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A Note on the Rocks of King Edward VII Land Collected by the Japanese Antarctic Expedition, 1911–1912.

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白瀬隊によつて採集されたキングエドワード七世陸地の岩石に関する覚え書

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要　　約

1911 年～1912 年にわたつて，白瀬隊はロス氷床に上陸南下を試みたが，その間，開南丸は東方キングエドワード七世陸地に向つて調査を行い，岩石と皇帝ペンギンを採集してきた．これらの岩石についての記載はこれまで行われていず，またキングエドワード七世陸地がアンデス褶曲帯に属するものか，あるいは，東部南極大陸の先カンブリア紀楯状地に属するものか，はつきりされていない状態である．

幸い，当時の岩石標本の薄片が東京大学地質学教室に保存されてあり，とくに久野教授のおすすめと御好意により，その薄片を拝借して検鏡することができた．それによる記載と多少の考察をのべた．

スチュワート (1939) やフェアブリッヂ (1952) はキングエドワード七世陸地の岩石は東部南極大陸の先カンブリア紀楯状地に属するものと述べているが，岩石学的にみても，スチュワートの分類の規準に反するものが多く，必ずしも先カンブリア紀のものというきめてはない．むしろどちらかと云えば，アンデス褶曲帯に属するものと云えそうである．何しろ薄片が六枚で，標本自体が見当らないのであるから，はっきりした結論は出す方が無理である．

皇帝ペンギンの胃の中から発見された岩石片は，東方のエドセルフォード山脈のものとまつたく同じで，この山脈はアンデス褶曲帯に属するものである．これは，ペンギンがエドセルフォード山脈の附近から氷に乗つて流れてくる可能性が考えられるが，そうでないとしたら面白いことになる．今後の調査が期待されるゆえんである．

Introduction

About a half century ago, Japan sent an expedition to the Antarctic continent under Lieutenant SHIRASE who made a few geological observations and collected some rock specimens. The "NANKYOKUKI", the official account of the Japanese Antarctic Expedition in 1910–1912, gives not only the account of their voyage and journey, but also a description of the mode of occurrence of the rock specimens. According to the account, Mr. T. TAKEDA, the scientist of the expedition, although not a geologist, tried to make a brief survey of the geology and geography of the King Edward VII Land; his account was greatly indebted to the suggestion of

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Professor T. W. E. DAVID, Australia, and Professor S. TOKUNAGA, Waseda University, Tokyo. Besides, the rock fragments from a few emperor penguin's stomachs of King Edward VII Land were also described by Assist. Professor Y. WADA, First High School, Tokyo.

A part of these specimens were sent to Professor DAVID, and the rest have been preserved in Waseda University, although they are not available now. Fortunately, thin sections of these rocks are found among the collections of the Geological Institute of the University of Tokyo. The petrographical characters of these rock specimens have not yet been described in detail except by Professor DAVID (DAVID and PRIESTLY, 1914). Therefore, in this paper, the writer intends to give a description of the rocks on the basis of these thin sections.

The writer is greatly obliged to Professor J. SUZUKI for the permission to carry out this work and for his careful review of the manuscript. He is also grateful to Professor H. KUNO of the University of Tokyo for lending him the thin sections, for suggesting the problem and for giving constant encouragement. He is also indebted to Mr. T. KANAYAMA for assisting him in this work.

