and nature of geomorphological processes operating in glacial environments.
• Research a range of distinctive glacial landforms found in contrasting glacial environments.

Report Title:
OPTION 2: Cold Environments – Landscapes and Change
2 Explain the relative importance of different geomorphological processes in creating distinctive glacial landforms.

(Total for Question 2 = 70 marks)

Plan:

Importance
- Plucking – most glacial erosion landforms
- Abrasion – striations – distinctive
- Freeze thaw
- Transportation / deposition – all distinctive landforms
- Fluvio – many non-distinctive – braided / varves / meltwater pro-g channels

Structure
- Erosion and weathering – landforms, Snowdonia, Swiss Alps
- Glacial trans and dep – Iceland
- Fluvio – Iceland

Distinctive processes ➔ distinctive landforms

1.0 Introduction

There is a range of glacial and fluvioglacial processes involved in the formation of a variety of glacial landforms ranging from erosional features to depositional ones. Different glacial landforms will be examined in order to determine to what extent they are formed by distinctive processes. Then concept of equifinality will be considered, as if a landform can be produced by several different process it is not distinctive.

Glacial landforms are produced by geomorphological processes, defined by the European Environment Agency as physical and chemical interactions between the earth's surface and the natural forces that act upon it to form landforms. Landforms are features of the earth's surface which have characteristic shapes, sizes and structures. Many landforms are created by the work of ice i.e. glacial landforms and are formed by weathering, erosion and deposition processes either on, in, beneath or close to areas of ice cover (glaciers, ice sheets and ice caps).

This report will examine to what extent glacial landforms are distinctive in terms of formation processes and characteristics by considering a range of landforms in different locations (see Figure 1):

Figure 1: landform processes

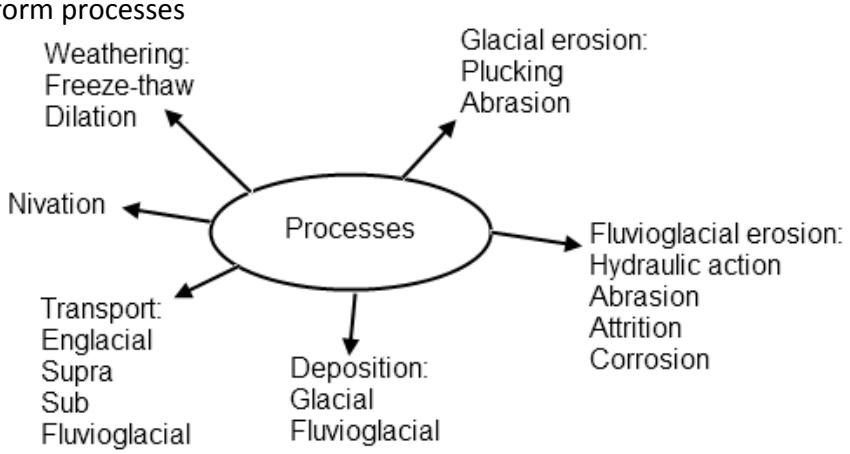

Figure 1 shows the range of processes active in glacial environments that lead to the formation of distinctive landforms. This report will examine the processes of plucking, abrasion, glacial deposition, freeze thaw, glacial transport and fluvioglacial action. The case studies used to demonstrate these processes include Snowdonia in Wales; a relict glacial landscape or erosive features formed by glacial erosion in an upland area. Iceland, the Breiðamerkurjökull glacier snout from the Vatnajokull ice cap, on the south side displays landforms of fluvioglacial deposition as well as glacial deposition in a lowland area. This glacier is currently active and in a modest phase of readvance. Eastern Yorkshire will be used as an example of fluvioglacial relict activity. The Swiss Alps Unteraargletscher glacier will be used to exemplify an active upland erosional landscape. The case studies and processes chosen will show a range of glacial processes forming both distinctive and non-distinctive landforms.

2.0 Methodology

Section	Processes and case study	Main sources
3.1	Weathering and erosional process Snowdonia case study	Physicalgeography.net (1)* Waugh (2000) Geography and Integrated Approach (2) Nagle and Witherick (2002) Cold Environments (3) Geofile 350 (2006) (C)
3.2	Glacial transport and deposition Iceland case study	A2 Edexcel Geography (2009) Dunn et al (4) Geofile 573 (2008) (A)
3.3	Fluvioglacial activity East Yorkshire case study	Anderson (2004) Glacial and Periglacial Environments (5) Geofile 533 (2007) (B)

*numbers and letters sources are used in the main analysis.

A range of textbooks and journals has been used. These can be thought of as reliable as they are written by academics and are peer reviewed. The source used for the Swiss Alps case study was primarily Swissedu.ch which was written for the general public and so some of the information was simplified. This source was therefore cross-checked for reliability. The least reliable source was wikipedia as this was written by unknown sources and so has to be cross-checked as the information could have a strong bias and could be inaccurate.
The geofiles where the most useful as the information was highly relevant and had much detail, as it is written by academics such as Gareth Nagle and Paul Sheppard who can be thought of as highly reliable.

