Qualification Accredited

OCR
Oxford Cambridge and RSA

A LEVEL
Independent Investigation Exemplar

GEOGRAPHY

H481
For first teaching in 2016

Independent Investigation Exemplar 2 – Glaciated Landscapes
(includes marking commentary)

Version 1

www.ocr.org.uk/geography

Contents

© OCR 2017

INTRODUCING THE EXEMPLAR INVESTIGATION

We have produced this exemplar A Level Independent Investigation and marking commentary to support teachers in understanding the marking criteria and how it can be applied to students work. This is one of three investigations which can be used to show the marking criteria applied to different topic contexts (Coastal Landscapes, Glaciated Landscapes and Changing Spaces; Making Places).

We have used existing geography investigations completed by students several years ago. We felt it was important to use projects from students rather than exemplars written by developers with geography degrees. Therefore, there needs to be a slightly cautionary note, as we have applied the marking criteria to investigations that were not written for this criteria, however there are considerable similarities. We have therefore not given the investigations a total mark and overall grade, as this would set the standard prior to the current students submitting their own independent investigations in May 2018. In the summer of 2018 the Principal Moderator and their team will moderate samples from centres across the country with the key aim of ensuring that centres are applying the marking criteria consistently.

The investigations we have picked and applied the marking criteria to represent a range of styles and by no means suggest a particular way of approaching an investigation (from the title and key questions through to the layout and techniques). The marking criteria is split into six sections (OCR A level Geography specification pages 59-64) and we have provided commentary on each section, as well as given an indication of areas where the student could have made improvements to move up the level(s). For each section of the marking criteria we have given an indication of what has been done to meet a particular level and the evidence base for this. We have not annotated the exemplar investigations so that they can be used by both teachers and students alike. We do however suggest that when teachers mark their own students Independent Investigations that they are annotated to clearly indicate where particular sections of the marking criteria have been applied.

We understand that this component (Investigative Geography) within the A Level Geography is new for a number of teachers and so we are providing both support resources and CPD, these include:

Support resources:

- Independent Investigation Student Support Guide
- Independent Investigation clinics – FAQ 11/2016 http://www.ocr.org.uk/qualifications/by-subject/geography/geography-news/a-level-geography-independent-investigation-webinar/ and FAQ 01/2017 http://www.ocr.org.uk/qualifications/by-subject/geography/geography-news/a-level-geography-independent-investigation-webinar-jan-2017/
- Joint Exam Board – Frequently Asked Questions
- Independent Investigation proposal form exemplars with commentary

CPD events:

- Tackling the independent Investigation https://www.cpdhub.ocr.org.uk/DesktopDefault.aspx?e=fjefcbdbhgnidcpindncdphpabihkmpcehicklnfcaaagjncol
- Marking the Independent Investigation (June 2017) https://www.cpdhub.ocr.org.uk/DesktopDefault.aspx?e=fjefcbdbhgnidcpindncdphpabihkmpcehicklnfcaaagkfjdj
- Understanding Human Fieldwork (resources to download) https://www.cpdhub.ocr.org.uk/DesktopDefault.aspx?e=eeefkacmhhpiblncfgpfbpeikncmoaehickbnbabadejjldoba
- Understanding Physical Fieldwork (resources to download) https://www.cpdhub.ocr.org.uk/DesktopDefault.aspx?e=eeefkacmhhpiblncfgpfbpeikncmoblajpgjmocabgaomipdli

Please see the CPD hub for more information: https://www.cpdhub.ocr.org.uk

© OCR 2017

INDEPENDENT INVESTIGATION MARKING COMMENTARY: GLACIATED LANDSCAPES

Section 1: Planning, purpose and introduction

For this section of the marking criteria the investigation has mostly elements of L1 and some aspects at L2. ***This is a holistic decision based on competencies and evidence from the work.***

- There is an incomplete attempt to plan with limited evidence in the introduction, there is a lack of clear aims, questions or hypotheses (page 5).
- There is limited evidence of research that supports the investigation through wider geographical links, comparisons, models or theory. This is a significant problem with this piece of work since the focus remains unclear throughout.
- The location is unclear. Whilst there is evidence of geo-spatial techniques (pages 2-3) these lack precision in clarifying where the investigation took place.
- The plan is based on an individual geographical topic or issue, within a research framework (implicit, page 5), but definitions are incomplete.
- There is some justification for the investigation provided in the introduction (implicit, not explicit).

Note (1) There is limited explicit evidence of research that supports the investigation through wider geographical links, comparisons, models or theory. However, in the context of this legacy piece of work that may not have been a requirement.

To potentially access higher levels within the marking criteria; the student might have considered the following:

- The focus of the work is confused and ideas need a theoretical background. This work demonstrates the importance of using a necessary theory or at least research to develop a research framework from. This work would have been substantially improved with a focus such as, "A mapping exercise to determine the size and reasons for the distribution of glacial pedestal rocks". Ideas around shear stress and shear strength might also have been included within the context and framework.
- The candidate could have considered clearer evidence of individual literature research, for example local blogs or forums linked to their topic, as well as more academic writing on usage of the high street. This could come from publications such as *Geography Review* and *GeoFactsheets*, or perhaps an undergraduate text. These will likely be free to access materials on the internet as well that could provide a theoretical background.
- The location of the glacial field sites could have been better located, e.g. use of Geographical Information Systems (GIS) or Google Earth as well as provide lat / long points. The maps (pages 2-3) were also missing scales. A smaller-scale published map (e.g. 1:2,500), or equivalent would have provided better geo-location aspects, connecting the reader more readily to the place under investigation.
- Geographical terminology needs to be included. A small table of definitions, e.g. pedestal rock (page 6) would have demonstrated that the candidate is clear in terms of wider geographical links as well as the context for the investigation.

© OCR 2017

Section 2: Data, information collection methods and sampling framework

For this section of the marking criteria the investigation clearly sits in both L1 and L2. *This is a holistic decision based on competencies and evidence from the work.*

- There is some knowledge and understanding of a range of data collection methodologies, including quantitative approaches, and are mostly appropriate to the investigation. Page 8 provides evidence.
- There is limited evidence of personalised methodologies and approaches to observe and record primary data and phenomena in the field, collected individually, e.g. page 8.
- The data design framework (sampling, frequency, range and location choice) is weak and with no relevant justification.

Note (1) ethical and socio-political considerations are absent from this legacy work, so have not been considered in the decision about an appropriate Level.
Note (2) digital-geo-located data would not have been either relevant or available for this legacy work.
Note (3) secondary data and information may not have been a requirement for this investigation, so has been excluded from the level marking decision.

To potentially access higher levels within the marking criteria; the student might have considered the following:

- Data design framework could be significantly improved, giving more consideration to an overall sampling framework, better linked to the focus. Some of the methods seem irrelevant or inappropriate, e.g. bearing, colour, as they have not been fully explained (page 8). Other measurements e.g. circumference are not explained as to why they might be relevant to this investigation focus.
- The position of the rocks could today be recorded in the field using GPS from a smartphone, e.g. https://play.google.com/store/apps/details?id=com.woozilli.gpscoordinates&hl=en
- Annotated photographs of using equipment would have been useful to show deeper understanding of the fieldwork process; they could have also be geo-located, e.g. detailed pictures from a phone often have "exif" data which contains a lat/long.
- The Field Studies Council (FSC) Fold-out key on projects http://www.field-studies-council.org/publications/pubs/geographical-investigations.aspx has a very useful set of ideas on fieldwork design that would have assisted the candidate.
- Also, the FSC website shows more details of sampling and glacial surveys, again useful for this candidate https://www.geography-fieldwork.org/a-level/glaciation/upland-landscapes/
- The ethical considerations might be linked to damage of the environment and a recognition that this is an important location to protect and preserve, especially if it holds a record of climate change for instance.
- This candidate would have benefitted from an individual planning sheet, linking together the fieldwork to the focus of the investigation, especially sampling and frequency.

© OCR 2017

Section 3: Data presentation techniques

For this section of the marking criteria the investigation sits mostly in L2, with some L3. ***This is a holistic decision based on competencies and evidence from the work, especially as in this project the presentation is integrated within the analysis as is shown over a large number of pages.***

- There is some selective presentation of the most influential data collected directly related to the investigation, e.g. pages 17, 19 and 24.
- The range of data presentation methods is mostly well selected, with some knowledge and understanding of the relevant techniques for representing results.
- There is an attempt to balance the simple and more sophisticated data representation methods, relevant to the topic.

To potentially access higher levels within the marking criteria; the student might have considered the following:

- The data presentation is technically accurate, but doesn't link well to the focus or purpose of the investigation. This is a function of the data collected, a lack of design, rather than actual presentation errors. Work should not be double-penalised so this section needs to be taken in context of the descriptors.
- Simpler techniques could be made more sophisticated by using annotations e.g. on scatter graphs to explain anomalies, the line of best fit and relationships between variables.
- Excel or similar could be used to plot much of the data, saving the candidate considerable time in terms of hand-drawn graphs *(Note (1))*.
- Nowadays, GIS and Google Earth would provide a good opportunity to geo-locate graphical presentation, e.g. dispersion diagrams. GIS could also have been used as a convenient method to present sediment distribution data for examples.
- Photographs seems to have been largely ignored as a data presentation technique and would have been relevant to provide evidence of sediment and pedestals. If these were labelled / annotated this could be an invaluable data presentation technique.

Note (1) This would not have been a requirement / common practice with this legacy work.

© OCR 2017

Section 4: Data analysis and explanation

For this section of the marking criteria the investigation sits mostly in L1, with some elements of L2. *This is a holistic decision based on competencies and evidence from the work.*

- There is partial knowledge and understanding of the techniques appropriate for analysing and explaining data and information, but only for certain aspects of the fieldwork, e.g. line of best fit, pages 15 and 17.
- Statistical analysis and significance testing are absent to both the data and topic of investigation.
- The analysis and explanation show a weak link to the stated aims or questions or hypotheses.
- There is limited evidence of knowledge, theory and geographical concepts being used to help explain findings. Again, this is since the work has a broad focus without sub-hypotheses or questions (to give a definite plan/focus) upon which to relate findings to.

