ON THE GRANITIC ROCKS IN HOKKAIDO

by

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(With 18 Figures and 3 Tables)

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Introduction

Granitic rocks including both those of intrusive and of metasomatic origin are extensively distributed in Japan. Exposures are especially well developed in the Inner Zone of Southwest Japan and the Outer Zone of Northeast Japan. However the areas of granitic intrusives are comparatively small in Hokkaido, though numerous outcrops of such rocks on a small scale are scattered in certain restricted parts.

From the results of general research, Hokkaido is considered to be composed of at least two geological provinces: namely the peninsular part of the southwestern district of the island and the remaining main parts of it. These two provinces are separated from each other by a tectonic line which may traverse mostly under the so-called Ishikari lowland. The two parts show remarkable difference in geology with a striking contrast between them. Of the two, the geology of the main province seems to be one peculiar to Hokkaido, while the southwestern province is nothing but a northerly extension of the Inner Zone of Northeast Japan.

In both provinces many granitic masses occur in the limited formations at various localities. Consequently the mutual geological relation between the granitic rock series in these two provinces can not be directly observed in the field, and it has not yet become clear whether the granitic rocks in the two provinces are to be closely related together or whether their intrusions occurred quite independently under different geological circumstances.

The acid intrusives which have been reported hitherto as granites in a broad sense in Hokkaido from field observation, do not always show the characters of a typical granite. It seems that they may comprehend,

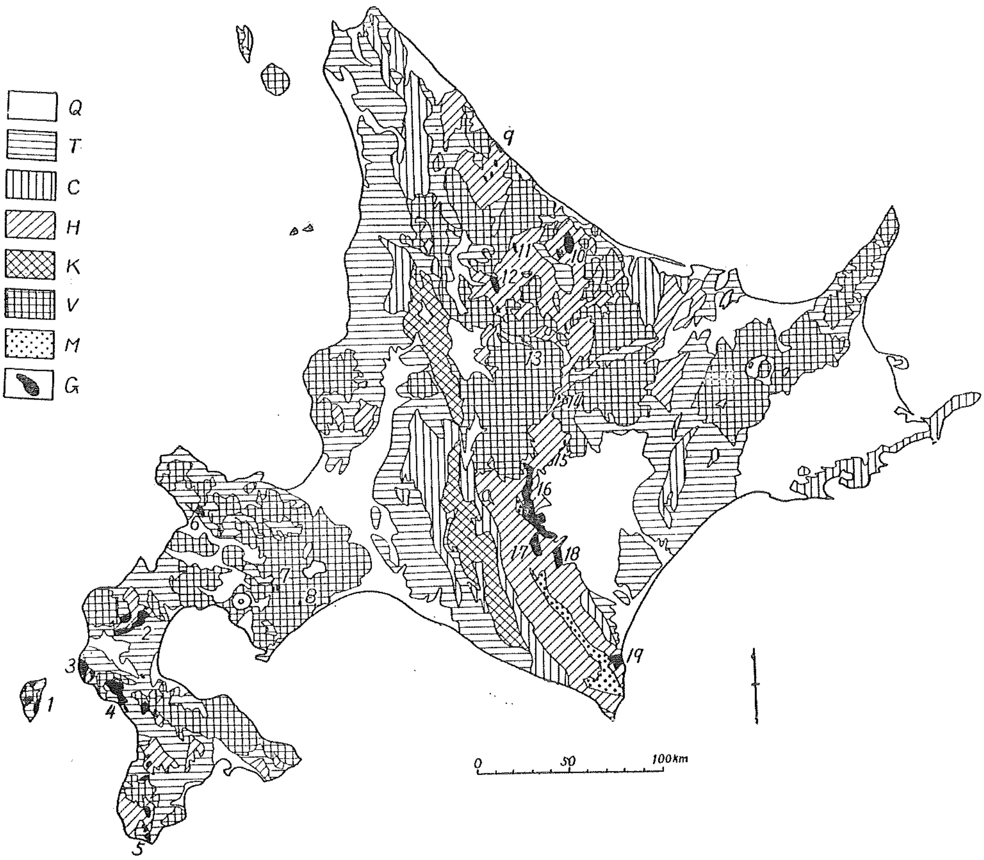

Fig. 1. Distribution map of granitic rocks of Hokkaido

Abbreviations

Q: Quarternary deposits. T: Tertiary formations. C: Cretaceous formations. K: Kamuikotan metamorphic complex, Jurassic formations and associated ultra-basic rocks. H: Hidaka formations and associated plutonics. V: Volcanic rocks. M: Migmatites. G: Granitic intrusives.

Localities

1) Okushiri Island 2) Imagane 3) Kudo 4) Kumaishi 5) Matsumae
6) Kayanuma 7) Sangaidaki 8) Kagenosawa 9) Otchube 10) Uttsu-dake
11) Ichinohashi 12) Okushibetsu 13) Shirakawa 14) Ishikari-dake
15) Tokachigawa 16) Karikachi 17) Pipairo 18) Tottabetsu 19) Oshirabetsu

not only various kinds of real plutonics, but also various intrusives with texture of granophyre, granite porphyry or even sometimes, quartz porphyry.

The areas of the distribution of the granitic intrusives in Hokkaido are shown in the accompanying map (Figure 1), when the occurrences of some acid intrusives with granitic appearance and intermediate intrusives are added for reference.

