PRELIMINARY REPORT

on the

GEOLOGY

of the

MARGUERITE BAY AREA, ANTARCTICA

Technical Report No. 6

by the

RONNE ANTARCTIC RESEARCH EXPEDITION

under

Contract Number N6onr280

with the

Geophysics Branch

QC
851
.R66
no. 6

LIBRARY
MAY 23 1949
WEATHER BUREAU

OFFICE OF NAVAL RESEARCH

DEPARTMENT OF THE NAVY • WASHINGTON, D. C.

NAVEXOS P-573

B-5546

National Oceanic and Atmospheric Administration

ERRATA NOTICE

One or more conditions of the original document may affect the quality of the image, such as:

Discolored pages
Faded or light ink
Binding intrudes into the text

This has been a co-operative project between the NOAA Central Library and the Climate Database Modernization Program, National Climate Data Center (NCDC). To view the original document, please contact the NOAA Central Library in Silver Spring, MD at (301) 713-2607 x124 or www.reference@nodc.noaa.gov.

LASON
Imaging Contractor
12200 Kiln Court
Beltsville, MD 20704-1387
March 21, 2005

FOREWORD

Submitted here is Technical Report No. 6 of the Ronne Antarctic Research Expedition. This report is a preliminary evaluation of the geology research conducted by Dr. Robert L. Nichols, Tufts College, who was a member of the Expedition. Final analyses of the findings and of the specimens brought back are yet to come. The report merely intends to give the reader an idea of the scope of the studies made and the areas covered. Some of the preliminary results may be modified when they are further surveyed.

for W. H. Leahy
Captain, USN
Assistant Chief for Research

B-5546

PREFACE

The geological research program was carried out by Dr. Robert L. Nichols, head of Geology Department at Tufts College. Dr. Nichols and Robert Dodson were in the field a total of 154 days, about 60 of these were spent on rock outcrops in the Marguerite Bay area.

Detailed studies were conducted on the rock formations and the glaciers on the Palmer Peninsula and Alexander Island. A thorough description of Dr. Nichols' findings will be published in scientific journals as soon as rock samples have been sliced and investigated and lengthy reports prepared. The report attached hereto is a preliminary account which was handed to me upon arrival in the United States in April 1948.

Finn Ronne
Commander USNR
Expedition Leader

CONTENTS

	Page
Introduction	1
Bed Rock	1
Surficial Deposits	3
Geomorphology	3
Economic Geology	5
Geologic History	5

PRELIMINARY REPORT OF GEOLOGY OF THE MARGUERITE BAY AREA, ANTARCTICA

INTRODUCTION

During the period from March 1947, to March 1948, members of the Ronne Antarctic Research Expedition had the opportunity of carrying out geological studies in the Marguerite Bay area, Palmer Peninsula, Antarctica.

Approximately 54 days were spent on the outcrop at the following widely scattered localities: Alexander Island, Mushroom Island, Terra Firma Islands, Cape Berteaux, Windy Valley, Black Thumb Mountain, Islands between Red Rock Ridge and Black Thumb Mountain, Red Rock Ridge, Neny Fjord, Neny Island, Stonington Island, Roman IV Mountain, Islands ten miles southwest of Adelside Island, and Islands 50 miles west of Stonington Island.

This report was written before any laboratory work was completed and consequently many of the ideas, correlations, and interpretations may later be modified.

Commander Finne Ronne made available all trail equipment for the geological program. Mr. Robert H. T. Dodson acted as geological assistant and furthered the work in ways too numerous to mention.

BED ROCK

The Neny Island schist is the oldest formation in the area. It is hornblendic and was originally a fine-grained rock. It is found at Neny Island, Roman IV Mt., Black Thumb Mt., and Stonington Island. It has been invaded by the Roman IV Mt. gneiss and at Roman IV Mt. it is found as elongated dike-shaped inclusions in the gneiss. At Stonington Island inclusions of it are found in the Stonington diorite. At the northern end of the Palmer Peninsula, there is a greywacke which is probably Ordovician. Schist erratics are also found in this area and it seems likely that the schist is Pre-Cambrian.[1] Tentative correlations of the Neny Island schist with the schist of these erratics are being made.

The Roman IV Mt. gneiss is pink and granitic and on Neny Island, and elsewhere, it has lit-par-lit invaded the Neny Island Schist. It is cut by a contorted aplite which is probably closely related to it as well as by other much younger intrusives. It is best seen on the north side of Roman IV Mt. next to the glacier and on the southeast end of Neny Island. Its age is not accurately known, but it is probably Pre-Late Mesozoic.