To potentially access higher levels within the marking criteria; the student might have considered the following:

- Overall this section feels to be the weakest part of the work since there are several missed opportunities in terms of quantitative data analysis. This could include, given the range of primary data, measures of centrality (means, modes, median, inter-quartiles, standard deviations etc) as well as tests for association and significance, e.g. Mann-Whitney and T-Test.Correlations which are discussed, e.g. page 13 are not fully worked through with null and alternative hypotheses. The language of statistics doesn't include a technical element.
- The analytical writing could have been strengthened by literature research. This would have made it less descriptive throughout the analysis.
- The candidate doesn't seem to be able to link together some of their data e.g. sediment / pedestal characteristics, and the focus for the study, especially in a comparative context. Some theory is needed to link together finings and processes.
- There is lack of wider geographical links could also have been much better established, again this is where the theory is absent. Technical documents, e.g. academic papers, would have helped with the analysis, allowing more relevant data to be used and comparisons made with other locations.
- The candidate could have made more use of qualitative data analysis, e.g. annotation of images.

Note (1) a literature research this was not a requirement when this legacy work was produced.

Note (2) for legacy work there would have been less emphasis on qualitative data analysis techniques.

© OCR 2017

Section 5: Conclusions and investigation evaluation

For this section of the marking criteria the investigation shows elements of both L1 and L2. *This is a holistic decision based on competencies and evidence from the work.*

- There is a limited attempt to reach conclusions which are linked to the aims or questions or hypotheses, communicated by limited means of extended writing (page 34).
- Although there are small ongoing conclusions, e.g. pages 25 and 30, they never provide either depth or detail and therefore are only basic.
- Limited elements of primary evidence linked to arguments and conclusions.
- There is no evidence that conducting an investigation extended geographical understanding with no reference to the wider geographical context of the investigation.
- The evaluation is implicit and often very limited to the identification of a few basic errors and problems – evidence for example on page 34.

Note (1) ethical and socio-political considerations are absent from this legacy work, so have not been considered in the decision about an appropriate Level.

To potentially access higher levels within the marking criteria; the student might have considered the following:

- The proposal form could have been used to develop a clear and succinct title / hypothesis with sub-hypotheses enabling a clear plan to develop.
- There seems to be a missed opportunity to consider the wider geographical context of this work, especially in terms of climate change, for example.
- The ethical and socio-political dimensions could be considered including a brief discussion regarding site protection, minimal disturbance to the glacial deposits, etc.
- The conclusions and investigation evaluations are missing a robust "success" framework which as it stands, is mostly linked to methodology (measurement and operator error) rather than comments regarding validity. The FSC Fold-out key on projects http://www.field-studies-council.org/publications/pubs/geographical-investigations.aspx has a very useful set of ideas on evaluation. It considers the meanings of accuracy, reliability, precision errors as well as validity.

© OCR 2017

Section 6: Overall quality and communication of written work

For this section of the marking criteria the investigation sits mostly in L2, with an aspect of L1. *This is a holistic decision based on competencies and evidence from the work.*

- There is a variable standard of communication that has some relevance to the geographic purpose of the investigation.
- Arguments are present showing elements of individuality. Once again these are mostly implicit rather than explicit.
- The work is partially structured and lacks a logical order, e.g. analysis is disjointed.
- Presentation is adequate with text and figures mostly integrated.
- Geographical terminology is present, but there are some written language errors.

Note (1) sources / references are absent from this legacy work, so have not been considered in the decision about an appropriate Level.

To potentially access higher levels within the marking criteria; the student might have considered the following:

- This reproduced typed version of this work comes in at just over 4300 words, but perhaps the candidate should have given more thought to the weighting of individual sections. The use of bullets, mini-summaries, annotations and tables, in some instances could have encouraged more technical summaries and succinctness. Candidates should be encouraged to consider other technical documents which are published to get ideas from.
- The candidate should have considered the discussion and analysis much more fully. Here a self-evaluation review framework would have been helpful, or been provided with examples of other documents where analysis has been successfully delivered.
- Harvard referencing should be encouraged at this level. One example of a guide is here http://education.exeter.ac.uk/dll/studyskills/harvard_referencing.htm. Alternatively tools within products such as MS word can create bibliographies automatically https://support.office.com/en-gb/article/Create-a-bibliography-17686589-4824-4940-9c69-342c289fa2a5
- Key questions, sub-hypotheses, etc. would enable the candidate to structure their work more clearly and appropriately for a 3000-4000 word piece.

© OCR 2017

An investigation to determine the factors that influence the position of rocks on a glacial surface

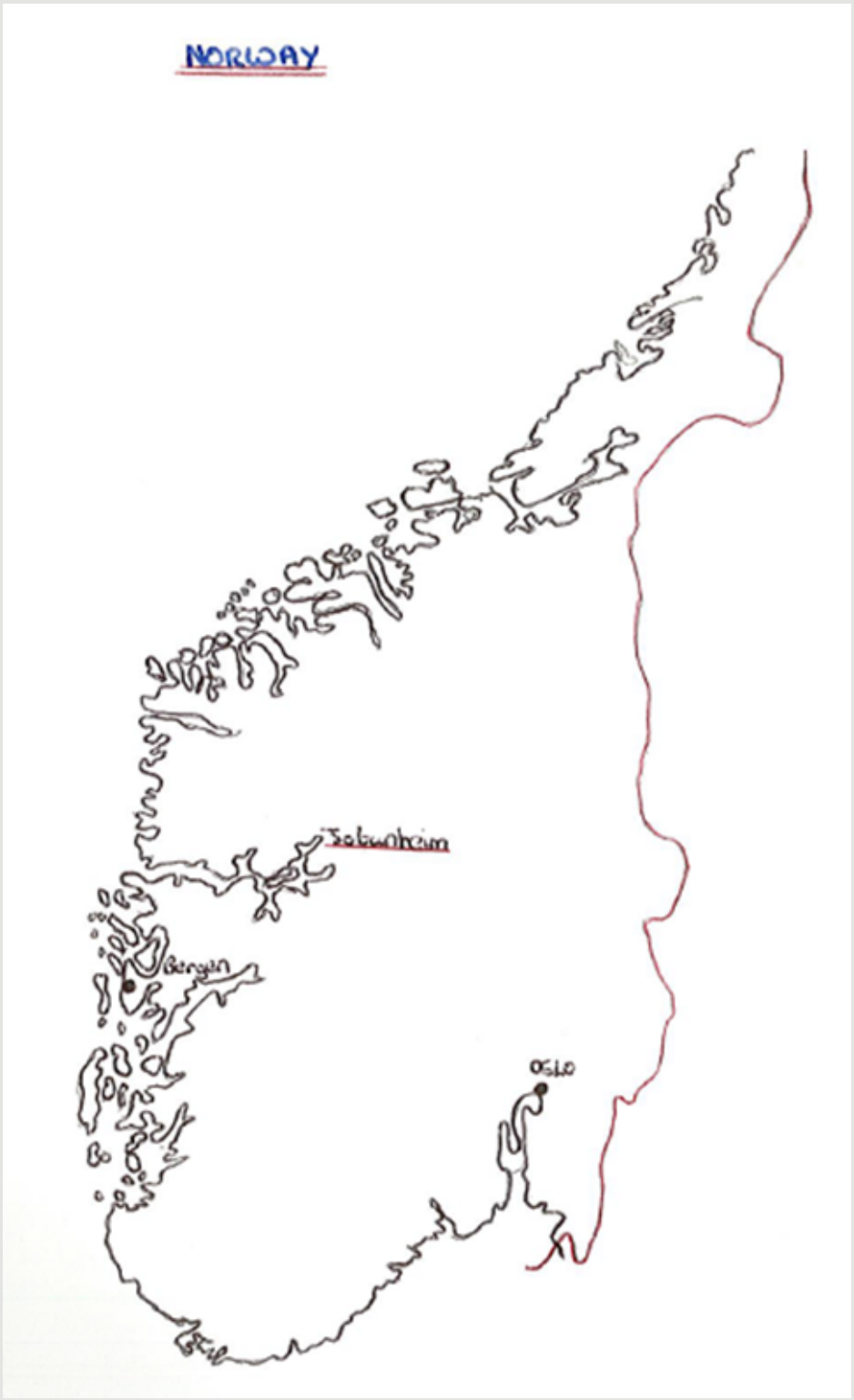
Area of investigation: Norway – Jotunheimen