In this paper the writer intends to describe chiefly the characters of the main granitic masses in various localities in Hokkaido, with special reference to their modal compositions under the microscope, and to compare the mutual relation of the variation of their essential mineral components. A comparison of the nature of some migmatites in the Hidaka orogenic zone with that of granitic intrusives in the same zone is also presented in this paper.

Granitic intrusives in the southwestern part

In the peninsular part on the southwestern Hokkaido, many small granitic masses of various sizes crop out in scattered areas. According to the previous publications, they are roughly divided into two main types: one is the masses which intruded into the basement of the so-called Paleozoic and are covered by the Neogene Tertiary formations, and the other is the masses which intruded into the Miocene and are covered by the younger Tertiary formations.

The intrusives of former type often show that they have exerted thermal contact effect upon the adjacent so-called Paleozoic sediments, causing the formation of various kinds of hornfels, which often certain newly produced minerals such as biotite, cordierite, andalusite, etc. Granitic masses of this type are known in the districts of Okushiri Island(1)*, Imagane(2), Kudo(3), Kumaishi**(4) and Matsumae(5). (NAGAO and SASA, 1933-34; HUKUTOMI et al., 1935-36; SUZUKI, 1935; AKIBA, 1954)

The granitic masses belonging to the second type which intruded into the Neogene Tertiary formations are observed in the Kayanuma(6) and Kagenosawa(8) districts. The formation in the former district has been reported to be Pliocene (SAITO et al, 1952) though it is not so clear but that the exact age of intrusion is now a matter under consideration.

* means locality number in the distribution map (Fig. 1). The same applies to those that follow.

** According to the latest personal communication from M. Ishibashi and T. Sakakibara, it is said that there occure intruded bodies of granitic rocks in the Miocene formation at the northern part of Kumaishi mass.

Regarding the latter district, the granitic rock is believed to have intruded into the lower Miocene and is covered by the younger Miocene. (SUGIMOTO,

TABLE 1. Chemical compositions of granitic rocks in Hokkaido

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
SiO_2	65.68	57.22	65.87	66.82	74.85	54.49	67.61	72.00	74.44	75.68	71.42	68.75
TiO_2	—	—	.36	tr	.20	.63	.64	.41	.18	.06	.19	.59
Al_2O_3	13.31	17,30	15.13	15.17	13.58	16.04	14.67	13.93	12.93	12.94	12.62	14.48
Fe_2O_3	1.62	1.19	1.02	.83	.38	2.97	1.19	.41	.63	.56	2.02	1.09
FeO	5.91	7.24	5.82	5.45	.97	5.80	3.35	1.92	.90	.86	1.93	3.30
MnO	tr	—	—	.30	.06	.09	.07	.03	—	.07	—	.11
MgO	1.88	3.25	1.61	1.88	.42	5.09	1.24	.76	1.08	.62	.62	1.11
CaO	5.14	7.01	2.64	3.87	1.38	9.06	3.15	2.26	1.48	1.05	1.53	3.28
Na_2O	4.02	3.28	3.48	3.84	3.62	3.28	3.27	3.28	3.75	3.91	3.18	3.11
K_2O	1.33	2.18	3.66	1.06	4.45	1.21	3.06	3.56	4.74	4.16	4.74	2.92
P_2O_5	—	—	—	tr	.15	.42	.36	.31	—	tr	—	.34
H_2O (+)	—	1.30	—	.42	.15	.59	.90	1.00	.56	—	.64	.61
H_2O (—)	—		—	.28	.15	.19	.21	.21	.12	—	.44	.20
Ig. loss	.64	—	.56	—	—	—	—	—	—	.28	—	—
Total	99.53	99.97	100.15	99.92	100.29	99.86	99.72	100.08	100.81	100.19	99.33	99.89

1) Hornblende biotite granodiorite. Yaemon-zaki, Okushiri Islands, Shiribeshi Prov. Anal., B. Sonoki (J. Suzuki and B. Sonoki (1935)).
2) Diorite. Raruishi, Hutoro, Shiribeshi Prov. Anal., Dept. of Agriculture and Commerce (T. Ishikawa (1986)).
3) Hornblende biotite granodiorite. Mizutare, Hutoro, Shiribeshi Prov. Anal., S. Yamaguchi (J. Suzuki and T. Nemoto (1935)).
4) Granodiorite. Pirika, Setana, Shiribeshi Prov. Anal., Y. Sasaki (J. Suzuki and T. Nemoto (1935)).
5) Biotite granite. Otchube, Esashi, Kitami Prov. Anal., T. Nemoto (J. Suzuki and T. Nemoto (1935)).
6) Quartz bearing hornblende diorite. Otarupen, Esashi, Kitami Prov. Anal., T. Nemoto (T. Nemoto (1932)).
7) Muscovite bearing hornblende biotite granite. Ichinohashi, Kamikawa, Teshio Prov. Anal., T. Nemoto (J. Suzuki and T. Nemoto (1935)).
8) Biotite granite. Kamishibetsu, Kamikawa, Teshio Prov. Anal., T. Nemoto (J. Suzuki and T. Nemoto (1935)).
9) Granite. Ishiyama, Shimizu, Tokachi Prov., Anal., S. Hashimoto (S. Hashimoto (1954)).
10) Biotite granite. Shimizu, Kamikawa, Tokachi Prov. Anal., A. Kannari (J. Suzuki (1934)).
11) Granite. Tokachi-Poroshiri-dake, Tokachi Prov., Anal., S. Sako (M. Hunahashi, and S. Hashimoto (1951)).
12) Hornblende and muscovite bearing biotite granite. Oshirabetsu, Biroo, Tokachi Prov. Anal., T. Nemoto (J. Suzuki (1934)).

