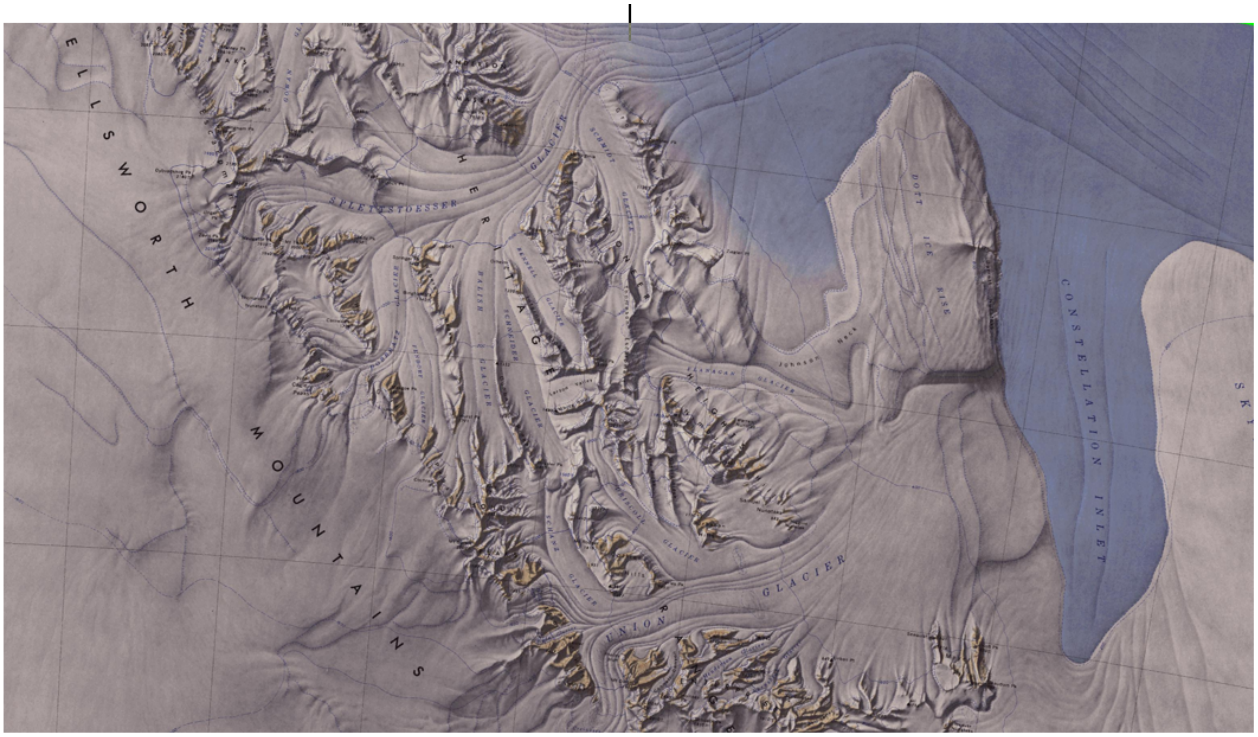
Investigating the distribution and characteristics of cryoconite holes in Antarctica



Source: USGS

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Executive Summary

To celebrate the 50th anniversary of the Commonwealth Trans Antarctic Expedition in 1956/8, the Fuchs Foundation supported four teachers on a scientific research expedition to Antarctica during November/December 2007. Each teacher conducted their own research with the aim of inspiring students and future geography and science teachers. The team spent 40 days in Antarctica, based initially at Patriot Hills for an acclimatization phase before flying by Twin Otter to the Henderson Glacier in the Ellsworth Mountains. Scientific research was trialed at Patriot Hills and then repeated on the Henderson Glacier and in Connell Canyon. Ruth Hollinger, one of the Fuchs Foundation team, working with Andy Hodson at Sheffield University Department of Geography investigated the distribution and characteristics of cryoconite holes. Cryoconite holes are formed by sediment on the surface of a glacier absorbing solar radiation, warming, and melting into the ice. Due to unusually high amounts of snow fall, the holes were difficult to locate. However, some samples were collected at Patriot Hills, the Heritage Range, the Henderson Glacier and Connell Canyon and brought back to the UK. At present, the samples are being analyzed at Sheffield University Department of Geography.

Introduction

Cryoconite holes are formed by sediment on the surface of a glacier absorbing solar radiation, warming, and melting into the ice (figure 1).