A black argillite is found on two islands which are approximately 8 - 13 miles south of Adelaide Island. It abundantly contains what appears to be flattened carbonized plant remains. It is in places well stratified. Minor amounts of black conglomerate and sandstone are interbedded in it, and it has been somewhat deformed. Trap and felsite dikes invade it and a coarse grained acidic igneous rock has stopped its way into it. This argillite probably correlates with that at Cape Keeler and at the northern end of the Palmer Peninsula, and it may be Juro-Cretaceous.

The Black Thumb pyrobolite is found at Black Thumb Mt., Neny Island, and on the south side of Neny Fjord 1-1/2 miles west of the Neny glacier barrier. It intrudes and also contains inclusions of the Neny Island schist. It has not been metamorphosed. The individual pyrobole grains may be as much as 1/2 in. across, and in places it grades impreceptably into a gabbro. At Black Thumb Mt. it is cut by a white granite and a pegmatite which is probably related to the granite.

The Neny Glacier Island gabbro is best seen on an island in Neny Fjord which is attached to the Neny Glacier. It is also found at the western end of Red Rock Ridge, Black Thumb Mt., Roman IV Mt., on islands 50 miles west of Stonington Island, and elsewhere. It varies in texture and mineral composition; it contains inclusions of the Black Thumb pyrobolite; it is found as inclusions in the Stonington deorite; and it is cut by several different kinds of plutonic rocks. Malachite stains are commonly associated with the pyrobolites and gabbros.

---

[1]Personal communication from Mr. Raymond Adie, Falkland Islands Dependency Survey.

The Stonington Island diorite is found at Neny Island, Moraine Bay, Roman IV Mt., and on the south side of Neny Fjord 1-1/2 miles west of the Neny glacier barrier, as well as on Stonington Island. It varies in texture and mineral composition; contains angular inclusions, elongated rounded inclusions, and schlieren so oriented and arranged that the rock can be called a gneiss; in places it is banded; and on Stonington Island, it is cut by many dikes of varying composition. The commonest and most conspicuous type of dike on Stonington Island is grey-black, contains grains of 1/16 in. diameter, contains inclusions of diorite and gabbro, and is cut by acidic igneous rocks. These dikes may be the fine-grained equivalent of the diorite.

The Penguin Rookery granodiorite is found at the penguin rookery at the west end of Red Rock Ridge. Two textural varieties are readily recognizable in the field. The finer-grained variety intrudes the coarse, and is therefore the younger. This granodiorite cuts the Neny Glacier Island gabbro with which it is in contact and it seems likely that it also cuts the Stonington diorite. Felsite, trap, and aplite dikes intrude it.

The type locality for the Chasm Island granite is a small island which is approximately 1-1/2 miles from Black Thumb Mt. This granite is coarse-grained and pink, and is composed of pink and buff feldspar, quartz, and mica. It is cut by trap, trap porphyry, felsite porphyry, and banded felsite dikes, and by aplite, pegmatite, and granite dikes which are closely related to it. It contains few inclusions and on Neny Glacier Island several varieties can be recognized. It cuts the Neny Glacier Island gabbro, the Stonington diorite, and presumably the Penguin Rookery granodiorite.

The Terra Firma volcanics are widespread. They are found at Mushroom Island, Terra Firma Islands, Black Thumb Mt., Neny Fjord, and Knowles reports similar volcanics at the Batterbee Mts.[2] They are usually black, grey, or brown and they consist of agglomerates, breccias, tuffs, welded tuffs, flow rocks, and dikes. In places the agglomerates and breccias contain only cognate ejectamenta; elsewhere they may be composed of a very high percentage of granitic fragments. At Black Thumb Mt. the percentage of accidental ejectamenta is in places so high that some of the pyroclastics approach reconstructed granites. These granitic fragments may be as much as four feet long and they are angular, sub angular, sub round, and round. The flow rocks are commonly banded and they may or may not be porphyritic. At Mushroom Island the volcanics have been pyritized and the rocks are in places heavily stained with limonite due to the oxidation of the pyrite. The volcanics at the Terra Firma Islands are cut be veins containing epidote, garnet, and calcite. These veins are not found in the adjacent rocks and it seems likely that the mineralizing solutions are genetically related to the volcanics.

There are two peaks over 3,000 ft. high on the south side of Neny Fjord east of the conspicuous low col which are composed of Terra Firma volcanics. The rocks in these peaks appear to dip less than 30° and it seems likely that here the volcanic series is more than 2,000 ft. thick. The volcanics are cut by trap, trap porphyry, red granite, granodiorite, and porphyritic, red, and banded felsite dikes. That the volcanics in the various areas are all of the same age is indicated by: (1) the similarity of lithology, (2) the short distance between areas, (3) the fact that they are all cut by trap and trap porphyry dikes. The volcanics are younger than the Chasm Island granite as large fragments of this granite are found in them and they are older than the Lateral Moraine pluton which cuts them.