Glacier: Storbreen

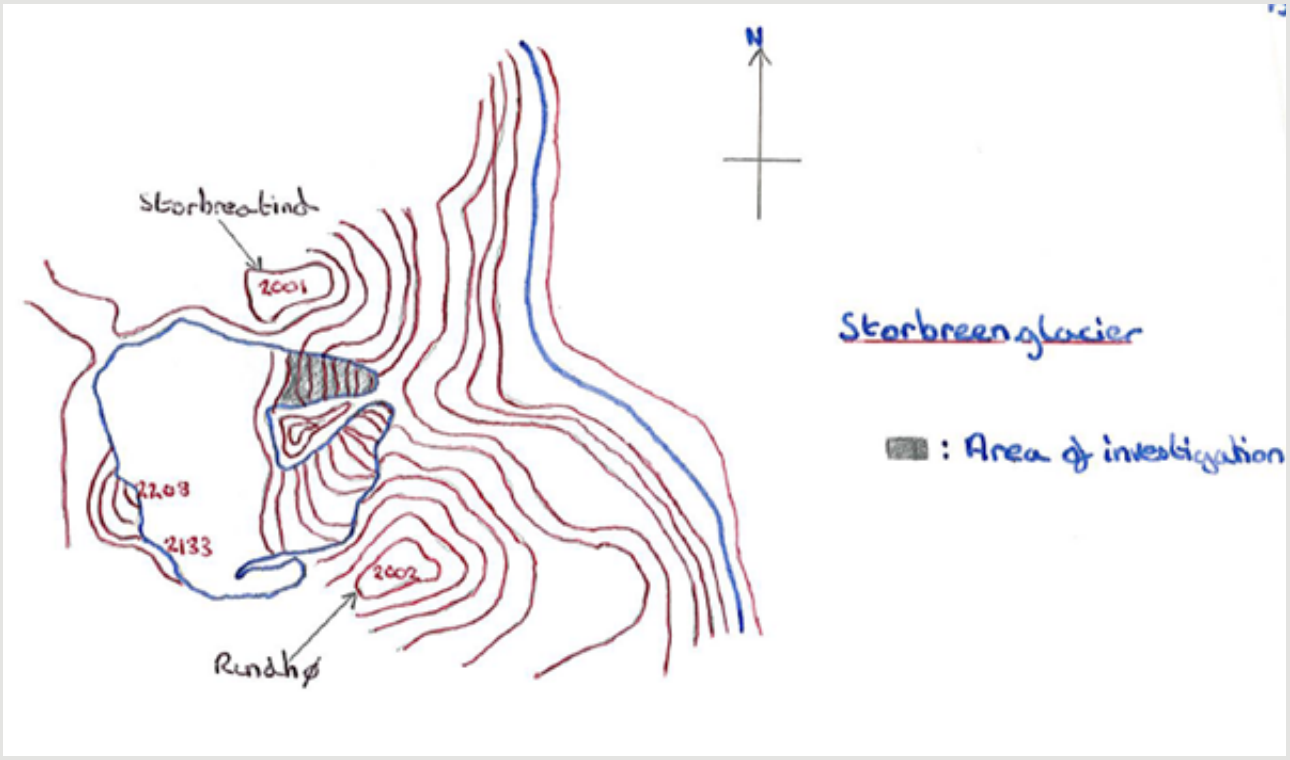
Hellstugubreen

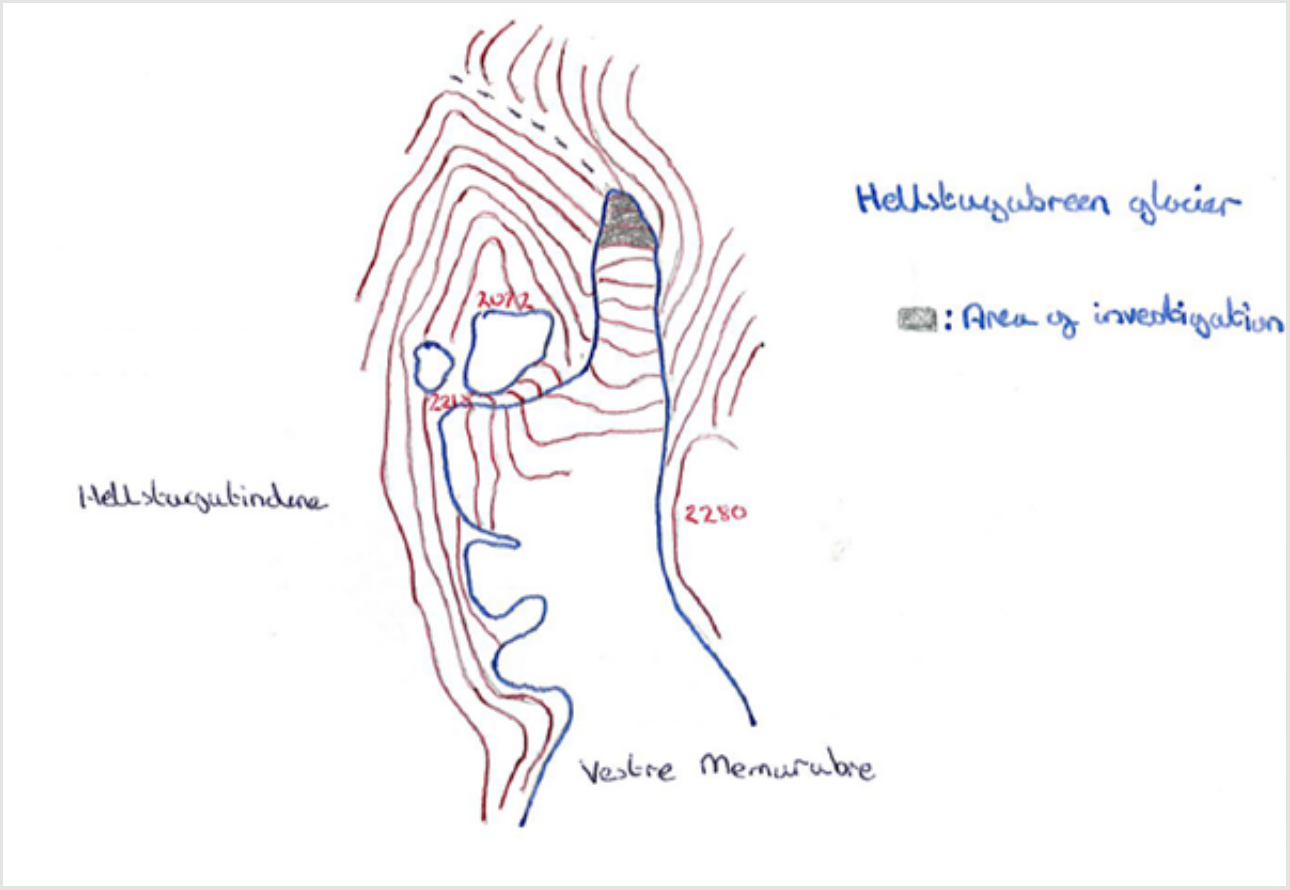
Date of investigation: July 1988

© OCR 2017



© OCR 2017


N
Storbreatind
2601
2208
2133
2602
Rundhø
Storbreen glacier
: Area of investigation


Hellstugubreen glacier
: Area of investigation
2073
2213
2280
Hellstugubtindene
Vestre Memurubre

© OCR 2017

HELLSTUGUBREEN

STORBREEN

© OCR 2017

Introduction:

Since the mini-ice age of the 18th century, glaciers and ice caps throughout the world have been retreating. There is much evidence to suggest that glaciers covered much of Northern Europe in the past. Today, one can see that glaciers are retreating not only be the eroded landforms and deposits left behind, but also by features on the glacial surface itself. These features are 'rock pedestals', or rocks that have become perched on columns of ice above the ice surface.

As the glacier melts certain rocks will protect the ice underneath for a certain period of time, therefore not allowing the ice to melt at the same rate as the ice surrounding it.

However it was also found that other rocks had not become perched on ice columns, and even some had become embedded in the ice. Ones first assumption of this is that the weight of the rock had forced itself into the ice, but as the results show, it were the smaller rocks that were embedded in the ice. Therefore I decided to investigate what factors influenced the position of these rocks on the snouts of glaciers.

The area in which the investigation was to be carried out was the Jotunheimen mountain region of Norway. The Jotunheimen, (or the 'house of the giants'), is the highest mountain range in Scandinavia. It lies 150 miles from the South coast of Norwayand North East of the Sogne Fford. The region contains over 300 glaciers ranging from niche and corrie glaciers to valley glaciers and ice caps, although few are larger in area than 5km². Many mountain peaks and ridges in the Jotunheimen exceed 2000metres and valley bottoms are commonly 900-1200metres, usually above the birds tree line. The landscape is one of low, middle and high Alpine character with local sub-Alpine pockets.

I chosel chose two glaciers to carry out my investigations on, Storbreen and Hellstugubreen. Both these glaciers have fairly narrow snouths and high scree slopes on either side therefore providing good conditions for rock pedestals to exist.

Storbreen is approximately 2000 metres above sea level and the snout faces in an easterly direction. Hellstugubreen is again approximately 200 metres above sea level and has a northerly facing snout. Most of the rock found of both glaciers were of the same type.

Rocks would have either fallen from the scree slopes or have been transported on the surface by the glacier itself.

© OCR 2017

Examples of rock pedestals on the Storbreen glacier:

© OCR 2017

© OCR 2017

Method:

On the two glaciers 25 samples were taken at random, as there was no even distribution of rocks across the glacier. For each rock six different factors were measured, they included;

1. The A/B/C axis.
2. The circumference of the rock exposed to direct sunlight.
3. The colour.
4. The bearing along the A axis.
5. The angle along the A axis.
6. The height from the ice surface, (or the column of ice).

The A/B/C axis of rock are; the largest measurement, usually the length; the second largest, usually the width; and the shortest length, usually the thickness of the rock. Measurements of all lengths are taken in centimetres.

The circumference of the rock exposed to direct sunlight is mainly the top of the rock which would be directly heated by the sun. This is only a rough estimate because a certain amount of the rocks sides would also be effected by direct sunlight. Measured in centimetres.

The colour of the rocks were recorded into four categories, Light Brown, Light Grey, Grey, Dark Grey.

The bearing of the rock was taken along the A axis so that a common line was used on all the rocks. This was measured with a compass.

The angle of the rock was also taken along the A axis, so that a common line was kept throughout the samples. This was measured with an ‘angle finder, (i.e. a clinometer).

Finally the height from the surface of each rock was taken. The positive figures represent height above the ice surface, the negative figures represent heights below the surface, (ie rocks that have become embedded in the ice.

All these results were compared with height to see which factor/s influence its height the greatest.