The Voyage to King Edward VII Land

According to "NANKYOKUKI", while the sledge party under Lieut. SHIRASE was

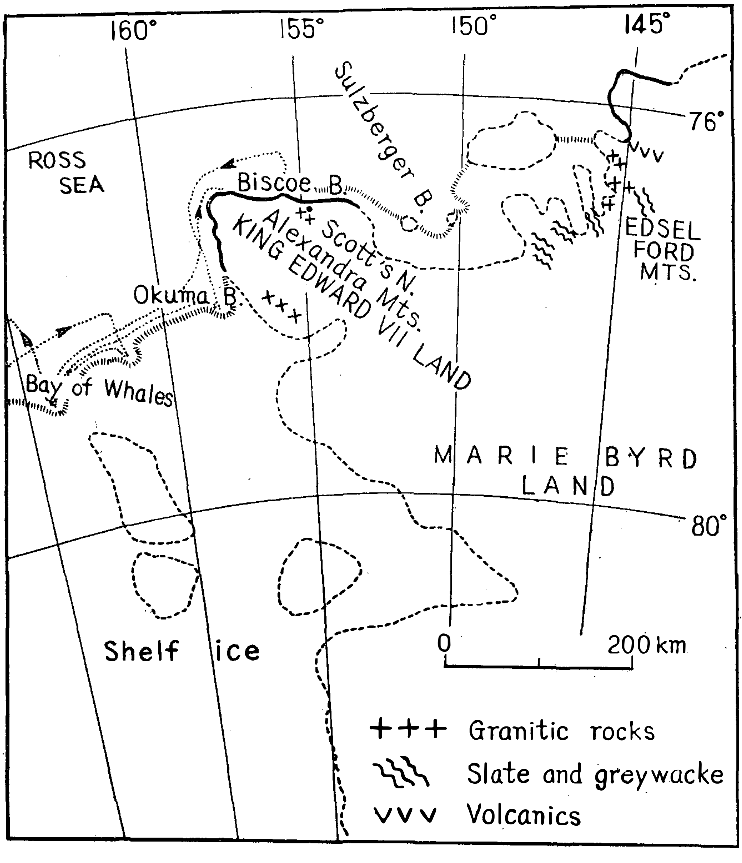


Fig. 1. Sketch map of King Edward VII Land and Edsel Ford Mts., based on the map of Antarctica prepared by the American Geographical Society (1956) and by R. W. Fairbridge (1952).

travelling to the south from the base camp of Bay of Whales, the *Kainan-maru*, the ship of the expedition, sailed for King Edward VII Land on January 19th, 1912, and she anchored at 76°56′ S, 155°55′ W in Biscoe Bay. On January 23rd, the landing party tried to ascend the highest point of Alexandra Mts. (perhaps Scott's Nunatacks) and intended to survey the rocky outcrops. Though their attempts were hindered by a great crevasse, the rock exposed on the other side seemed to be a grey granite. The party constructed a wooden monument in memory of reaching there, and turned back to the ship. The bottom of Biscoe Bay at the point of anchoring was found to be composed of grey clay by dredging, and the depth was 140 fathoms by sounding.

Returning to Bay of Whales on 29th, they found a small bay at 77°50′ S, 158°40′ W which was named "Okuma Bay". It is 5.6 km from east to west and 3.2 km from north to south. The bottom was made up of solid rock at 30 fathoms. They also found more than ten rock fragments on an ice-berg, and further, on the next day, obtained a large block of about 120 kg. from the same ice-berg. These rocks were angular and mixed with clay and sand. Accordingly, it was supposed that these rocks were derived from King Edward VII Land, but it was not so certain as written by DAVID and PRIESTLY (1914, pp. 4) "····the specimens of biotite-- hornblende granite found there *in situ* in 1912 by Lieut. SHIRASE of the Japanese Expedition". The thin sections of these rocks are described below.

Description of the Rocks

The rocks are divided into four groups: granodiorite, biotite-quartz diorite, microdiorite, and metasandstone. The mineral assemblage and their modal analysis are represented in Table 1.

Table 1. Mineral assemblage and modal analysis of the rocks.

No. of specimen	20	21	22	23	24	25
plagioclase	51.15	47.74	52.06	○	○	47.29
quartz	12.36	25.58	23.14	○	○	30.20
biotite	15.24	13.40	14.24	○	○	15.22
hornblende	1.15	3.29	8.55	○	○	5.26
kali-feldspar	14.66	9.99	2.01			2.07
magnetite		○	○		○	○
sphene		○		○	○	○
zircon		○	○			○
apatite	○	○	○			○
sericite	○	○			○	
zoisite	○ } 5.43				○	○
chlorite	○	○	○	○		
tourmaline	○					○
myrmekite	○	○				

Granodiorite (Nos. 20 and 21)

The rock-forming minerals aggregate in granoblastic structure and sometimes include large phenocrystic plagioclase (max. 4 mm. in length). Plagioclase, the most abundant and widely distributed feldspar, is subhedral and commonly shows twinning as well as zonal structure. The anorthite content of common plagioclase ranges from 23 per cent in the margin to 30 per cent in the core and that of the large phenocrystic plagioclase from 23 per cent to 37 per cent. Saussuritized core is common in the large phenocrysts especially. Quartz is interstitial. It does not show undulatory extinction and includes liquid inclusions in the core. Biotite (1 mm. in diameter) has a strong pleochroism: X=pale greenish brown, Y=brown, Z =reddish brown and sometimes shows undulatory extinction in bent crystals. Hornblende shows also a strong pleochroism in various shades of green and sometimes is twinned on 100 (Table 2). Potash feldspar is not very abundant, but

Table 2. Optical properties of hornblendes.

