Building on Decades of Research on the McMurdo Volcanic Group, Antarctica: A Geologic Field Guide to Observation Hill

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1. Introduction

A geologic field guide to the Observation Hill walking tracks near McMurdo Station, Antarctica has been developed. The geologic field guide is an outcome of questions generated by: (1) Teachers participating in the Andrill Research Immersion for Science Educators (ARISE) program; (2) McMurdo Station support staff, as well as (3) Questions asked by geoscientists with specialties outside volcanology and petrology. Whilst all three groups are aware of the more than a century of references to Observation Hill in exploration literature, there is little in the way of easily-accessible information about the geologic history of Hut Point and Observation Hill, or of other nearby volcanoes (e.g. Mt. Erebus, White and Black Islands), or the larger-scale geologic features (e.g. Transantarctic Mountains) that can be seen from the vantage point of McMurdo Station and Observation Hill. The Guide was developed to bridge this gap.



ANDRILL ARISE SMS participants: Joanna Hubbard, Rainer Lehmann, Bob Williams, Ken Mankoff, Graziano Scotto di Clemente (back, L to R); Kate Pound, Julia Dooley, Robin Frisch-Gleason, Louise Huffman (front)

2. Development of the Field Guide

Information in the trail guide is derived from research publications by Kyle (1990) and Wright & Kyle (1990) in LeMasurier & Thomson (1990), as well as mapping and research reported by Cole et al (1971) and Kyle & Cole (1974). The data in these publications were integrated with field observations by Pound and Panter (Oct-Dec 2007), and comments by McIntosh (pers. comm.), as well as suggestions by the ANDRILL SMS team members.

Feedback on the first edition of the guide from the teachers and non-scientists indicated that it was 'far too wordy and technical.' Whilst a copy of that early version has been preserved, a shorter, less wordy version has now been developed for non-scientists. The 'wordy & too-technical' version is currently being adapted to make a Google Earth layer that will also include some introductory teaching materials on volcanology and igneous rock geochemistry.

3. Summary of Selected Components of the Field Guide

Geologic Setting



View of Observation Hill from Crary Lab, showing Route to Summit and Prominent bench.

Observation Hill is one of many small volcanic centers that are part of the McMurdo Volcanic Group, which includes currently active volcanoes such as Mount Erebus, as well 20 million-year old volcanic structures such as Mount Morning. These volcanic rocks formed from molten rock that reached the earth's surface through fractures in the crust.

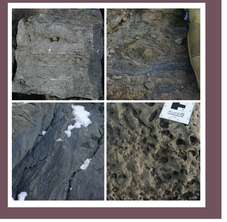
What are the different rock types?

There are two main rock types at Observation Hill - BASALT and PHONOLITE. See if you can identify them.



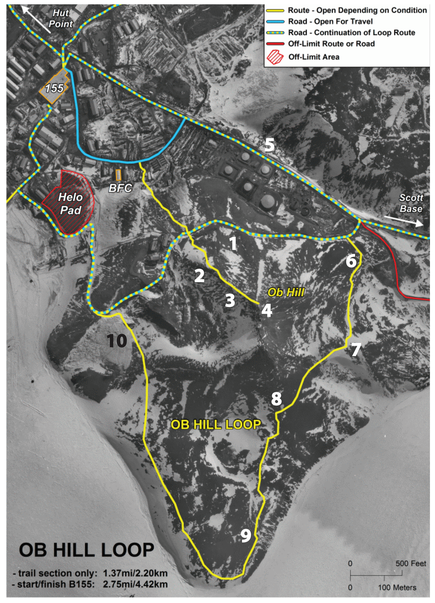
The basalts are dark red, grey,and brown. The variation reflect varying amounts of chemical alteration. There are essentially four types of basalt: 1. Dark reddish brown basalt with abundant air bubbles (vesicles); 2. Orange-brown (altered) basalt with vesicles; 3. Dark grey to black basalt with crystals of olivine (apple green) and pyroxene (blackish green) and fewer vesicles; 4. Dark grey to black basalt with vesicles. Both (1) and (2) are termed 'Scoria.' Basalt is present at Stops 6, 7, 8 & 9.