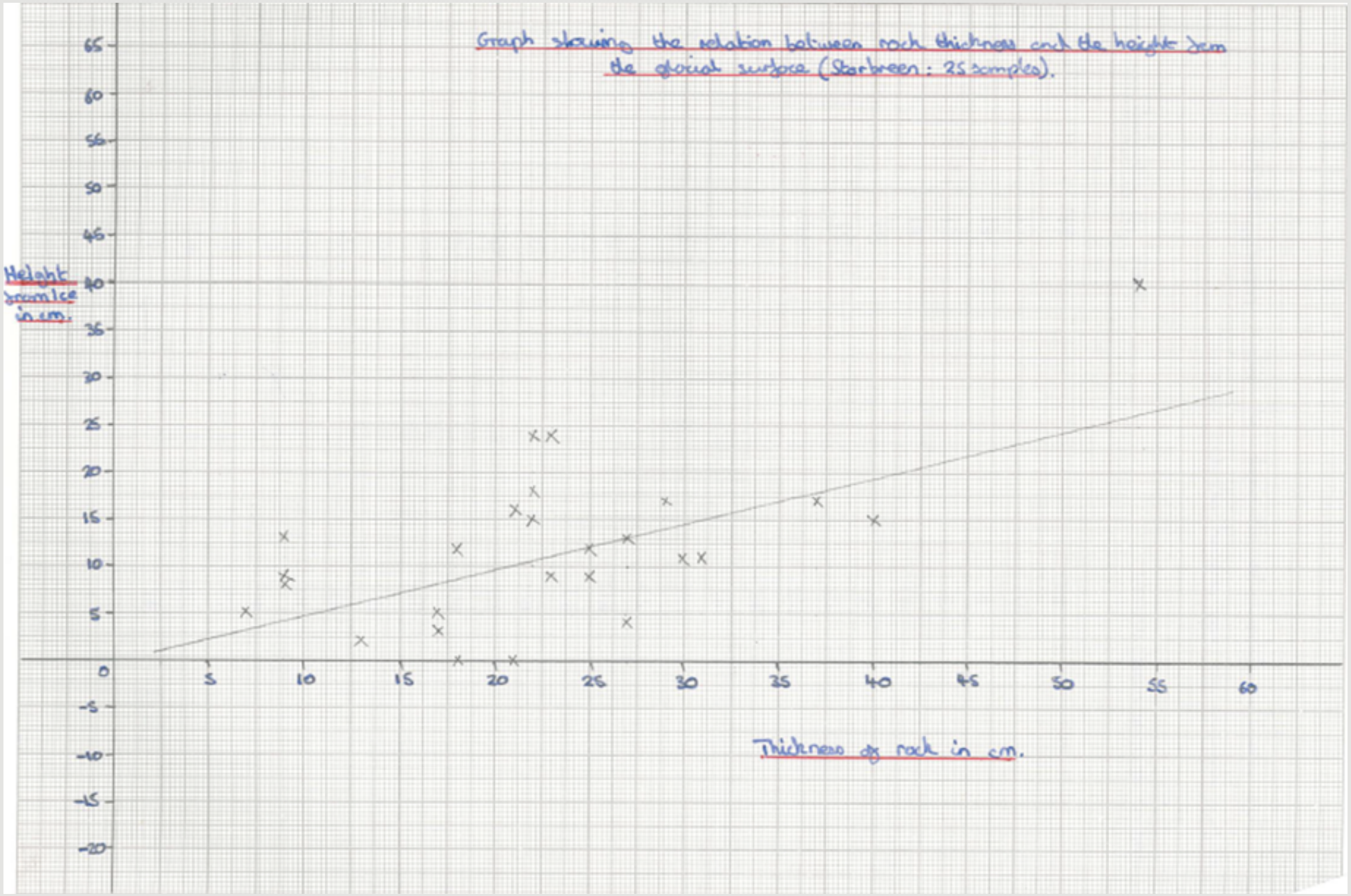
I also calculated a sphericity index for each rock. This is a value given for the closeness of the shape to a perfect sphere. Values range from 1, (for a perfect sphere), to 0.

© OCR 2017

Storbreen: Data to show the relationship between rock thickness and the height from the glacial surface.

Thickness of rock	Height from glacial surface
17	3
21	0
18	0
27	4
17	5.5
13	2
22	18
7	5
40	15
23	24
18	12
23	9
30	11
25	9
25	12
8	13
37	17
29	17
22	24
21	16
31	11
27	13
54	40
23	15
9 (cm)	9 (cm)

© OCR 2017

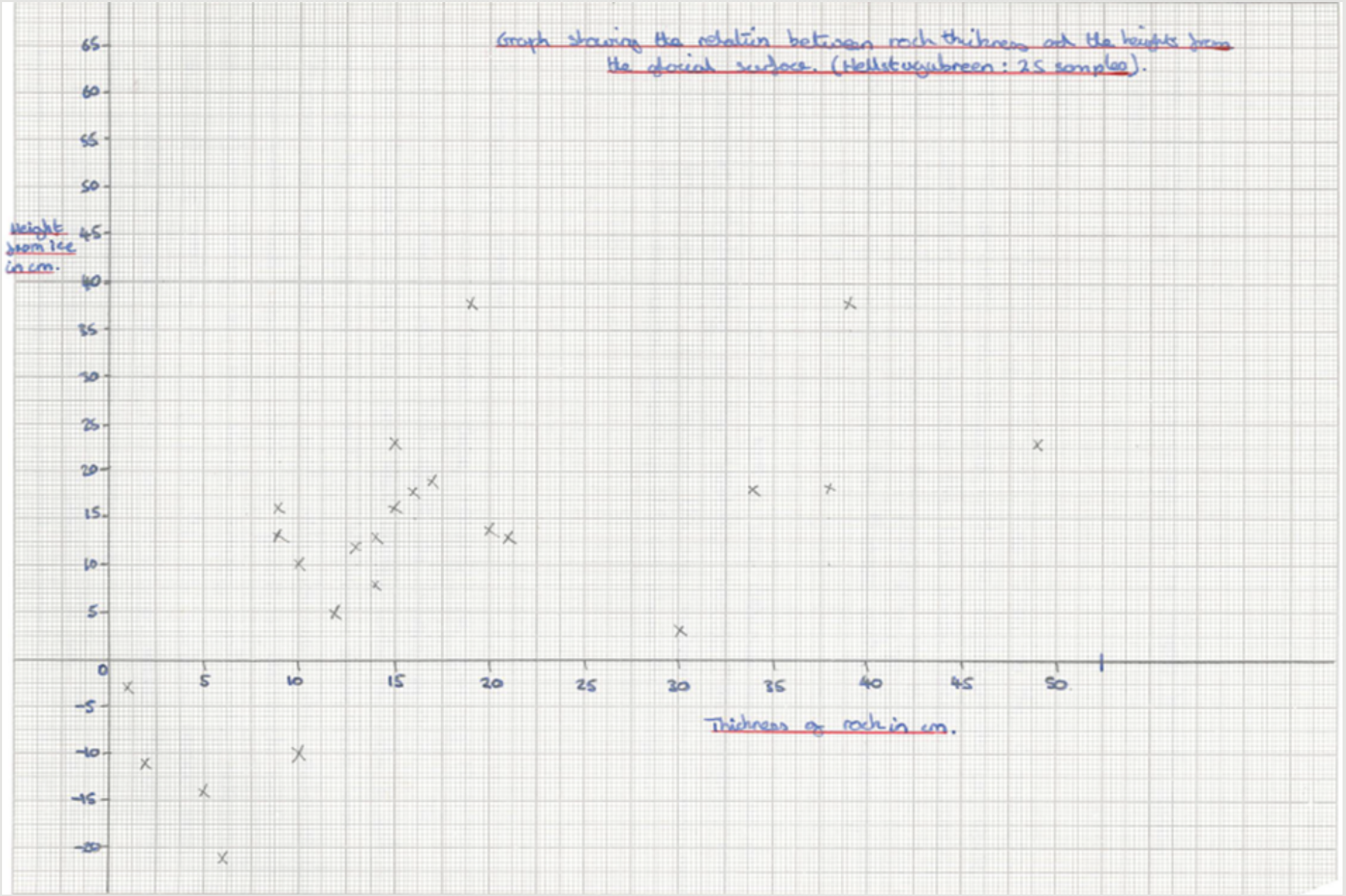

Graph showing the relation between rock thickness and the height from the glacial surface (Starbreen : 25 samples).
Height from ice in cm.
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
5
10
15
20
25
30
35
40
45
50
55
60
Thickness of rock in cm.

© OCR 2017

Hellstugubreen: Data to show the relationship between rock thickness and height from the glacial surface.

Thickness of rock	Height from glacial surface
38	78
10	10
14	8
12	5
13	12
19	38
15	23
48	24
39	38
15	16
6	-21
1	-3
5	-14
16	18
2	-11
37	18
17	19
10	-10
30	3
21	13
24	18
20	14
9	13
14	13
9 (cm)	16 (cm)

© OCR 2017


Graph showing the relation between rock thickness and the heights from the glacial surface. (Hellstugubreen : 25 samples).
Height from ice in cm.
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
0
5
10
15
20
25
30
35
40
45
50
Thickness of rock in cm.

© OCR 2017

The thickness of rock compared to the height from the glacial surface.

Storbreen:

The thickness of the rock was taken as the C axis, (the shortest measurement), and compared with the height from the ice. Quite a good correlation occurs between the two with height increasing as the rock thickness increases. For example, the thinnest rock, 7cm, has a height of 5cm, while the thickest rock, 54 has a height of 40 cm.

Hellstugubreen:

The correlation here is less defined but one can see a similar relationship as the Storbreen results. The smallest rock is 1cm thick and in 3cm below the ice surface; the thickest rock is 49cm thick and has a height of 23 cm above the surface.

Conclusion of graphs:

From these results we can see that the rock thickness is a major factor that effects the height of rocks. The thicker the rock is, then the less heat energy will be able to get through the ice, so less melting. However rocks that have a thickness less than 8cm sink into the ice. This could be due to the fact that heat is able to penetrate the rock easily and so therefore storing it. The stored energy continually acts on the ice and so melting its way into the ice surface. Larger rocks are unable to melt the ice because the energy needed to penetreate them is much greater than the smaller ones.