1954) It is remarkable that the marginal part of the intrusive masses in the Kayanuma district does not show typical plutonic texture. In its neighbouring area, there develop many intrusives of typical quartz porphyry, which show similar occurrence to that granitic mass. From these features it is rather better to consider that the Kayanuma masses may be more or less related to the deep facies of these quartz porphyries.

The character of the rocks of these masses of young type may resemble each other; they do not show any very conspicuous effect of contact with their surroundings, while they may sometimes be accompanied by an ore deposit on a small scale. (SAITO et al, 1952, SUGIMOTO, 1954)

Beside the above two examples, there is a small granitic mass in the Tertiary area at Sangaidaki(7) near the Kagenosawa district. (HUJIWARA, 1954) The rock is somewhat leucocratic and is characterized by association with granophyric facies containing a small amount of tourmaline as an accessory constituent. As the mass forms the basement of the region being overlain by the Neogene Tertiary, the age of its intrusion is uncertain. From the geological circumstances, however, it may be young of similar age as the above cited two.

The chemical composition of the granitic rocks from the southwestern province in Hokkaido are shown in Table 1 (1-4), quoted from previous papers, for reference.

Granitic rocks in the principal zone

In the zonal terrain along the N-S axial mountain range in central Hokkaido, there widely develop thick formations of Cretaceous and pre-Cretaceous rocks which belong to the so-called Hidaka formations. The total length of the zone measures nearly 320 km. from north to south.

The formations are composed of various kinds of sediments, metamorphics and migmatites locally associated with some acid to ultra-basic intrusives arranging sub-parallel to the general trend of the formations. The several granitic masses which occur at Karikachi pass (16) on the western side of Shimizu and Mikage towns, at Pipairo(17) and Tottabetsu(18), as well as near Oshirabetsu(19) in southern Tokachi province are examples of the intrusive types in the zone. Of these masses the comparatively widespread occurrence of acid intrusion in the Karikachi district is conspicuous. (YAMANE, 1911; OKAMURA, 1911; ODAIRA, 1926, 1928; SUZUKI, 1934b; HUNAHASHI and HASHIMOTO, 1951; HASHIMOTO, 1953, 1954)

From the geological evidence, several small masses of granitic rocks in the areas of the northern part of the central zone, are considered to have relation with those in the southern part. The chief localities of the granitic masses in the northern half of the zone are as follows: vicinity of Ishikari-dake (14), Shirakawa (13) in Ishikari Province, Uttsu-dake (10) in Kitami Province, Ichinohashi (11) and Okushibetsu (12) and Otchube (9) in Teshio Province. None of them is of any considerable area in comparison with those in the southern half of the zone. (OKAMURA, 1912, 1913; NEMOTO, 1932; SAKO, 1952)

The granitic masses in the central zone intruded always with the various kinds of sedimentaries and migmatites of the so-called Hidaka formation and exerted conspicuous contact effect on the surrounding rocks. It is not seldom that some granite masses especially in the northern part of the central zone, are locally covered by Cenozoic sediments and young volcanic materials.

It can now be said only that the intrusions of the granitic rocks are younger in age than the late Paleozoic or Jurassic and older than Miocene from the field evidences. However, in view of the structural consideration on the Hidaka mountain region, at least the plutonic masses in the eastern side of the Hidaka district are thought to have appeared in late Mesozoic age.

The known chemical analyses of the granitic rocks in the central zone of Hokkaido, which have already been reported in various papers will be refered to Table 1 (5-12).

Modal relations of the granitic rocks

As the modal analysis is very convenient and significant to use in petrological researches on plutonic rock, the writer has calculated the modal proportion of the essential constituents of the various rock facies in the main granitic masses in Hokkaido by means of point counter method under microscope. The results of those calculations are cited in Tables 2 and 3.

To compare the compositions of these various masses, triangular diagrams in which the spots are plotted to show respectively the ratio of quartz plus potash felspar, plagioclase and mafic minerals of every rock facies, are reproduced in Figure 2 (a-e).

It can be recognized in these diagrams that most of the spots fall in the so-called modal plutonic field proposed by the writer (SUZUKI, Y. 1955), constructed by plotting percentages of essential mineral constituents of plutonics, and the spots indicate a pretty characteristic variation of the rock facies among these masses and within the masses themselves.

TABLE 2. Average modal value of each granitic mass.