The Lateral Moraine pluton is composed of a coarse-grained rock of intermediate composition. It is found on the south side of Neny Fjord east of the low col. In places it is more or less devoid of inclusions, elsewhere it is filled with xenoliths of Chasm Island granite, the pyroclastic facies of the Terra Firma volcanics, and other rocks. It intrudes the Terra Firma volcanics and is in turn intruded by the Red Rock Ridge granite.

The Red Rock Ridge granite is found at Black Thumb Mt., Red Rock Ridge, on the north side of Neny Fjord near the terminus of the Neny Glacier, and elsewhere. It is pink, contains molybdenite, and is characterized by

[2] Paul Knowles, U. S. Antarctic Service 1939 - 1941.

vugs which contain terminated quartz crystals, chlorite, and limonite. It invades the Terra Firma volcanics, the Lateral Moraine pluton, and it is the youngest pluton in the area. It is cut by various kinds of trap and felsite dikes.

The area is invaded by a multitude of dikes. They vary from a fraction of an inch to more than 30 ft. in width. They have emplaced themselves by wedging, stopping, and to a minor degree, by replacement. Single, multiple, and composite dikes are common. Some have been epidotized, others are cut by epidote veins, and a few have been faulted. Aplite, pegmatite, granite, and felsite dikes are associated with the granites; felsite dikes are related to the volcanics; dikes of intermediate composition are related to the diorites; and trap, diabase, and trap porphyry dikes are very common and some of them may be equivalent in age to the Tertiary volcanics on the northern end of the Palmer Peninsula and in the Andes of South America.

There is some evidence suggesting that the Terra Firma volcanics may rest on an erosion surface. At the Terra Firma Islands the volcanics are adjacent to and younger than a coarse-grained gabbro. The contact which was not reached is either a sedimentary or fault contact. If sedimentary there is a profound erosion period between the gabbro and volcanics. Coarse pink granite fragments are found in the volcanics. It is tentatively suggested that the older rocks into which the pink granite was intruded as well as the marginal facies of the pink granite itself are not as abundant in the volcanics as is the pink granite. This also suggests the existence of an erosion period prior to the deposition of the volcanics.

If an erosion period separates the volcanics from older igneous rocks it appears that there are two magmatic series in the area. An older pre-volcanic series (?) which includes types ranging from pyrobolite to granite and a younger series (?) which includes the volcanics, the Lateral Moraine pluton, and the Red Rock Ridge granite.

The field evidence suggests that the argillite is cut by both magmatic series. If so they are probably Post Juro-Cretaceous in age.

SURFICIAL DEPOSITS

Elevated beaches have been found at more than a score of localities. The highest near the west end of Red Rock Ridge is approximately 105 ft. above sea level. Some of these raised beaches are being progressively buried by talus, alluvium, and snow drift ice slabs. Their elevated position is due to deglaciation.

Modern beaches have been found at places too numerous to mention.

Ground moraine, although not common, was found near Windy Valley, at Terra Firma Islands, and elsewhere. Lateral, ablation, and recessional moraines are not uncommon.

Talus cones several hundred feet high are present on the north side of Neny Island and large aprons and cones are also found on Roman IV Mt., Pyramid Mt., and elsewhere.

Running water is of no importance as a geomorphic process at the present time. However, a small alluvial fan was found on the north side of Neny Island and insignificant amounts of alluvium are being deposited from snow covers onto the beaches.

Frost action and other weathering processes have formed thin deposits of spalled grains and fragments. The thinness of these deposits and their limited extent is due to the recentcy of deglaciation.

GEOMORPHOLOGY

Elevated Erosion Surface

A plateau between 5000 - 6000 ft. above sea level is found to the east of Stonington Island. Domal snow-covered hills which rise several hundred feet above the general plateau level are common. In places the plateau surface is rolling; elsewhere it is more or less flat. It surely extends for

scores of miles along the peninsula perhaps for hundres of miles. Where badly dissected it is narrow; in other areas it is scores of miles wide. It is well developed both north and south of Neny Fjord and also southwest of Mt. Edgell.

Paul Knowles, U. S. Antarctic Service, found that east of Stonington Island the surface rocks of the plateau were plutonic igneous rocks. The writer's field work suggests that elsewhere they are either metamorphic or igneous rocks. The surface is therefore an erosion surface and it seems likely that it was formed close to sea level and subsequently uplifted. Nothing is known of the mechanism of uplift nor of the relation of the axis of uplift to the crest of the plateau.

As the surface is cut on Late Mesozoic or Early Tertiary rocks, it seems logical to suppose that it was cut and uplifted during the Tertiary and early enough in it so that considerable dissection could take place prior to the Pleistocene.