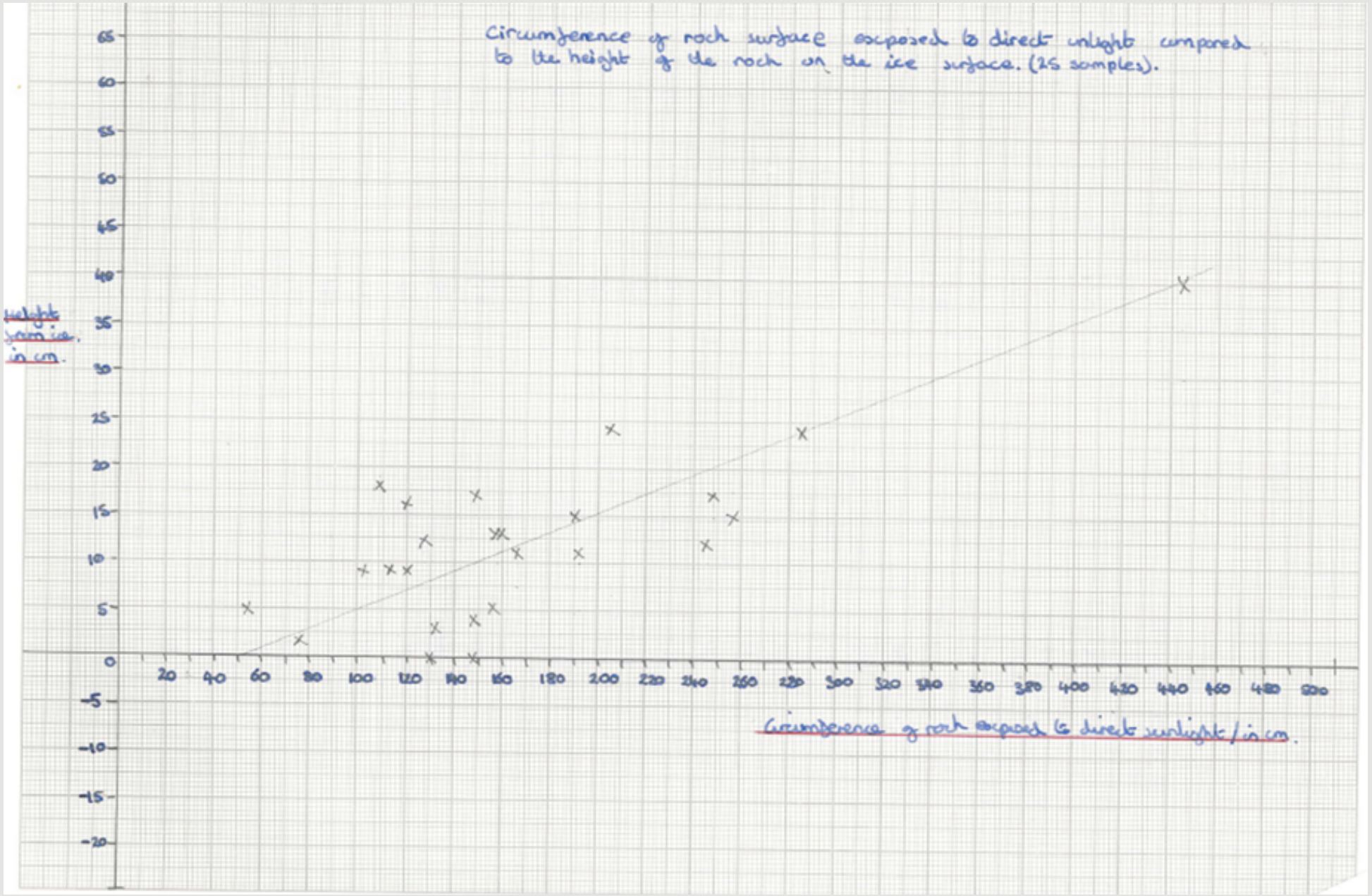
The lack of data of rocks embedded in the ice may be due to human activity. Storbreen is a favourite glacier for tourists and geographers because of its accessibility. (There was another group of students working in this area when we arrived). Hellstugubreen is on a public footpath, so rocks could easily have been kicked or moved from the original positions.

© OCR 2017

Storbreen: Data.

Circumference of rock (in cm)		Height from ice
Top	Underside	(in cm)
135	73	3
148	92	0
130	114	0
148	55	4
157	95	5.5
77	69	2
018	69	18
52	42	5
191	50	15
285	108	24
128	101	12
120	76	9
166	122	11
113	68	9
245	181	12
160	76	13
248	136	17
159	91	17
205	100	24
120	90	16
192	118	11
159	95	13
455	375	40
258	160	15
103	72	9

© OCR 2017

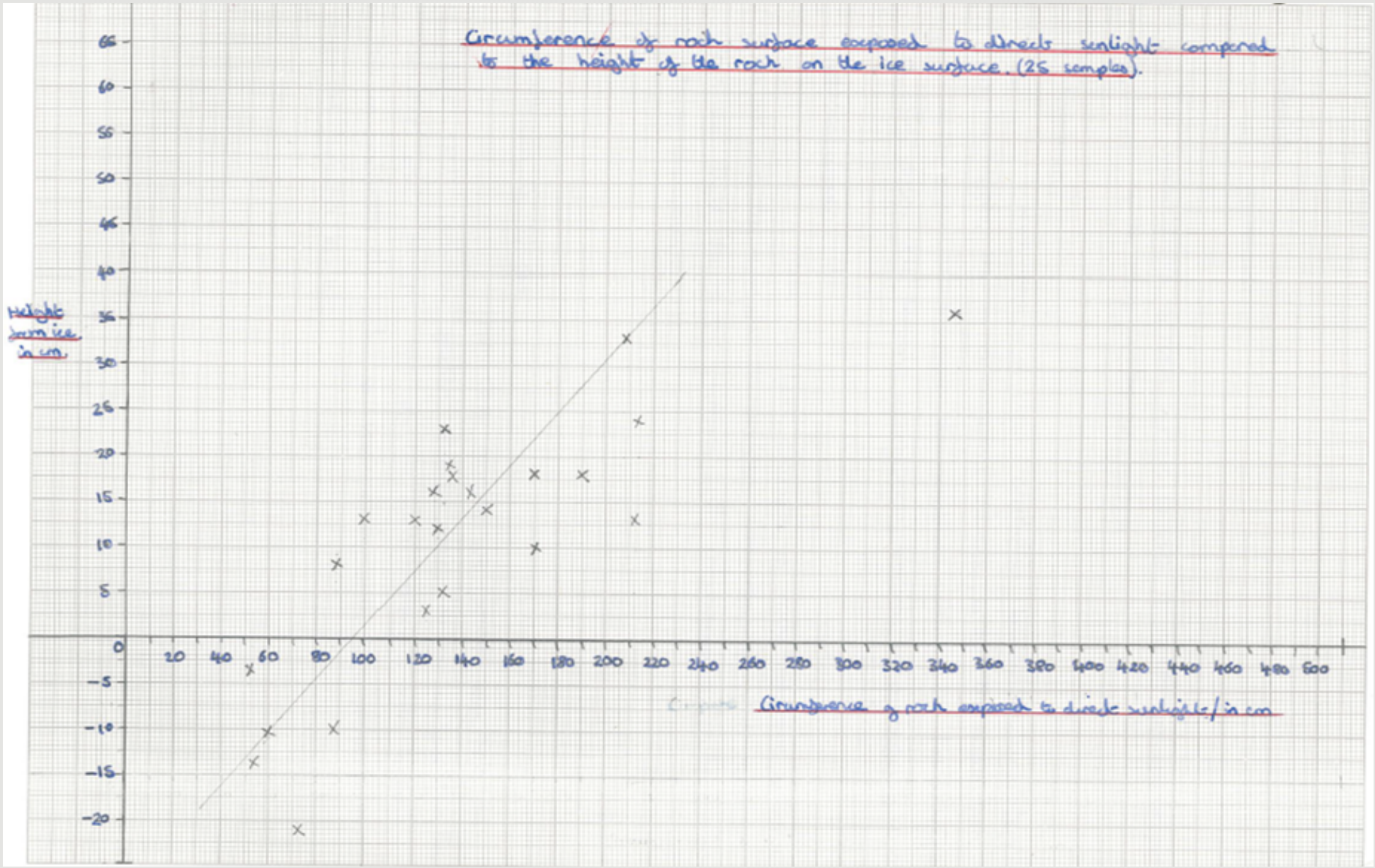

Circumference of rock surface exposed to direct unlight compared to the height of the rock on the ice surface. (25 samples).
Height from ice in cm.
Circumference of rock exposed to direct sunlight / in cm.

© OCR 2017

Hellstugubreen: Data.

Circumference of rock (in cm)		Height from ice
Top	Underside	(in cm)
430	150	78
171	130	10
88	75	8
132	92	5
131	108	12
207	170	38
134	112	23
214	192	24
346	190	38
128	112	16
74	64	-21
53	53	-3
56	56	-14
132	96	18
60	60	-11
170	130	18
134	118	19
89	89	-10
123	103	3
212	170	13
190	168	18
150	115	14
100	65	13
120	76	13
143	109	16

© OCR 2017


Circumference of rock surface exposed to direct sunlight compared to the height of the rock on the ice surface. (25 samples).
Height from ice in cm
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
Circumference of rock exposed to direct sunlight / in cm

© OCR 2017

Results:

Storbreen

The circumference of rock surface exposed to direct sunlight compared to height of the rock on the ice surface.

Storbreen:

Here there is a clear correlation between the circumference and the height. As the circumference increases, so does the height from the ice surface. For example, the smallest circumferencehas a height of only 5cm, the largest circumference, 442 cm, has a height of 40cm.

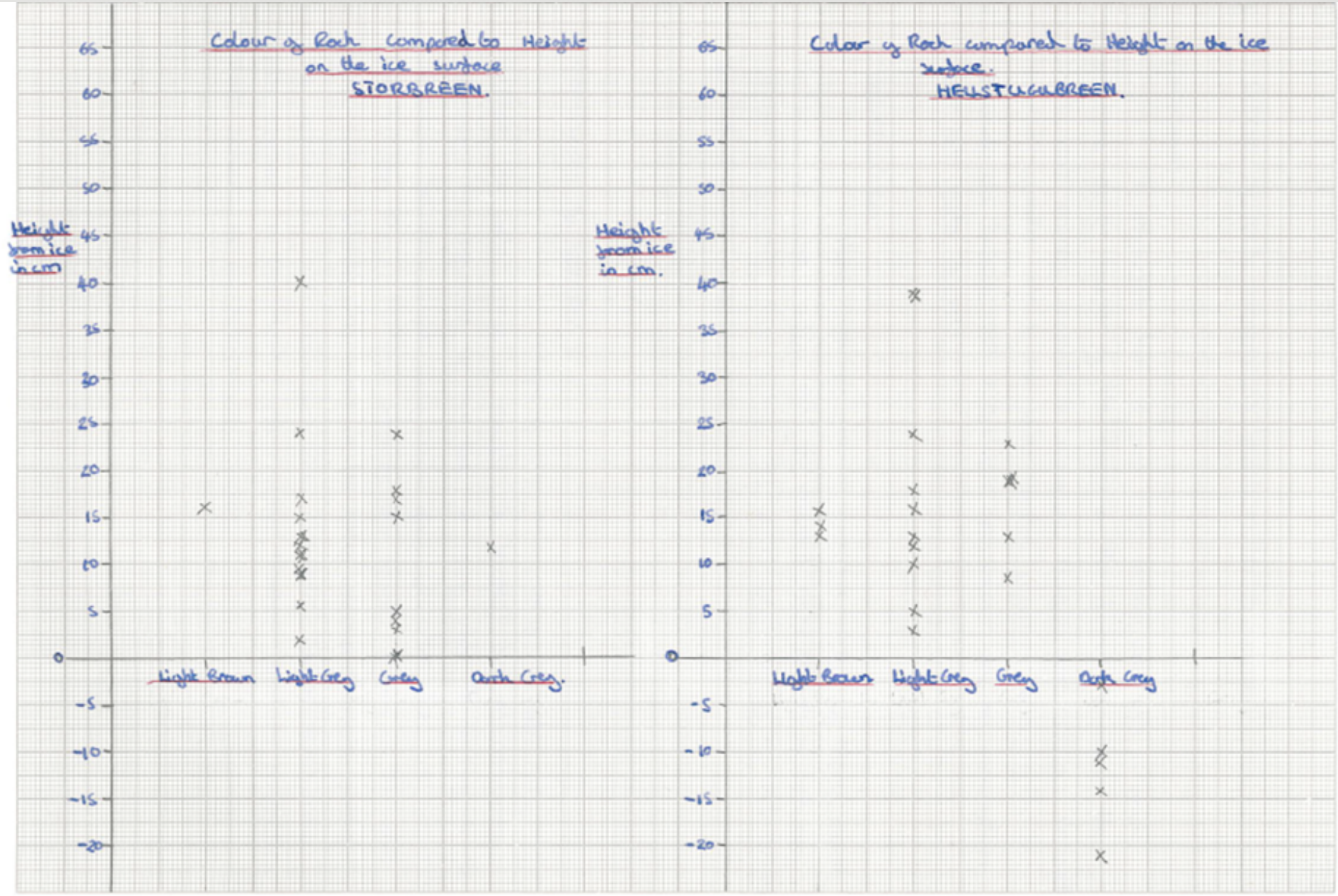
Hellstugubreen:

Here we have examples of rocks that have sunken into the ice, and they represent the smaller circumferences. But again we can see the height increases with circumference, (on the picture side of the graph).