(A) Granitic intrusives

Locality	Number of analysed samples	Quartz	Potash felspar	Plagio-clase	Biotite	Horn-blende	Others
Okushiri	11	23.8	13.3	46.0	5.0	7.6	4.3
Kumaishi	5	27.7	6.6	45.5	13.1	3.8	3.3
Imagane	3	20	13	45	12	9	1
Sangaidaki	6	24.7	24.6	38.1	1.2	6.2	5.2
Otchube	8	29.2	20.2	42.0	8.5	0.0	0.1
Uttsu-dake	1	30.3	20.9	43.9	2.6	0.0	2.3
Shirakawa	1	26.4	16.0	45.2	8.6	3.1	0.7
Ishikari-dake	4	17.3	0.0	55.3	8.8	18.3	0.3
Karikachi	15	30.2	24.1	36.4	8.7	0.4	0.2
Oshirabetsu	36	23.7	8.0	52.9	13.6	1.2	0.6

(B) Migmatitic rocks in Hidaka district

Cordierite migmatite	39	35.9	1.4	40.1	21.3*	0.0	1.3**
Granitic migmatite	45	30.2	3.2	52.8	13.1	0.4	0.3

* Including muscovite (3.2%).
** Including cordierite (0.9%).

TABLE 3. Modal analyses of granitic rocks in Hokkaido.

(All data measured by the writer except the rock of Imagane district)

Okushiri Island

Sample No.	Quartz	Potash felspar	Plagio-clase	Biotite	Horn-blende	Others
7	3.6	1.3	66.8	0.0	13.7	14.6
10	15.1	0.0	48.4	11.7	23.3	1.5
11	25.8	20.9	41.7	7.7	3.1	0.8
14	18.3	24.6	44.3	0.0	9.5*1	3.3
15	24.6	11.8	41.3	10.3	11.7	0.3
17	24.4	10.2	50.7	7.2	6.0	1.5
18	28.6	9.8	50.9	7.9*2	2.6*3	0.2
19	30.5	11.3	42.7	8.4	5.8	1.3
20	35.6	11.8	43.9	4.1	4.2	0.4
23	24.0	19.8	41.1	7.3*4	2.9	4.9
25	30.9	25.3	34.5	6.1	3.1	0.1

*1 includes pyroxene (0.3%). *2 *3 *4 wholly altered to chlorite.

Kumaishi district (collected by K. Makino).

Sample No.	Quartz	Potash felspar	Plagio-clase	Biotite	Horn-blende	Others
16	22.0	10.9	43.2	15.5	0.0	8.4
125	30.5	11.0	44.0	9.1	3.8	1.6
139	33.4	5.0	45.6	10.1	0.5	5.4
316	23.2	3.0	47.1	19.5	6.5	0.7
331	29.6	3.0	47.6	11.4	8.1	0.3

Imagane district (data from C. Akiba (1954)).

	20	13	45	12	9	1

Sangaidaki district (collected by T. Hujiwara).

5A	17.5	26.1	41.8	2.2	8.1	4.3*5
73	29.0	45.1	21.5	0.3	3.1	1.0
78	24.9	34.0	31.3	0.1	8.5	1.2
125A	25.2	15.5	45.6	0.0	4.1	9.6*6
126	25.1	13.1	49.2	3.4	4.1	5.1
137	26.5	14.1	38.9	1.1	9.6*7	9.8

*5 includes tourmaline (0.6%).
*6 includes tourmaline (0.8%).
*7 includes augite (7.4%).

Otchube district (collected by H. Ando).

17	14.9	41.0	40.5	3.6	0.0	0.0
19	27.4	37.8	31.3	3.5	0.0	0.0
23	23.9	9.1	55.1	11.3	0.0	0.6
25	27.4	1.9	54.2	16.5	0.0	0.0
26	40.0	28.3	25.3	6.4	0.0	0.0
29	37.0	19.8	37.9	5.3	0.0	0.0
18	28.3	11.5	49.6	10.4	0.0	0.2
9	34.8	12.3	42.2	10.7	0.0	0.0

Uttsu-dake district (collected by Y. Urashima).

	30.3	20.9	43.9	2.6	0.0	2.3

Ishikari-dake district (collected by Y. Katsui)

202	13.2	0.0	58.6	9.7	18.3*8	0.2
203	15.2	0.0	58.0	8.3	18.1*9	0.4
206	20.6	0.0	55.1	9.3	14.8*10	0.2
211	20.4	0.0	49.7	7.7	22.0*11	0.2

*8, *9, *10, & *11 contain chlorite (*8, 6.6%; *9, 6.9%; *10, 5.7%; *11, 5.1%).

Shirakawa district.

65	26.4	16.0	45.2	8.6	3.1	0.7

Karikachi district (collected by S. Hashimoto).

Sample No.	Quartz	Potash felspar	Plagio-clase	Biotite	Horn-blende	Others
Pass	21.7	23.5	47.6	6.1	1.0	0.1
51156	32.2	37.3	27.9	2.5	0.0	0.1
51150A	34.9	28.2	33.7	3.1	0.0	0.1
51150B	37.3	26.2	32.6	3.7	0.0	0.2
51150C	40.1	24.8	30.7	4.4	0.0	0.0
Shimizu-Oni-A	26.0	30.0	34.7	8.8	0.4	0.1
Shimizu-Oni-B	32.4	27.9	33.7	5.7	0.3	0.0
Shimizu A	26.3	14.4	39.4	19.5	0.0	0.4
Shimizu B	26.1	11.4	44.0	17.9	0.0	0.6
Shimizu C	26.2	17.2	34.2	21.8	0.0	0.6
51154	28.2	29.5	39.6	2.7	0.0	0.0
51152	30.1	15.2	46.5	7.5	0.6	0.1
51151	25.2	4.4	49.5	18.4	2.1	0.4
51157	34.2	38.2	23.4	3.9	0.0	0.3
51159	32.7	33.6	27.3	5.0	1.2	0.3

Oshirabetsu district (collected by H. Sato and S. Hashimoto).