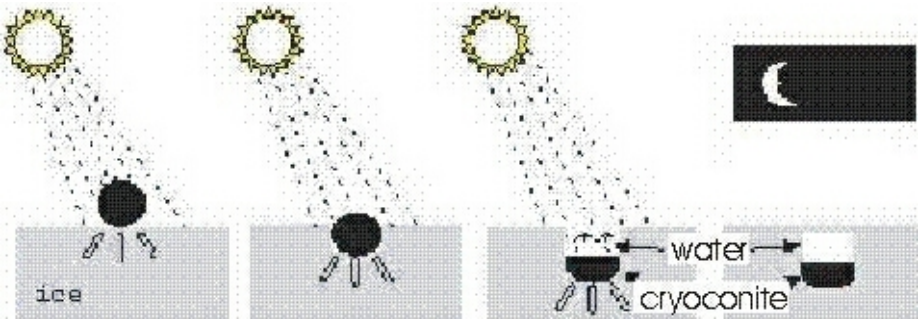
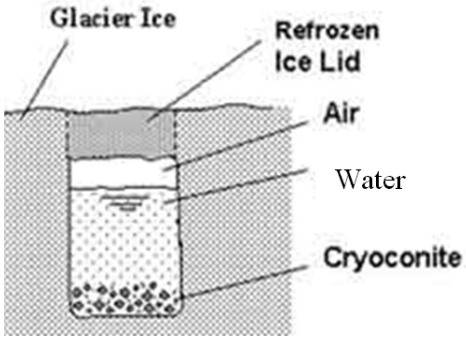


Figure 1: Formation of cryoconite holes

Cryoconite holes are common to many glaciers worldwide, but in Antarctica, ice lids often form (figure 2), trapping sediment and isolating the water, producing unusual water chemistries that are quite different from the surrounding ice.



Figu *e hole*

Photo: Ola Brandt

It was the intention to photographically map the distribution of the cryoconite holes and investigate their characteristics by collecting samples for analysis in the UK.