Conclusion of graphs:

From these results we could say that the larger rocks cast a greater shadow over the ice surface than the smaller ones. Therefore less of the suns energy is able to reach the ice underneath the rock, so less melting will take place, so a small column is left.

© OCR 2017


Colour of Rock compared to Height on the ice surface STORBREEN.
Height from ice in cm
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
Light Brown
Light Grey
Grey
Dark Grey.
Colour of Rock compared to Height on the ice surface. HELLSTUGUBREEN.
Height from ice in cm.
Light Brown
Light Grey
Grey
Dark Grey

© OCR 2017

Colour of rock compared to height on the ice surface.

Storbreen:

I expected here to find that the colour will have a great influence on the height of the rock, ie The darker the colour the more heat energy would be absorbed therefore melting. The lighter colours would reflect the heat therefore preventing the melting of the ice. However the highest rock is of a light grey colour so my assumption was not quite correct.

Hellstugubreen:

Here, with samples of embedded rocks my theory seems to be a bit more valid. All the embedded rocks are of a dark grey colour suggesting that perhaps the dark colour helped the rock to melt through the ice surface.

Conclusion of graphs:

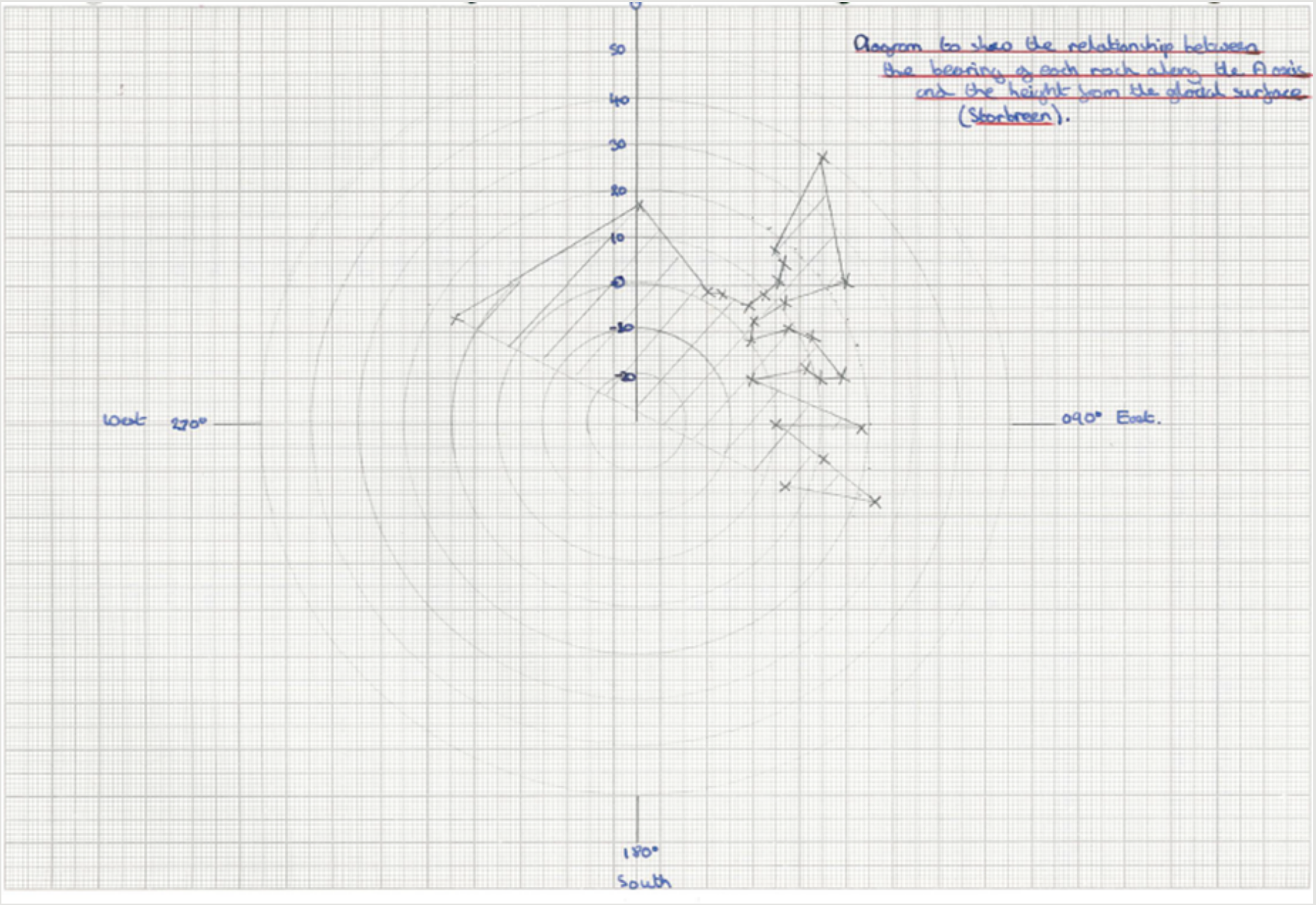
Most of the rocks are of a light grey colour therefore the wide range of results (, ie heights), are not particularly surprising. The difficulty of this test, is being able to distinguish the difference between light grey and grey, (ie, where does one draw the line between them). Perhaps some of the lower heights in the light grey group should be over in the grey column, therefore making the correlation more distinguishable. However, the embedded rocks all appear in the dark grey group, therefore perhaps suggesting that colour is a determining factor.

© OCR 2017

Storbreen: Data to show the relationship between the bearing of each rock along the A axis and the height from the glacial surface.

Bearing along A axis	Height from the glacial surface
034°	3
055°	0
090°	0
050°	4
113°	505
030°	2
091°	18
044°	5
300°	15
108°	24
070°	-4
058°	9
100°	11
044°	9
064°	12
044°	13
001°	17
038°	17
056°	24
042°	16
076°	11
051°	13
034°	40
090°	15
070°	9

© OCR 2017


A diagram to show the relationship between the bearing of each rock along the A axis and the height from the glacial surface (Storbreen).
50
40
30
20
10
0
-10
-20
West 270°
090° East.
180°
South

© OCR 2017

Hellstugubreen: Data to show the relationship between the bearing of each rock along the A axis and the height from the glacial surface.

Bearing along A axis	Height from the glacial surface
290°	78
251°	10
210°	8
314°	5
230°	12
274°	38
330°	23
020°	24
280°	38
189°	16
224°	-21
350°	-3
170°	-14
260°	18
230°	-11
356°	18
290°	19
240°	-10
010°	3
340°	13
310°	18
276°	14
310°	13
350°	13
330°	16.