3.0 Analysis

3.1 Weathering and erosion processes

Freeze-thaw is a process of weathering that weakens rocks. Water enters cracks in rocks and then freezes and expands 9-10% by volume. This exerts a force and widens the crack. It occurs were temperatures repeatedly cycle above and below 0°C either by day / night or seasonally (1). Plucking can occur as sub-glacial ice melts due to pressure melting and then this meltwater seeps into cracks and refreezes. As the glacier moves downslope due to gravity, bits of rock are pulled away from the bedrock and are the transported by the glacier in either sub-glacial ice or at the sides of the glacier against the valley walls and subs against the bedrock. The rock debris carried by at the base of the glacier scratches (abrades) the bedrock leaving grooves and marks parallel to each other known as striations. The process of glacial abrasion also created finely ground-down rock flour (1).
The landforms produced by these processes include corries / cirques. These are an armchair shaped basin with a steep back-wall formed by plucking and a rounded bottom from rotational ice flow and abrasion. When 2 corries erode back-wards towards each other a knife-edge ridge is formed. An example of this is Crib Goch on Snowdon. Cwn Gaswyn, a corrie, is also found on

Mt Snowdon (Geofile 350). When 3 or more corries erode backward towards each other a pyramidal peak is formed e.g. Mt Snowdon.

Figure 2:

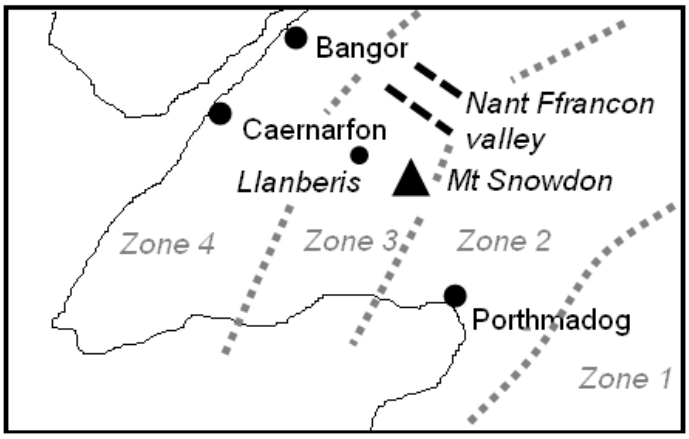

Figure 2 shows a sketch map of Snowdonia. Zone 1 is the Migneint plateau which was the centre of the ice sheet and being cold-based has few erosional features due to little ice movement. Zone 2 shows the Moelwyn area which consists of a knoc and lochan topography of small lakes and roche moutonee formed by areal scouring. Zone 3 is an area one dominated by faster moving valley glaciers which have the most distinctive erosional features, including 15 corries and many glacial troughs which is similar to the active glacial landscape of the Swiss Alps today. Zone 4 is an area of glacial deposition with thick till sediment cover and drumlins (2).

3.1.1 Sub-conclusion

All the landforms formed by plucking are distinctive, making plucking a very important process. Glacial environments are the only one in which this process occurs. It also involves the production of a wide range of landforms including truncated spurs and roche moutonees. In order for plucking to occur freeze thaw must take place as plucking cannot occur in a non-weakened rock, therefore making freeze thaw as important as plucking itself. Freeze thaw does not directly produce landforms but it does contribute to their formation. Abrasion produces striations, but striations can be produced in non-glacial environments e.g. Tremblay (1961) observed striations in Northern Alberta, Canada, produced by wind erosion. They can also occur in fluvial environments therefore abrasion is less important in producing distinctive glacial landforms.

3.2 Glacial transport and deposition

Glacial sediment is transported by a glacial either en -, sub- or supra-glacially. When a glacier slows down, ablates or loses momentum it deposits material. Glacial deposits are called till. Till consists of angular sediment because glacial erosion has limited attrition unlike in fluvial landscapes were sediment is rounded by attrition. Glacial erratics are large boulders dumped by ice which are foreign to the surrounding bedrock geology of the environment they were deposited in.

When till is shaped by a moving glacier it forms landforms called moraines. Moraines include lateral moraines deposited at the side of a glacier, medial moraines formed when two glaciers converge and lateral moraines join and terminal moraines deposited at a glaciers maximum extent. Recessional moraines are deposited by receding glaciers and show the positions of the ice front as ice retreated.
These landforms can be seen in Iceland at the Breiðamerkurjökull glacier snout. Large medial moraine can be seen as well as lateral moraines and a terminal moraine. (geofile 573). Eastern Yorkshire also displays examples of terminal and recessional moraines in the Vale of York.