No.	pleochroism	2V(−)	Z∧c
21	X: greenish yellow Y: green Z: deep green	70°—72° 71°	14°—20° 14°
22	X: pale green Y: green Z: brownish green	68°—80° 71°	13°—19° 14°
24	X: pale yellowish green Y: pale green Z: green	74°—84° 74°	11°—16° 12°
25	X: pale greenish brown Y: pale brownish green Z: brownish green	70°—68° 70°	12°—13° 12°

microcline-perthite including small quartz grains is common. Myrmekitic intergrowth between plagioclase and microcline is often developed. The thin section of No. 20 reveals some crushing effects, so the plagioclase and quartz are granulated parallel to a crack, and also biotites are chloritized.

Biotite-quartz diorite (Nos. 22 and 25)

Granoblastic structure containing phenocrystic plagioclase is also characteristic. Subidiomorphic plagioclase (max. 3.5 mm. in length, generally 0.7 mm.) is in lath-shape and shows twinning and zonal structure. The large phenocrysts are anhedral and sometimes composed of an aggregate of small ones including smaller hornblende, biotite and sericite crystals (Fig. 2). The anorthite content of the large zoned plagioclase ranges from 20 per cent at the margin to 37 per cent at the core, but in some plagioclase it ranges from 23 or 10 per cent to 45 per cent. Accordingly, it is considered that these large phenocrysts have been produced as a porphyroblasts in a late stage of crystallization. Interstitial quartz is fresh and not undulatory. Smaller plagioclase and hornblende crystals are included in the fresh larger quartz grains. Biotite (1.5 mm in diameter) has a strong pleochroism: X=yellow, Y =brown, Z=reddish brown. Magnetite and zircon are usually included in biotite and the latter shows a pleochroic halo more or less. In rare occasions, biotite crystals have suffered tourmalinization at margin. Brownish green hornblende (màx. 1 mm. in length) is xenomorphic and occasionally reveals bluish green tint. As above noted, large phenocrystic plagioclase, some quartz and potash feldspar have also many features which are suggestive of their formation through post-magmatic action or to granitization.

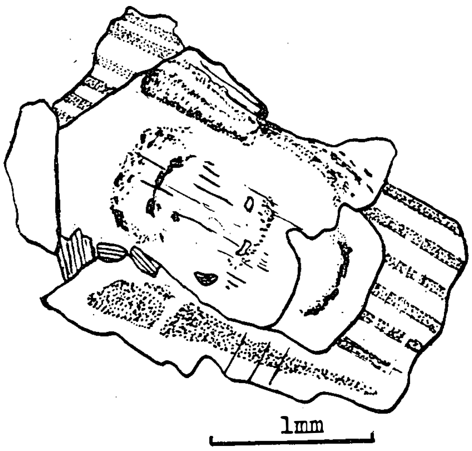


Fig. 2. Plagioclase phenocryst in biotite-quartz diorite.

Table 3. Anorthite contents of plagioclases.

No. of specimen	20	21	22	24	25
Large phenocryst	20—23	23—37	23—32 10—		20—37
Small phenocryst		24—30	23—45 10—45	23—38 50	20—27

Microdiorite (No. 24)

The rock is fine-grained and is composed mostly of plagioclase laths (0.2 mm in length). Phenocrystic plàgioclase is rather frequent; it is partially saussuritized and altered. The anorthite content varies from 23 per cent to 38 per cent and sometimes 50 per cent. Anhedral green hornblende and brown biotite occur in small amounts. Interstitial quartz is fresh and not undulatory.

Metasandstone (No. 23)

Metasandstone shows a feebly schistose character; it is composed of quartz (0.3 mm. in diameter and fresh), fine biotite and plagioclase (0.1 mm. in diameter), but it preserves original texture of sandstone.