© OCR 2017

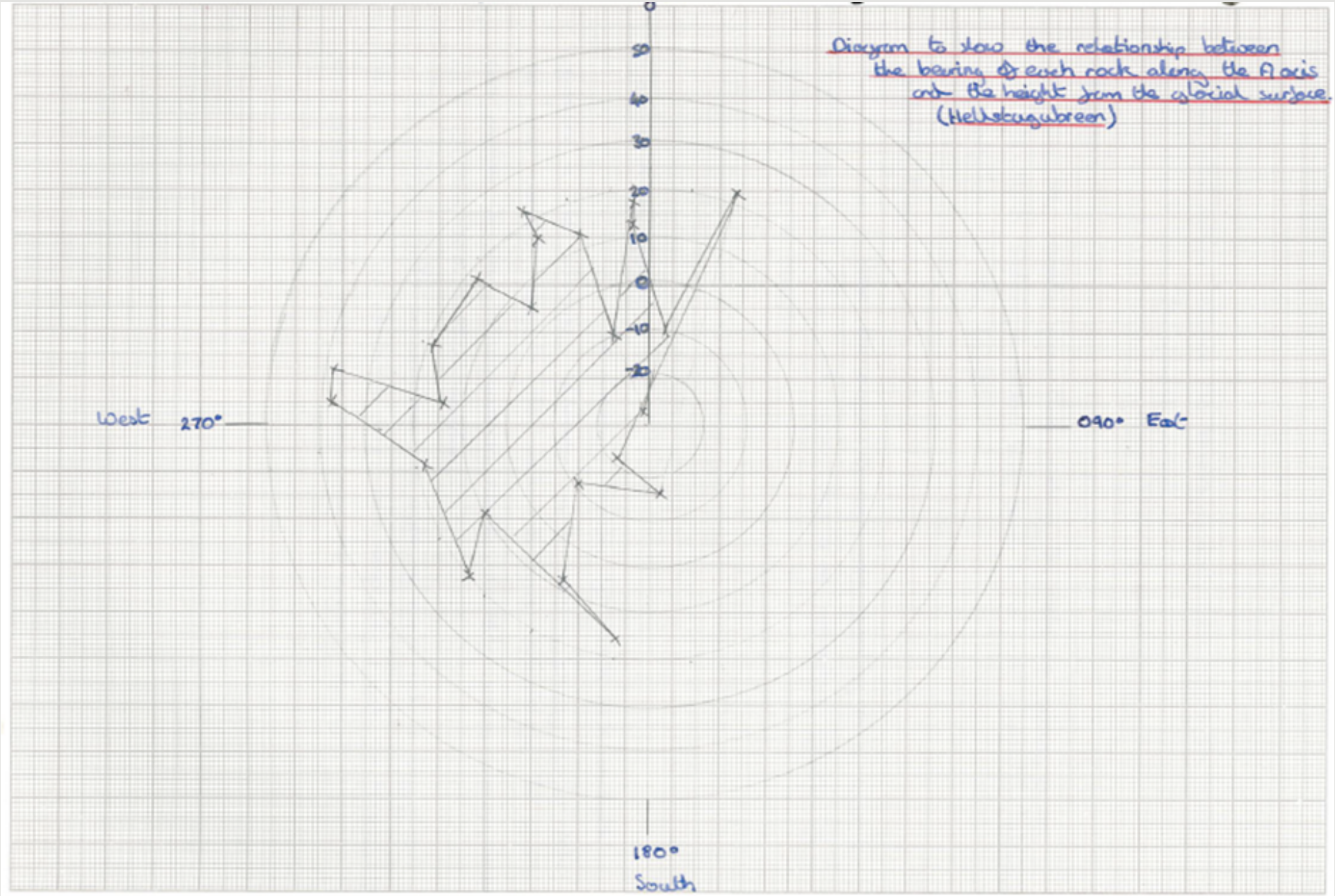


Diagram to show the relationship between the bearing of each rock along the A axis and the height from the glacial surface. (Hellstugubreen)
50
40
30
20
10
0
-10
-20
West
270°
090°
East
180°
South

© OCR 2017

The relationship between the bearing of each rock along the A axis and the height from the glacial surface.

Storbreen:

The results show that most of the rocks are facing in an East to North Easterly direction, but there is no real correlation between the direction and the height.

Hellstugubreen:

Here the major of rocks are pointing in a West to North Westerly direction, and again there is no correlation between the direction and the height.

Conclusion of graphs:

The average bearing for each rock on both glaciers is no surprise. Storbreen is an easterly facing glacier and so one would expect the rocks to face downslope. The same case applies to the Hellstugubreen results, northerly facing glacier, therefore rocks pointing in a northerly direction.

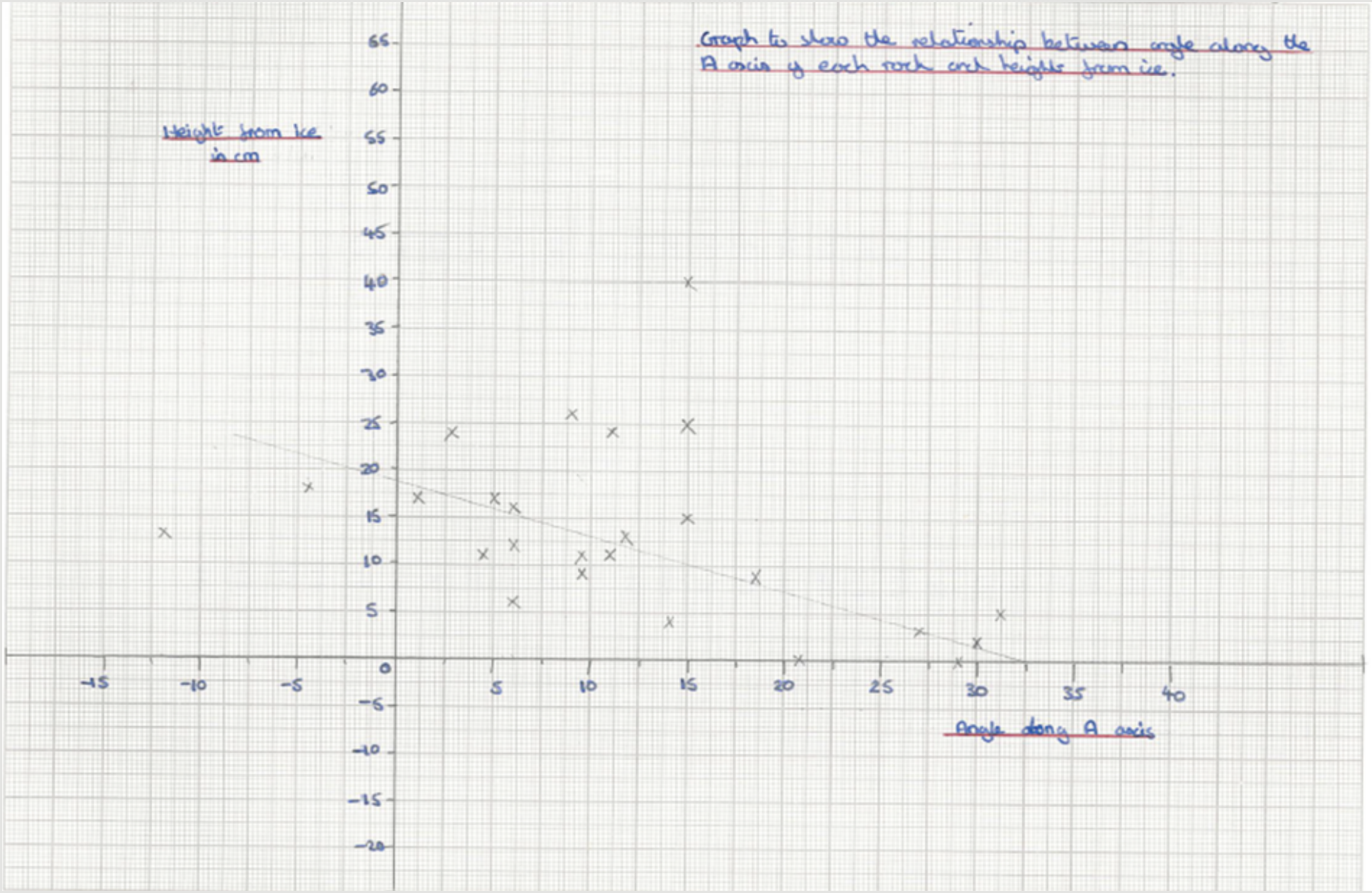
The problem with calculating the angle of each rock is trying to define the line in which it lies. For simplicity I used the A axis, which was also the line used for measuring the angle of the rock.

© OCR 2017

Storbreen: Data.

Bearing along A axis	Height from ice (in cm)
27	3
21	0
29	0
14	4
32	5.5
30	2
-4	18
6	5
15	15
11	24
12	12
11	9
4	11
18	9
9	12
-12	13
5	17
1	17
3	24
6	16
11	11
12	13
15	40
25	15
26	9

© OCR 2017

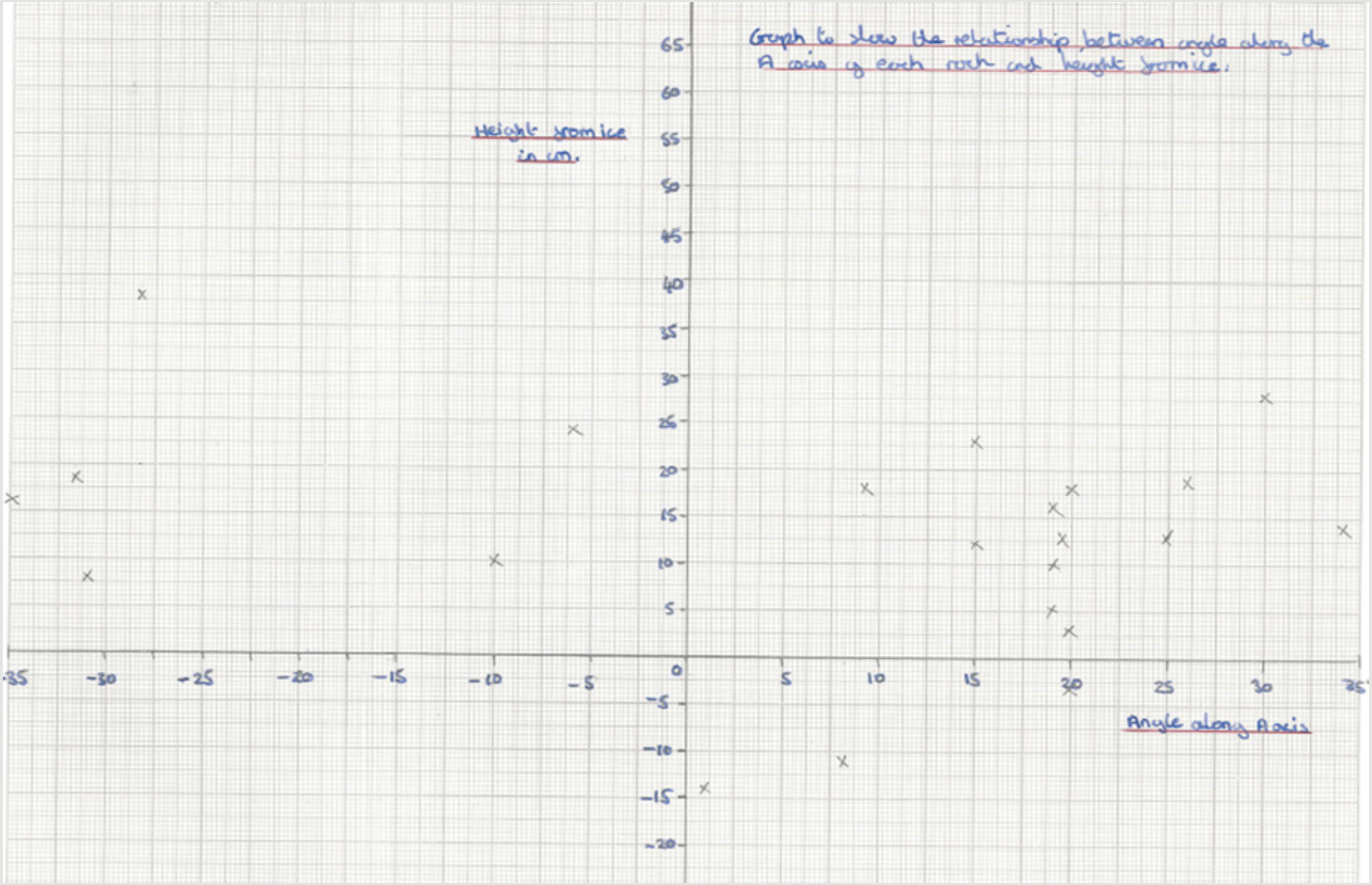

Graph to show the relationship between angle along the A axis of each rock and height from ice.
Height from ice in cm
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-15
-10
-5
5
10
15
20
25
30
35
40
Angle along A axis

© OCR 2017

Hellstugubreen: Data.