11305	32.3	15.8	37.9	13.6	0.0	0.4
188R	24.8	16.8	44.1	13.2	0.1	1.0
61Sm	28.4	15.8	40.3	15.3	0.0	0.2
53Y	25.6	20.8	39.9	12.0	0.1	1.6
63Sm	28.5	22.1	39.6	7.9	0.0	1.9
71404	18.1	3.1	66.2	12.2	0.0	0.4
70406	17.8	3.1	59.5	12.8	6.6	0.2
73107	29.7	2.2	58.8	7.8	0.2	1.3
73101	21.3	11.7	50.2	14.6	2.1	0.1
70801	25.2	9.7	54.4	10.3	0.1	0.3
Kokkyo	24.2	9.1	51.4	12.3	2.3	0.7
76b	11.5	5.0	61.3	11.6	10.3	0.3
205P	21.5	7.0	61.4	8.9	1.0	0.2
80604	25.8	9.3	51.4	13.2	0.2	0.1
81306	25.6	6.3	53.8	12.5	1.2	0.6
82307	23.9	0.3	59.7	15.5	0.0	0.6
82313	24.8	5.1	54.2	15.1	0.7	0.1
81201	25.3	7.5	47.9	16.1	1.0	2.2
80407	29.3	14.3	48.0	7.9	0.0	0.5
81902	23.3	0.7	49.1	26.2	0.1	0.6
806A	16.4	0.5	65.9	14.8	1.9	0.5
81906	19.4	6.8	51.8	19.2	1.6	1.2
81912	17.5	0.0	53.3	19.4	9.3	0.5
81917	15.5	21.1	47.8	13.6	1.1	0.9
81811B	31.7	2.2	49.2	16.1	0.0	0.8

81811 C	25.1	5.3	51.3	17.7	0.4	0.2
72616	27.8	1.2	62.2	8.6	0.0	0.2
72607	16.7	0.0	69.4	12.3	1.5	0.1
72606	29.7	9.8	53.0	7.1	0.0	0.4
72505	24.8	6.8	57.9	9.9	0.0	0.6
81507	28.6	19.1	43.3	8.9	0.0	0.1
81504	20.8	7.0	57.9	14.0	0.0	0.3
81513	29.4	2.3	52.7	15.3	0.0	0.3
72301	22.9	11.7	46.5	18.4	0.2	0.3
81525	20.1	4.8	57.1	17.2	0.3	0.5
81524	21.5	4.6	57.2	16.3	0.0	0.4

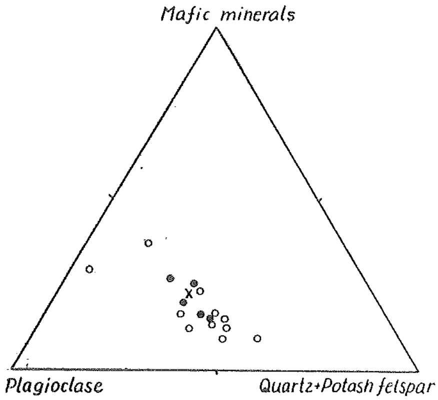

Fig. 2a.
White circle: Okushiri Island.
Black circle: Kumaishi district.
Diagonal cross: Imagane district.

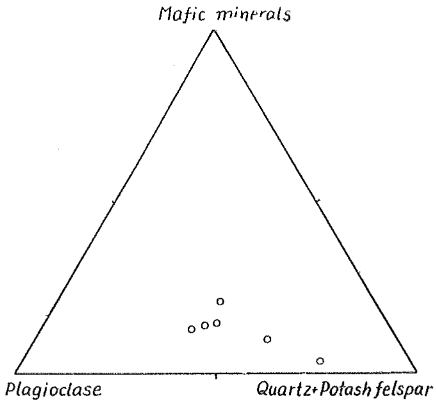

Fig. 2b.
Sangaidaki district.

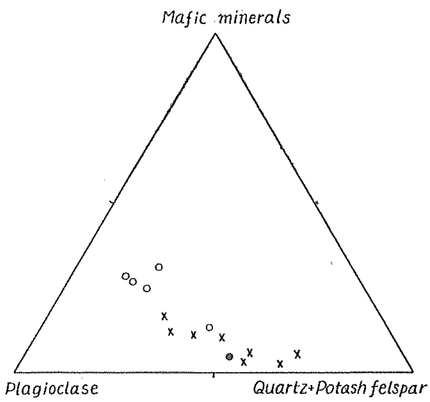

Fig. 2c.
Diagonal cross: Otchube district.
White circle: Ishikari-dake and Shirakawa districts.
Black circle: Uttsu-dake district.

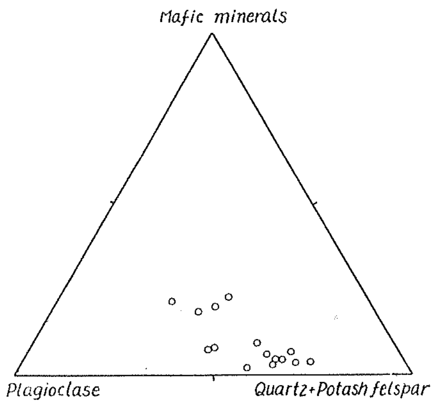

Fig. 2d.
Karikachi district.