The phonolites are pale grey to tan. The variations reflect the presence or absence of banding (layering), and amount of weathering. Unaltered phonolites are light to medium grey color with tiny (1-3mm) individual crystals of the mineral feldspar (rectangular, pale whitish color); they may also contain a darker mineral (amphibole). The layering or banding formed as the phonolite flowed and divided into layers with crystals, and glassy layers without crystals. Best seen at Stops 1, 2, 3, 4 & 7.



Two Trails

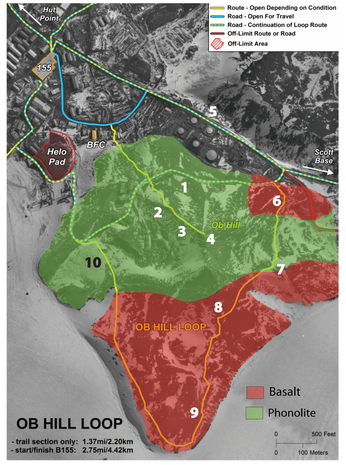
1. The trail to Observation Hill summit (Stops 1-4). It passes through a variety of phonolites, and affords excellent views.
2. The Loop trail (Stops 6-10), which allows examination of both the basalts and the phonolites, as well as scree slopes, and a variety of erosional features.



What are those 'Scoop Shapes' on White Island?

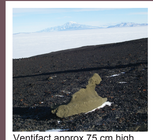
White Island to the SW is made up of basaltic rocks ranging from 0.17 to 5 million years old. The semi-circular depressions filled with snow and ice are probably former cirque basins. They extend below current sea level, implying that they formed during periods of lower sea level associated with the last glacial maximum (14,000 to 24,000 years ago).





What are the Strangely-Shaped Rocks?

At Stop 9 notice the larger rocks that have been sculpted by windblown sand; they are called ventifacts, and are common in the Dry Valleys. Some geologists have interpreted the relatively level natural bench here to record erosion during a period of higher sea level. Note the patterned ground (hexagonal patterns) - this is characteristic of permafrost regions.



Ventifact approx 75 cm high

What is the Prominent Rock Bench?

The distinct bench (visible from town) is at the head of a SW-facing gully (Stop 10). The bench is the site of the 1.8 MW nuclear power station erected by the US Navy in 1962. The reactor was shipped back to the US during 1973/4 and 1975/6. The site was decontaminated and released by the DOE in May 1989. Note the significant grooming associated with the decontamination process. Note also the ice sitting in the lower part of the gully; it is the remnant of a once-larger body of ice



Ice filling SW-facing gully. Ice 'cliff' is about 15-20 m.

How Did Observation Hill Form?

It formed in several stages. Basaltic lavas built scoria cones and formed lava flows, then phonolites intruded; the phonlites have an age of 1.18 million years.



Much of the basalt at Stop 6 is made up of 'volcanic bombs' that contain blocks of rock carried up from deep in the earth's crust. At Stop 7 look for fragments of basalt in the phonolite - what does this tell you about relative age?

What About the Rocks that form the Royal Society Range?

As you look to the west across the sea ice, you see the Royal Society Range of the Transantarctic Mountains. Beyond, lies the East Antarctic Ice Sheet.

The rocks range in age from 570 million years old (and older) to 180 million years old. The dark horizontal layer between Mt. Huggins & Mt. Lister is the Ferrar Dolerite, which intruded the Beacon Sandstone.

Uplift of the rocks now forming the Range began about 50 million years ago, at about the same time that the basin marked by the Ross Sea started to form.

The valleys facing us were carved by outlet glaciers that spilled across the Range from the Ice Sheet. Geologists have differing interpretations for when the Dry Valleys were carved, ranging from 13 to 3 million years ago.



4. Get a Paper Copy of the Trail Guide

Take a copy of the 'wordy & technical' version or the 'simple' version from the pile - or download them from the ANDRILL website: http://www.andrill.org/education

5. Get an MP3 Version of the Trail Guide

So you don't have to carry a piece of paper or have it blown away! Download the MP3 file to your computer or ipod/MP3 player. Available soon at: http://www.andrill.org/education

6. Development of a Google Earth Layer

The 'wordy & technical' version of the Trail Guide is in the process of being adapted for a Google Earth Layer that can be used for Introductory Teaching.

7. References

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Please provide us with suggestions & corrections Thank you.