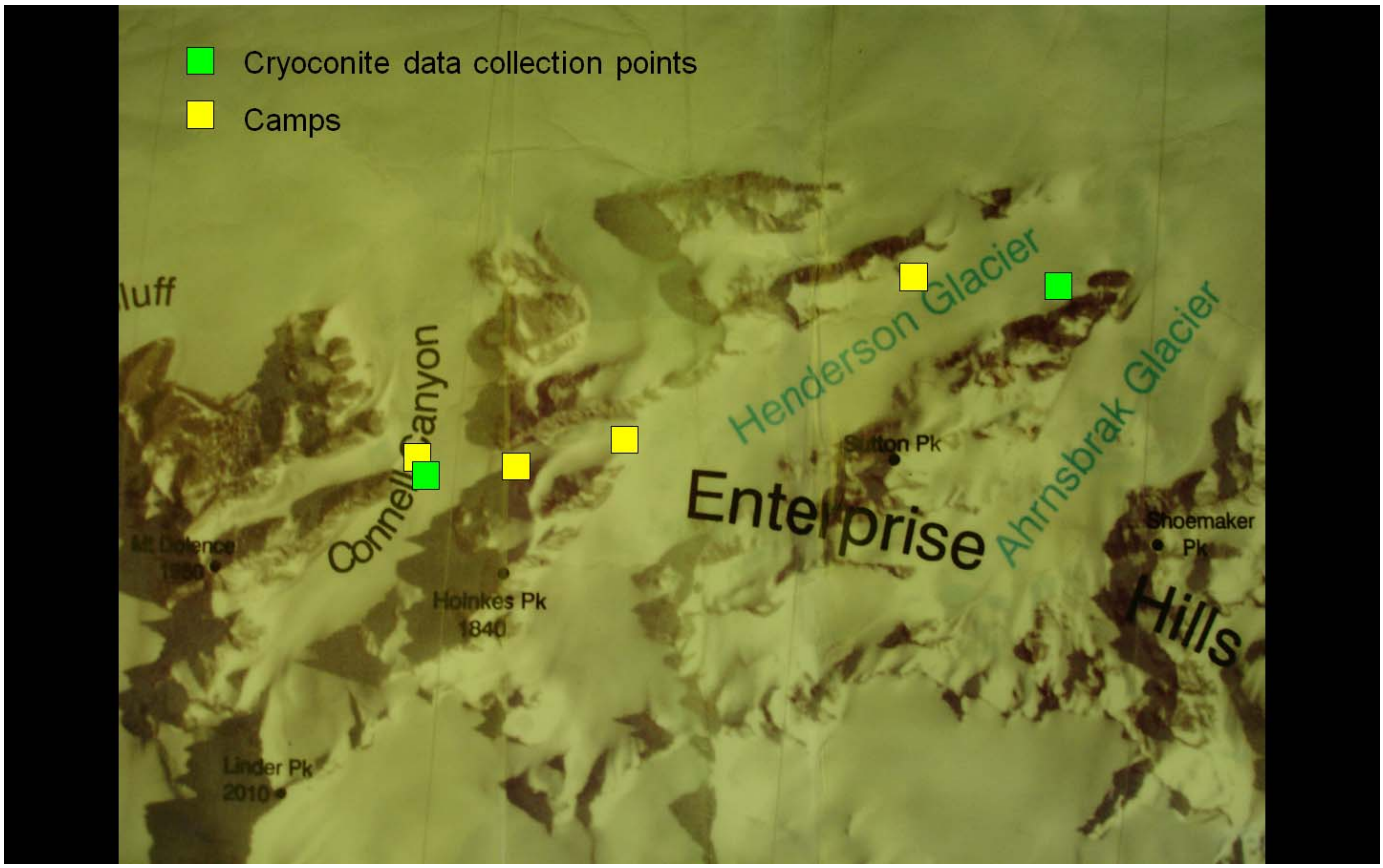
Methodology

Upon arrival at Patriot Hills, an exploratory walk was undertaken to determine the location of cryoconite holes and trial the methodology. This would allow it to be refined before the main phase of the expedition in the Henderson Glacier and Connell Canyon areas. (The methodology had already been trialed on the Jostedalsbreen Glacier in Norway in August 2007). Due to unusually high amounts of snowfall it was difficult to locate many samples. In some instances a small brush was used to sweep the area free of snow to see if holes lay beneath. When a sample was located, its position was noted using a 'Garmin eTrex H' hand held GPS. The inclination of the glacier was measured using a clinometer and the altitude

was noted from the GPS. The sample was photographed by placing a 0.5m x 0.5m quadrat over the hole. The sample was removed using a sterile ice ace and placed in a sample bag or sample bottle. If a bag was used the sample was triple bagged to prevent damage and leakage. The sample was clearly labeled using a permanent marker. The quadrat was placed over the hole again and another image was taken. Samples were stored in the dark and cool as much as was practically possible and returned to the UK for analysis at Sheffield University Department of Geography.

Data collection

					GPS	
Date	Location	Name of sample	Altitude (m)	Slope angle	S	W
12/11/2007	Patriot Hills	Cryo1	749	5	80 19 187	81 28 535
12/11/2007	Patriot Hills	Cryo2	749	5	80 19 183	81 28 465
12/11/2007	Patriot Hills	Cryo3	749	4	80 18 359	81 23 186
14/11/2007	Heritage Range	H1	839	4	80 20 450	81 41 654
14/11/2007	Heritage Range	H2	839	3	80 20 450	81 41 654
14/11/2007	Heritage Range	H3	839	5	80 20 450	81 41 654
14/11/2007	Heritage Range	H4	839	4	80 20 450	81 41 654
18/11/2007	Henderson Glacier	HE1	695	0	79 47 559	82 26 406
18/11/2007	Henderson Glacier	HE2	709	0	79 47 599	82 26 599
29/11/2007	Connell Canyon	CO1	838	10	79 48 344	83 05 143
29/11/2007	Connell Canyon	CO2	855	10	79 49 231	83 01 494
29/11/2007	Connell Canyon	CO3	908	10	79 49 436	83 03 086
29/11/2007	Connell Canyon	CO4	908	10	79 49 436	83 03 086
29/11/2007	Connell Canyon	CO5	908	10	79 49 436	83 03 086
29/11/2007	Connell Canyon	CO6	908	10	79 49 436	83 03 086



Scale not known

Results and Analysis

The samples are currently being analyzed at Sheffield University Department of Geography and results of analysis will be available shortly.

Conclusions

To find cryoconite holes you require areas of blue ice. Due to an unusually high amount of snowfall many blue ice areas were covered. This made data collection exceptionally difficult. Furthermore, in certain areas there was lots of large rock debris on the surface of the glacier and within the glacier. From the surface the sample looked like cryoconite but when the samples were removed using the ice axe they were simply large rocks. It was much more difficult to remove the samples than anticipated as all the ice was completely frozen. Fragments of samples were 'pinged' away unless extreme care was taken.

Acknowledgements

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