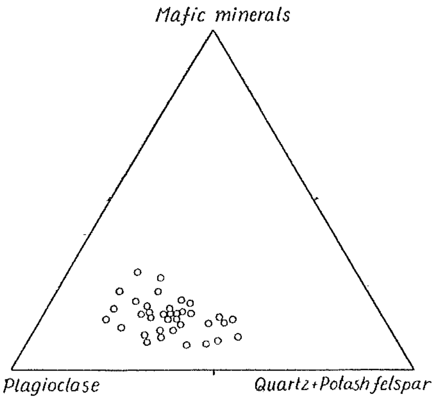

Fig. 2e.
Oshirabetsu district.

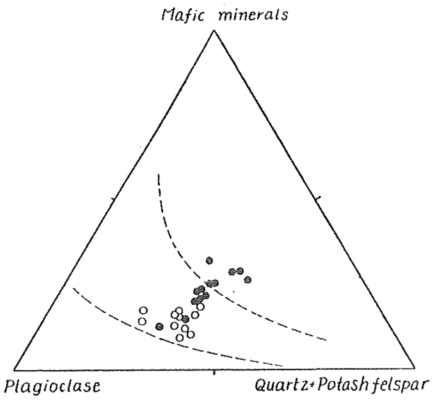

Fig. 2f.
Migmatitic rocks in Hidaka district.
White circle: Granitic migmatite.
Black circle: Cordierite migmatite.
The broken lines are drown to indicate the modal plutonic field (Y. Suzuki, 1955).

Fig. 2. The Mf, Pl and Q–Kf diagrams for plutonic masses in Hokkaido.

In order to scrutinize the characteristic chemical relations of rocks, the principle of the variation diagram by Harker has often been adopted by petrologists. Now the writer proposes to describe the variation diagrams in terms of modal proportion of mineralogical composition instead of chemical percentage of plutonic rocks in order to test specific relations between the rock series.

Petrographically the color index of Shand is a very convenient and familiar for the easy examination of the properties of rocks. Accordingly a diagram was next made from the modal composition of the granitic rock in Hokkaido, in which the (100-color index) of the rocks are taken as abscissa, and the modal contents of essential salic minerals in these rocks are in each case plotted as ordinates. The diagram represents analyses by a series of points arranged with reference to rectangular cordinates. Sometimes a rapid change of nature is observed even through a single rock-mass in detailed investigation on the subject, the variation in different parts of an individual rock mass is generally of the serial character, when some plutonic rocks of cognate origin will show a continuous relationship to one another. However, the character of variation may generally occur along a certain definite line indicating that in each case there is a strong family likeness.

The trends of variation of each component of salic minerals accompanying with the change of color index are expressed obviously by the method of Figure 3 (a-h). In general the results of modal investigation are more or less scattered but the general trend of the modal composition of each mass is recognizable by noting the average inclination.

When the rock becomes leucocratic, as is usual as each component of salic minerals increases, the inclination of increase of plagioclase content is not only very slow, but its content sometimes even decreases. Generally a certain mass has its own pretty distinctive regularity in variation of minerals, but when comparison is made one against another there may be seen a considerably different relation among them. It is reasonable to consider that the character of masses which occur in the same geological province and have resemblant natures with one another, may be caused by some similarity in their genesis.

The abscissa of this diagram will indicate roughly the increasing of silica content and the decreasing of Mg, Fe content in chemical composition. It may be said the variation curves of modal quartz and potash felspar in the diagram directly indicate the increase of SiO_2 (in other cases Niggli's qz or Norm Q), or K_2O respectively, while the curve of plagioclase indicates the decrease of CaO. In short this modal variation diagram roughly corresponds to some parts of Harker's variation diagram. In these cases Na_2O content may show more or less increase along with silica content.

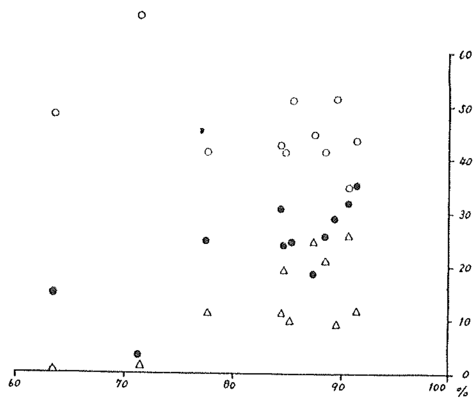

Fig. 3a.

Okushiri Island.

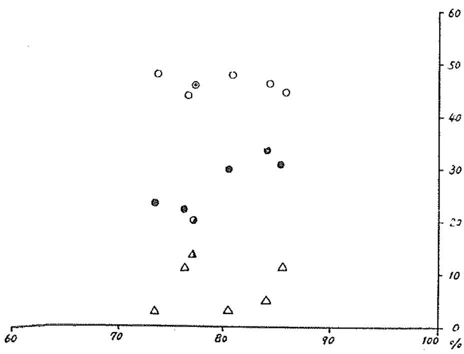

Fig. 3b.

Kumaishi and Imagane districts.
Imagane (double circle, half black circle and half black triangle).