Discussion and Conclusion

Lieut. PRESTRUD in AMUNDSEN's Expedition collected from Scott's Nunatacks a series of rocks which have been determined by SCHETELIG (1915) as granodiorite, hornfels, biotite-quartz diorite and quartz-diorite schist. SCHETELIG stated that these rocks were similar to those of Queen Maud Range in South Victoria Land. STEWART (1934, 1939) also indicated the same possibility from the petrographical point of view. STEWART (1939) concluded "Intrusives of the Queen Maud Mountains, South Victoria Land, and those of the Rockefeller Mountains, King Edward VII Land, high in the alkalies, but lacking in the zonally banding of the feldspar, should be placed on a third petrographic province."

In the Edsel Ford Mountains, PASSEL (1945) noted that dark, fine-grained sandstone alternating with shales would seem to be correlated with those of the Palaeozoic or Mesozoic flysch-greywacke-mudstones of other parts of West Antarctica.

On the other hand, STEWART (1941) mentioned two sandstones collected by WADE in the Edsel Ford Mountains which were quite similar to the Beacon Sandstone characteristic of East Antarctica.

According to FAIRBRIDGE (1952) "the King Edward VII Land suite is correlated best with the Pre-Cambrian of South Victoria Land, while Marie Byrd Land (Edsel Ford Mountains) presents an association of rocks best matched with the Palaeozoic Andean Geosynclinal rocks of Graham Land and the Scotia Arc."

However, it appears that STEWART's division is not necessary because the zoned plagioclase generally occurs in the rocks here described, and in granitic rocks the alkali components may possibly be high in the Andean Folding Zone of West Antarctica as well as in East Antarctica.

Therefore, the rocks in question are possibly correlated with the Andean Folding Zone, as indicated also by metasandstone which does not correspond with the Beacon Sandstone. The writer believes that more detailed tectonic and petrographical investigation is necessary before a conclusion can be reached.

Appendix

The rock fragments from emperor penguin's stomach

The landing party caught a few emperor penguins near Biscoe Bay in King Edward VII Land. The rock fragments from the penguin's stomach are as follows.

Tuff (greenish white, light and soft)
Volcanics (including magnetite or titanite)
Schalstein (dark greenish black, heavy and hard)
Quartzite
Sandstone (yellowish)
Greywacke sandstone (grey and hard)
Clay slate (black)
Greenschist
Granite gneiss

Assuming that these penguins had not migrated from Edsel Ford Mountains, these rocks should have derived from King Edward VII Land. As the rock assemblage is comparable to that of Edsel Ford Mountains, the geology of King Edward VII Land appears to be similar to that of the former.

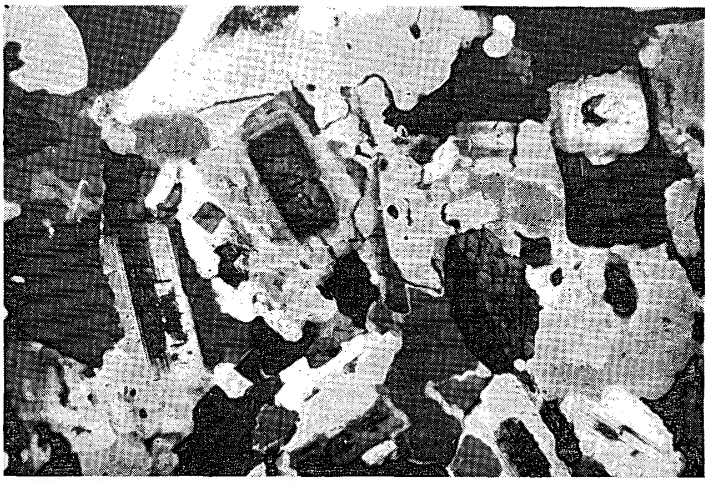
PL. I.

A

B

C

PL. II.



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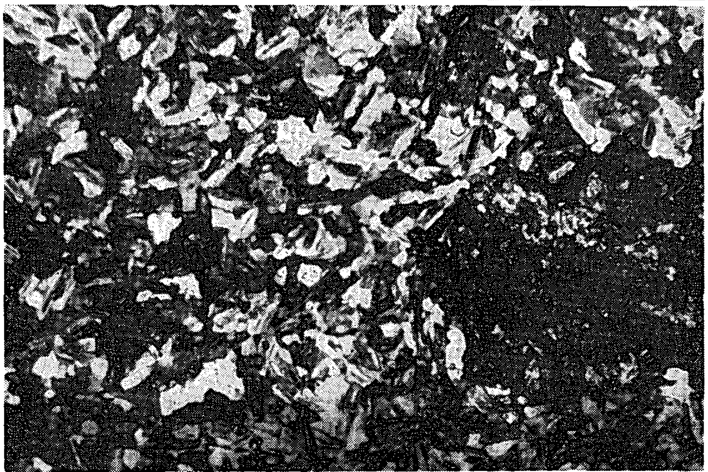