3.2.1 Sub-conclusion
All of the landforms produced by glacial transport and deposition are distinctive. The moraines are distinctive due to their unique arc-like shape in the case of a valley glacier terminal moraine and the fact that till is angular showing it was not formed in moving water. The presence of erratics in some glacial till proves that the material must have been carried by ice. Till in also often unsorted and unstratified and consists of large angular clasts as well as finely ground rock flour. These are not characteristics of fluvial or wind formed deposits which tend to be rounded and sorted. Boulders similar to erratics can be deposited by large floods but would tend to be rounded not angular. Angular boulders are also produced by rock falls, in non-glacial uplands, but these would not have moved far enough to be foreign to the surrounding bedrock.

3.3 Fluvioglacial activity
Fluvioglacial processes include fuvioglacial deposition and erosion (5). Erosion occurs as abrasion, attrition (debris knocks against each other creating rounded sediment, and smaller) corrosion (minerals from rocks dissolve and are washed away as solute (5)), hydraulic action (the force of water on river banks). These processes produce landforms of sorted and stratified debris due to changes in seasonal flow. In summer when glaciers are ablating more meltwater is present so larger debris can be carried and deposited. In autumn and winter there is less ablation so fluvioglacial streams have less capacity to carry sediment and only small size material is deposited.
Landforms produced by these processes include lake varves, braided streams, eskers, delta terraces and delta kames. Examples of these landforms can be seen in Iceland. Breiðamerkurjökull glacier has a large outwash plain at the glacier snout. Braided streams and varve deposits can be seen which result from fluvioglacial erosion and deposition (3).Meltwater channels can be seen in eastern Yorkshire at Newton Dale and at Kirkham Abbey Gorge. Eskers can be seen at Kelsey Hill and Kettle Holes are present at Hornsea Mere (B).

3.3.1 Sub-conclusion
Fluvioglacial processes can also occur in fluvial landscapes but the presence of the glacier affects the landforms produced. Eskers are formed by sub-glacial channels depositing material creating long sinuous ridges that can travel up-hill due to hydrostatic pressure from the glacier confined channel. Braided streams and varves are not distinctive. Both landforms can be found in upland streams and lakes and periglacial landscapes such as the Copper River in Alaska (Rains, 2011) as these areas also have seasonal variations in river flow. Sorted and stratified fluvial deposits can also be created in semi-arid conditions such as desert wadis.

As there are some landforms which are not distinctive to glacial environments the processes of fluvioglacial deposition are not as important in producing distinctive landforms. Distinctive glacier landforms are usually a result of the work of ice directly not the influence of flowing water e.g. kettle holes where a block of ice is needed as well as meltwater (4).

4.0 Conclusion

The majority of glacial landforms are distinctive, therefore the processes operating in glacial environments are different to those at work in other locations. Plucking is one of the most important processes as it helps produce landforms such as roche moutonees, corries and arêtes which are only found in upland glacial environments.

Freeze thaw is a weathering process which is essential in order for plucking to occur therefore it is indirectly influential in the formation of glacial landforms making it very important, although it does occur in non-glacial landscapes. Plucking is a unique glacial process as it requires glacial ice to operate. The majority of glacial landforms are unique because of the scale and power of glaciers which produce a unique set of landforms which characteristic shapes and sizes.
The processes of glacial transport and deposition are also important as they form distinctive landforms made out of till and other glacial deposits. They are distinctive due to the unsorted, unstratified nature of till and its composition of angular clasts and rock flour. Plucking, along with abrasion, helps provide the eroded material that eventually forms till. This reinforces the importance of plucking as a process.

The processes of fluvioglacial deposition have less importance because many of the landforms produced are non-distinctive and the same processes occur in a variety of fluvial environments. The action of ice produces a large number of distinctive landforms, therefore any process which relies on the presence of ice is the most important is producing distinctive landforms.

Comments

Mark scheme section	Strengths	Areas for improvement	Mark scheme level
Introducing, defining and focusing on the question (10)	• Focus on the question i.e. distinctiveness • Good terminology and definitions • Framework in terms of distinctive / non-distinctive • Mentions case studies and scope of the report	• Could develop a clearer direction / argument	9-10 marks (Level 4)
Researching and methodology (15)	• Range of sources identified with dates • Some comments on suitability / reliability • Range of examples, locations and different processes which are all relevant • Broadly accurate	• Could develop conceptual research e.g. equifinality	12-15 marks (Level 4)
Analysis, application and understanding (20)	• Content is linked to the question • Diagrams used to good effect (although not for landforms) • Relevant range and some detail	• Some conceptual understanding but this could be incorporated more fully / developed	17-20 marks (Level 4)
Conclusions and evaluation (15)	• Includes ongoing evaluation • Meaningful conclusion – recognises distinctive / non-distinctive difference • Mostly thorough recall	• Some element of complexity recognised but could develop	12-15 marks (Level 4)
QWC (10)	• Uses numbers / letters in main text to link to methodology sources • Logical structure and report style • Accurate use of terminology • Diagrams used effectively		9-10 marks (Level 4)