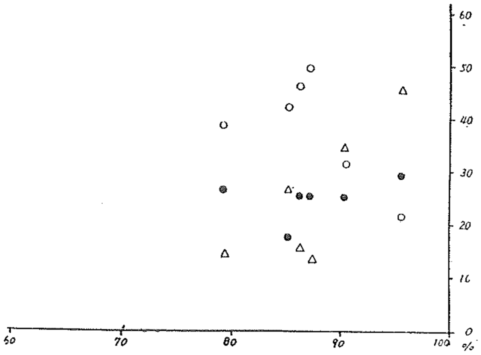

Fig. 3c.
Sangaidaki district.

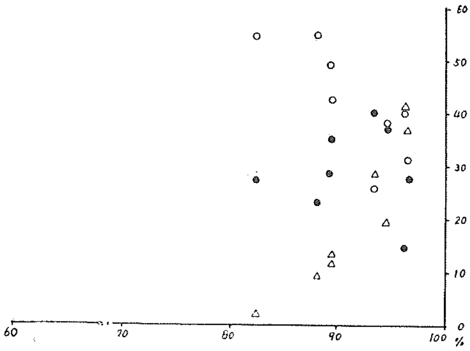

Fig. 3d.
Otchube district.

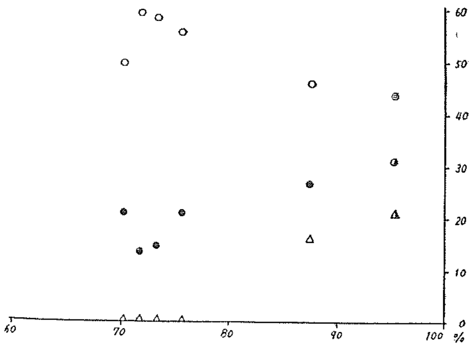

Fig. 3e.

Ishikari-dake, Shirakawa (neutral position) and Uttsu-dake (right end) districts. Uttsu-dake (double circle, half black circle and half black triangle).

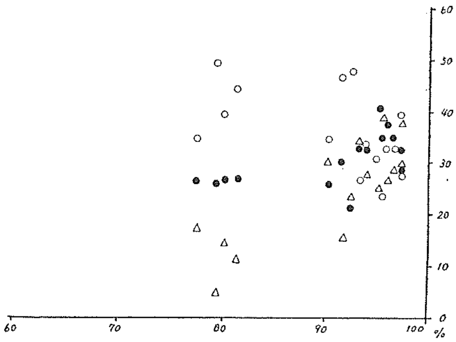

Fig. 3f.

Karikachi district

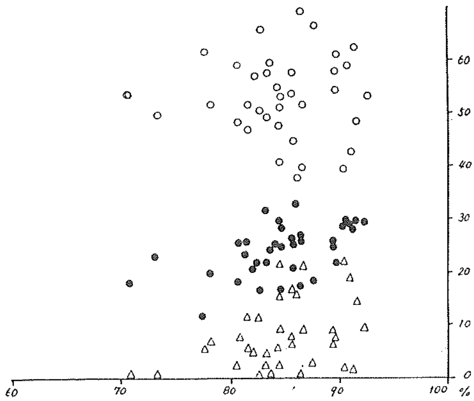

Fig. 3g.

Oshirabetsu district.

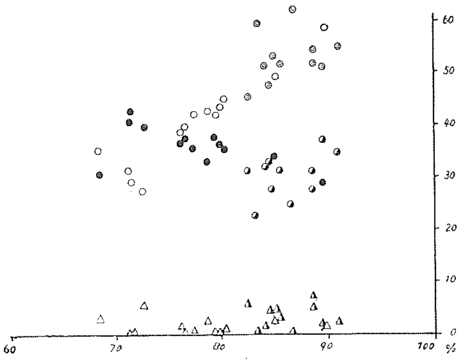

Fig. 3h.

Migmatitic rocks in Hidaka district.
Left half: Cordierite migmatite.
Right half: Granitic migmatite.

Fig. 3. Relation diagrams of modal salic minerals of granitic rocks in Hokkaido.

White circle: Plagioclase.
Black circle: Quartz.
Triangle: Potash felspar.

The symbol of each mineral of Imagane and Uttsu-dake masses and granitic migmatite are as following,

Double circle: Plagioclase.
Half black circle: Quartz.
Half black triangle: Potash felspar.

Abscissa: Sum of quartz, potash felspar and plagioclase.

Properties of the granitic rocks

As shown in Figures 2 and 3, the mineralogical characters of granitic rock gathered from various localities in Hokkaido, are pretty obviously illustrated by using the modal variation diagrams. They indicate that most of the masses are to be identified rather as intermediate or sometimes basic in character though considerable acid or leucocratic bodies are locally observed in them. For example the main part of the Karikachi mass can be called granite on the basis of its mineral composition and texture, but the other masses all have rather granodioritic to quartz dioritic composition.

Though only one section has been examined, it seems that the granitic masses of Uttsu-dake continuously vary in composition becoming similar to the masses of the Shirakawa and Ishikari-dake districts, and the analysis of it closely fits the variation line of the latter two. On the other hand, the Otchube mass rather shows a strong difference in the inclination of modal variation from the modal variations of two lacalities, in spite of the good similarity on the average composition between the masses of Otchube and Uttsu-dake districts. They may be affected by local geological circumstances.