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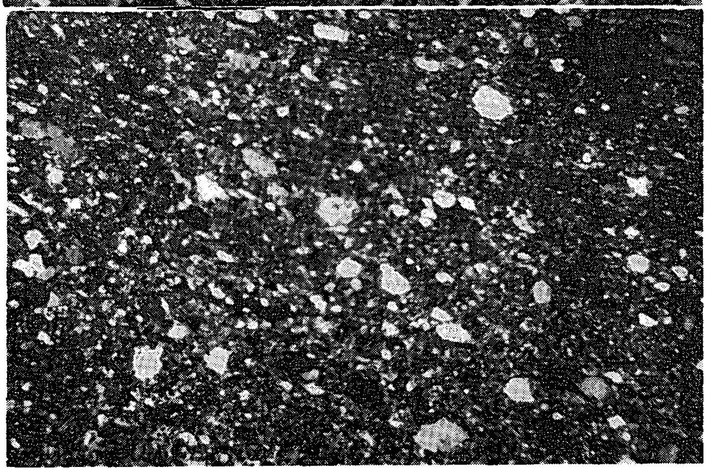

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References cited

1) Fairbridge, R. W. (1952): The geology of the Antarctic, in The Antarctic Today. New Zealand Antarctic Society, pp. 56–101.

2) Davies, W. E. (1956): Antarctic stratigraphy and structure, in Antarctica in the International Geophysical Years. Geophysical Monograph, No. 1, Am. Geoph. Union, No. 462, pp. 44–51.

3) David, T. W. E. and Priestly, R. F. (1914): Glaciology, physiography, stratigraphy and tectonic geology of South Victoria Land. Brit. Antarct. Exped., 1907–9. Geol., vol. **1**, pp. 319.

4) Passel, C. F. (1945): Sedimentary rocks of the southern Edsel Ford Ranges, Marie Byrd Land, Antarctica; Report on scientific results of the United States Antarctic Service Expedition, 1939–41. Proc. Amer. Philos. Soc., vol. **89**, pp. 123–131.

5) Prior, C. T. (1907): Report on the rock specimens collected during the Discovery Antarctic Expedition, 1901–4. Nat. Antarct. Exped., Nat. Hist., vol. (Geol.), pp. 101–140.

6) Schetelig, J. (1915): Report on rock specimens collected on Roald Amundsen's South Polar Expedition. Vidensk. Skrift., Christiana (1. Math. Naturs. Kl.), No. 4, pp. 1–32.

7) Stewart, D. Jr. (1934): A contribution to Antarctic petrography. J. Geol., vol. **42**, pp. 546–550.

8) Stewart, D. Jr. (1939): Petrography of some South Victoria Land rocks. Amer. Mineral., vol. **24**, pp. 155–161.

9) Stewart, D. Jr. (1941): Notes on some Marie Byrd Land rocks. Amer. Mineral., vol. **26**, pp. 42–49.

10) Stewart, D. Jr. (1956): On the petrology of Antarctica, in Antarctica in the International Geophysical Years. Geophysical Monograph. No. 1, Amer. Geoph. Union, No. 462, pp. 52–74.

11) Tatsumi, T., Kikuchi, T. and Kuno, H. (1957): Geology of the Antarctic Territory (in Japanese). Jour. Geogr., vol. **69** pp. 17–33.

12) Wade, F.A. (1937): Petrologic and structural relations of the Edsel Ford Range, Marie Byrd Land, to other Antarctic mountains. Bull. Geol. Soc. Amer., vol. **48**, pp. 1394.

13) The Nankyokuki (the official account of the Japanese Antartic Expedition, 1910–1912), edited by the Society for the Support of the Expedition. Tokyo, 1913 (in Japanese).

EXPLANATION OF PLATES I & II

All ×60

A. Granodiorite (Nos. 20 and 21)
B. Granodiorite
C. Biotite-quartz diorite (No. 22)
D. Biotite-quartz diorite (No. 25)
E. Microdiorite (No. 24)
F. Metasandstone (No. 23)