Drowned Coastline

The east and west coasts of the Palmer Peninsula are characterized by islands, promontories, irregular offshore profiles and coastlines, capes, bays, and drowned valleys. These coasts are excellent examples, as is the southwestern coast of South America, of drowned coastlines. Following the uplift of the Tertiary erosion surface another period of erosion took place which cut deep valleys in the margins of the plateau. This was in turn followed by a submergence of several hundred feet which was responsible for the major features of the coastline. The magnitude of it is probably too great to have resulted from the weight of glacial ice and it seems reasonable to assume that it took place in Pleistocene or Pre-Pleistocene time.

Glaciation

Cirques, U-valleys, hanging valleys, arretes, cols, truncated spurs, fjords, and other topographic features resulting from glaciation are common. However, these glacial features are of only secondary topographic importance as the major geomorphic elements have resulted from the dissection and subsequent submergence of an elevated erosion surface.

Hanging, cirque, valley, fringing, piedmont, highland, tributary, reconstructed, and outlet glaciers are common and snow drift ice slabs are found at many places. Lateral and ablation moraines are found on some of these glaciers. Under suitable conditions of exposure and topography as on the northwest side of Stonington Island the snowline may be found at sea level.

Deglaciation

There is abundant evidence that deglaciation has been going on in the immediate past. The Terra Firma Islands are approximately ten miles from the mainland. On the largest island of the group there is a flat at the 600 ft. level, which has an area of many acres. Here the country rock is a blackish felsitic pyroclastic breccia. This flat is veneered with till and covered with thousands of conspicuous red granite erratics. A few of the erratics have glacial striations and all are fresh and unweathered. The red granite of which the erratics are composed is found in place on the adjacent mainland. As the upper limit of glaciation was not found it is obvious that a short time ago geologically speaking the ice was more than 600 ft. thick ten miles off shore. When due allowance for the gradient of the glacier is made it seems certain that the ice was at that time a 1000 ft. thicker on the mainland than at present.

Red Rock Ridge is on the southern side of Neny Fjord. To the east of the small glacier near its western end there is a flat which is approximately 1500 ft. high. Here the country rock is Red Rock Ridge granite which is cut by trap and felsite dikes. Mantling this flat there are many pyrobolite, gabbro, diorite, and felsite breccia erratics which stand out in sharp contrast to the red granite basement. On the ridge to the east of the flat

erratics are found with increasing sparseness up to 1700 ft. The rocks of which these erratics are composed are all found in situ at the eastern end of the fjord and the terminus of the Neny glacier which transported and deposited these erratics is now more than 12 miles to the east of the flat. At the Red Rock Ridge stage of glaciation the Neny glacier was probably more than 2000 ft. thicker at the eastern end of the fjord than at present.

The bed rock of two islands which are between 10 - 15 miles southwest of Adelaide Island is beautifully striated. The uniform orientation of the striations indicates that mainland ice and not a local ice cap was responsible for them. They indicate that when formed the land ice extended more than 20 miles beyond its present position.

Raised lateral moraines and recently uncovered bed rock attest to a progressive deglaciation which has continued down to the present.

ECONOMIC GEOLOGY

Limonite gossans are common and widespread in the Marguerite Bay area. They have resulted from the oxidation of pyrite. They are of no economic value as the individual gassans have limited extent and are low grade.

Thin malachite stains are also widespread. They are usually found on basic rocks. They also have no economic importance as the primary minerals from which they were derived are not abundant.

A mineralized zone on Stonington Island was tested with a geiger counter for uranium. The results were negative.

Gold and silver values too low grade to have economic significance were reported by Paul Knowles, U. S. Antarctic Service, for samples collected on Stonington Island.

In conclusion it may be said that so far as is now known, nothing of economic value was found.

GEOLOGIC HISTORY

Pre-Cambrian	1.	The deposition, extrusion, or intrusion of a fine-grained rock.
	2.	Metamorphism. Formation of Neny Island schist.
?	3.	Intrusion of Roman IV Mt. gneiss.
Juro-Cretaceous	4.	Deposition of gravel, sand, and mud.
	5.	Folding, metamorphism, and formation of argillite.
Post Juro-Cretaceous	6.	Intrusion of Black Thumb Mt. pyrobolite.
	7.	Intrusion of Neny Glacier Island gabbro.
	8.	Intrusion of Stonington Island diorite.
	9.	Intrusion of Penguin Rookery granodiorite.
	10.	Intrusion of Chasm Island granite.
	11.	Period of erosion?
	12.	Formation of Terra Firma volcanic series.
	13.	Intrusion of Lateral Moraine pluton.
	14.	Intrusion of Red Rock Ridge granite.
Tertiary	15.	Intrusion of dikes.
Middle ? and Late Tertiary	16.	Formation of erosion surface.
	17.	Uplift, plateau.
	18.	Erosion.
	19.	Submergence, drowned topography.
Pleistocene	20.	Glaciation, cirques, fjords, etc.
Recent	21.	Deglaciation, uplift.
	22.	Moraine, raised beaches, talus, weathering, alluvium.