Bearing along A axis	Height from ice (in cm)
-43	78
19	10
-31	8
19	5
15	12
30	38
15	23
-6	24
-28	38
-35	16
0	-21
20	-3
2	-14
-32	18
8	-11
20	18
26	19
10	-10
20	3
19	13
46	18
34	14
8	13
25	13
18	16

© OCR 2017


Graph to show the relationship between angle along the A axis of each rock and height from ice.
Height from ice in cm.
Angle along Axis
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-35
-30
-25
-20
-15
-10
-5
5
10
15
20
25
30
35

© OCR 2017

Angle of rock along the A axis compared to the height from the glacial surface.

Storbreen:

The graph show a faint correlation between angle and height, ie as angle increases the height decreases.

Hellstugubreen:

Here there is no correlation that can be recognised. The results have become dispersed throughout the graph making it difficult to distinguish a relationship.

Conclusion of graphs:

Although the results for the Storbreen glacier show a small correlation, the angle seems to have no influence on the height of the rocks. The correlation in the first graph is probably due to stochastic factors, (chance), rather than a specific relationship between height and angle.

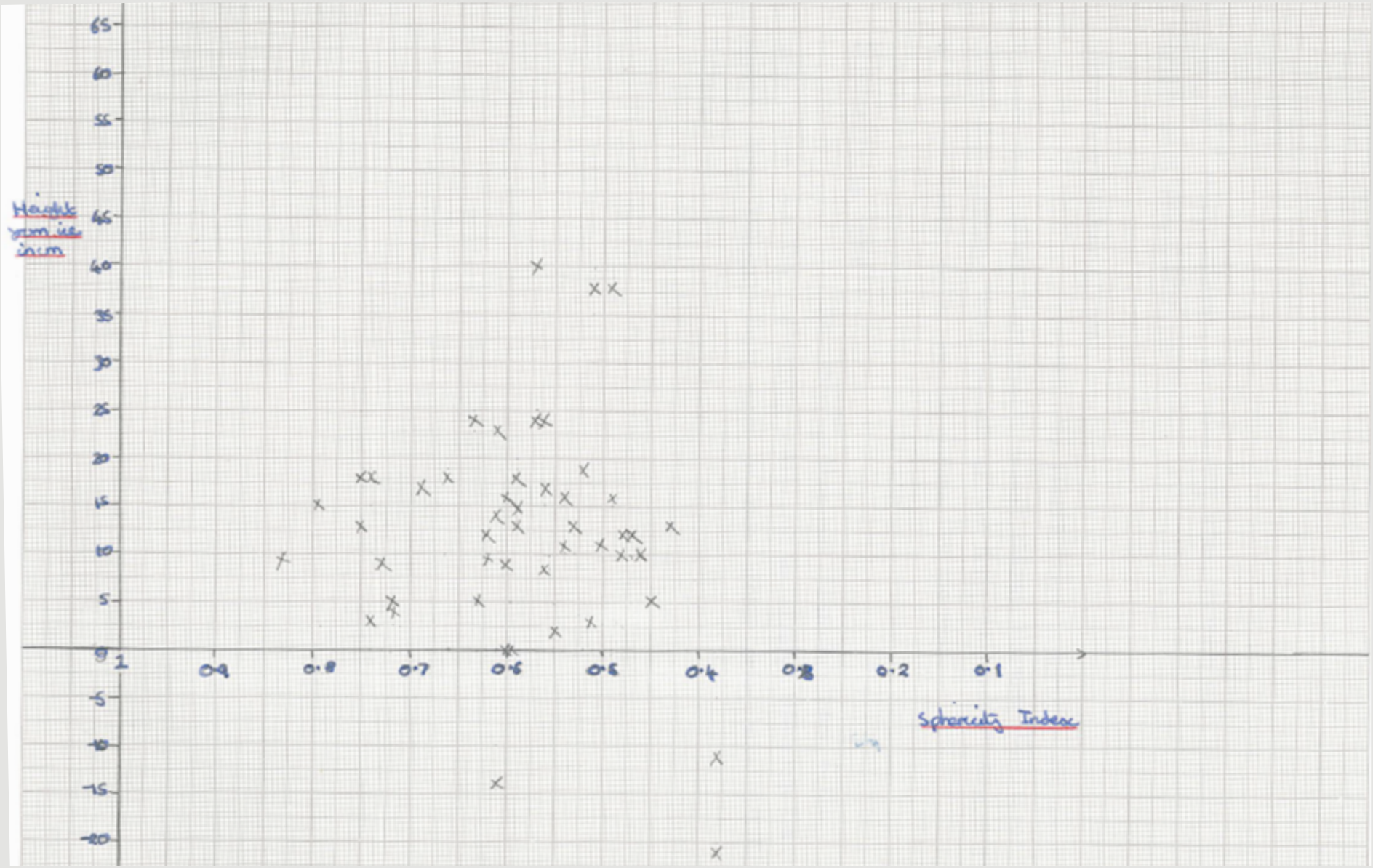
Like measuring the bearing of the rock, one finds it difficult to get an accurate representation of the angle due to its natural shape and the difficulty in finding a common line to measure the angle on. I attempted to partially solve this problem by always measuring along the A axis, but I could not always take into account its natural slope.

© OCR 2017

The relationship between the sphericity index of each rock and the height from the glacial surface.

Storbreen		Hellstugubreen	
Sphericity Index	Height	Sphericity Index	Height
0.515	3	0.558	78
0.598	0	0.462	10
0.606	0	0.564	8
0.718	4	0.457	5
0.630	5.5	0.623	12
0.555	2	0.497	38
0.666	18	0.611	23
0.729	5	0.578	24
0.794	15	0.515	38
0.636	24	0.548	16
0.477	12	0.383	-21
0.739	9	0.291	-3
0.504	11	0.617	-14
0.833	9	0.539	18
0.626	12	0.380	-11
0.436	13	0.750	18
0.568	17	0.526	19
0.690	17	0.480	-10
0.562	24	0.746	3
0.606	16	0.537	13
0.549	11	0.743	18
0.752	13	0.616	14
0.575	40	0.482	13
0.587	15	0.594	13
0.608	9	0.499	16

© OCR 2017


65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
1
0·9
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
Sphericity Index

© OCR 2017

The relationship between the sphericity index of each rock and the height from the glacial surface.

Storbreen + Hellstugubreen:

All the results were put into one graph to make any pattern that might appear clearer. However there is no relationship between them, except perhaps that the rounder stones, 0.45 to 0.3, are lower on the ice ice surface than the rest.

Conclusion of graph:

No relationship was expected here as the calculation for the sphericity index are so rough. Although the graph does suggest that most rocks range only from 0.8 to 0.4.

© OCR 2017

Overall conclusion:

Factors influencing the position of rocks on a glacial surface:

From all of the data collected and the results, I have concluded two major points, (factors), that influence the position of rocks.

1. Circumference of area exposed to direct sunlight.
2. Thickness of rock.

1) Circumference of area exposed to direct sunlight:-
Rock pedestals are formed by the melting of the surface ice surrounding the rock at a faster rate that the ice directly underneath it. Therefore there must be something preventing the suns heat energy from melting the ice. A shadow cast over the area would slow the melting rate considerably and it is this factor that is preventing the ice under the rock from being melted. The area on top of the rock blocks out the suns energy so stops it from melting the ice.

2) Thickness of rock:-
The thickness of the rock will determine how much heat energy will be able to pass through and reach the ice. Thin rock allow the whole mass of the rock to be heated up, therefore being able to store that energy for quite sometime. Thin rocks therefore are able to melt through the surface because the heat is still acting on the ice, when the rest of the surface is no longer melting. Thick rocks are unable to store the same amount of heat energy as the sun is unable to penetrate through them. This thick protection prevents the ice under the rock from melting at the same rate as the surrounding surface, so a pedestals is left.

It is the combination of these two factors and others, (like the colours), that enable the pedestals to exist.

Where rocks have been embedded in the ice, rock thicknessesand colour are probably the two important factors. The results show that all the embedded rocks are very thin and are of a dark colour.

These results however will be affected by stochastic and human factor. Stochastic factors were probably responsible for the correlation (even if it was feint), shown on the Storbreen results for the angle of rock in relation to its height.

As this area is a popular place for walkers/climbers etc, (especially at the Hellstugubreen glacier); the results may again be affected. When I returned to the Storbreen a few days later, the samples I had used had been moved. The second of my photographs showing a rock pedestal, is a typical example of what can be found, but when I returned it had fallen off its pedestal. This may be due to human activity or the natural processes that occur in a retreating glacier.

© OCR 2017

The small print

We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest

OCR Resources: *the small print*
OCR's resources are provided to support the delivery of OCR qualifications, but in no way constitute an endorsed teaching method that is required by OCR. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources. We update our resources on a regular basis, so please check the OCR website to ensure you have the most up to date version.

This resource may be freely copied and distributed, as long as the OCR logo and this small print remain intact and OCR is acknowledged as the originator of this work.

OCR acknowledges the use of the following content:
Square down and Square up: alexwhite/Shutterstock.com

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk

Looking for a resource?

There is now a quick and easy search tool to help find **free** resources for your qualification:

www.ocr.org.uk/i-want-to/find-resources/

ocr.org.uk/alevelreform
OCR customer contact centre

General qualifications
Telephone 01223 553998
Facsimile 01223 552627
Email general.qualifications@ocr.org.uk

OCR is part of Cambridge Assessment, a department of the University of Cambridge. *For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored.*

© **OCR 2017** Oxford Cambridge and RSA Examinations is a Company Limited by Guarantee. Registered in England. Registered office 1 Hills Road, Cambridge CB1 2EU. Registered company number 3484466. OCR is an exempt charity.

Cambridge Assessment

LLOYD'S REGISTER · LRQA
ISO 9001
UKAS MANAGEMENT SYSTEMS
001