These small granitic masses of the northern part of central Hokkaido considerably resemble each other, and seem to have somewhat of genetical connection with one another. It will be satisfactory to consider that they differ in general characters from the granitic intrusives in the southern part of central Hokkaido along the Hidaka mountain region.

The granitic rocks of the Karikachi district seem to be of a type pretty characteristic to Hokkaido in their rather normal granitic nature indicating they have much potash felspar content in contrast with that of plagioclase.

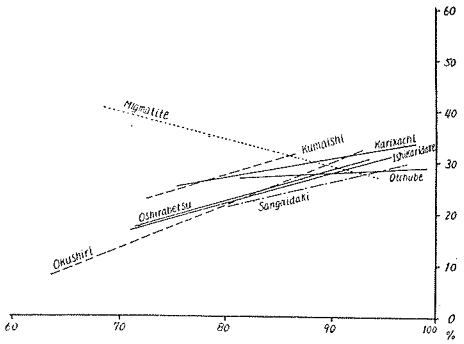

Fig. 4a. Quartz

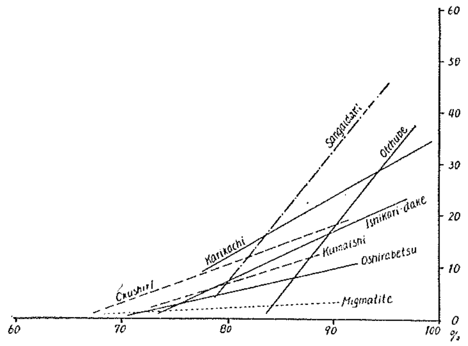

Fig. 4b. Potash felspar

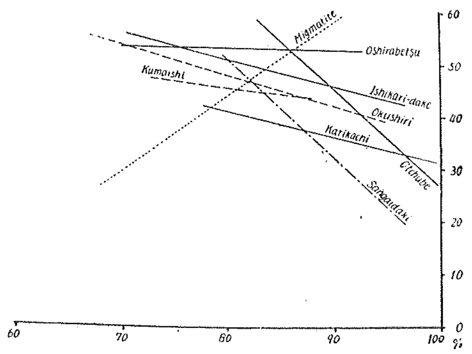

Fig. 4c. Plagioclase

Fig. 4. General trend of each mineral content in regard to the total salic content shown as abscissa.

Although the mass of Oshirabetsu granite is located in the eastern side of the central mountain region similarly to the Karikachi granites, this intrusive mass has relatively large quantity of plagioclase and small potash felspar, indicating that the feature of mass is also highly characteristic for normal plutonic series. It is very curious that the mass has little hornblende and large biotite contents in spite of the fact that the mass possesses a comparatively large amount of plagioclase content.

On the whole, the general character of the plutonic masses in the provinces along the eastern side of the back-bone ridge of central Hokkaido, is not very clear, but there seems to be a tendency that the masses in the northern parts have a larger content and a rapid increasing of the potash felspar in company with the diminution of color index, as compared with the masses of the southern parts. The quartz content throughout the masses is not so very different. The chief points of dissimilarity among the rock series are found in the ratio between the potash felspar and plagioclase contents; the content of plagioclase is substituted by potash felspar content according to increasing of salic minerals.

With respect to the Sangaidaki mass in the Oshima Peninsula some part of it is comparatively leucocratic; the more the potash felspar content of the mass increases, the more leucocratic the rock becomes, as is often observed in the case of aplite. As has already been mentioned frequently these extreme leucocratic parts in the mass show graphic intergrowth between potash felspar and quartz under the microscope. In spite of its granitic composition the whole mass will not be a real plutonic, and is better to consider it to be an acid hypabyssal rock in character and at least some part of that mass must be recognized as granophyric facies.

The modes of occurrence and petrographical characters of the Okushiri and Kumaishi masses are somewhat like each other, and they show pretty wide differences from the other masses in Hokkaido. These southwestern masses contain a comparatively large quantity of quartz rather than of potash felspar, exhibiting a typical granodioritic composition. It is noticeable that the trend of variation of the rocks from those two localities are rather much similar to those of the granodioritic rocks in the Kitakami district in the northeastern part of Japan. (SUZUKI, Y. 1952, 1954)

Beside the above-mentioned intrusive masses, there distribute wide migmatite zones especially in the southern half of the central zone along the Hidaka mountain region, which were formerly considered to be granitic masses. In the field the migmatite seems to be gneiss with granitic appearence but it is very conspicuous that the variation of the mineral constituents of the migmatite entirely differ from that of the intrusives. For comparison and contrast the diagram for the modal composition of migmatite series may be considered here. In general when a granitic rock becomes leucocratic the quartz content and potash felspar content increase in ordinary plutonic rocks. But when the model compositions of the migmatites, calculated by Y. SOTOZAKI (1956), are plotted in the above described variation diagram, the quartz content in the rocks obviously decreases in opposite direction, and potash felspar content is invariable, comparing with the contents of the intrusives. (Fig. 3h) However it is of much importance that the average values of granitic migmatite show much resemblance to those of adjacent Oshirabetsu intrusives and it may be considered that some genetical relations exist between them.

These considerations also can be proved by the points arranged with reference to triangular cordinates (Fig. 2-f), in which the trend of variation of migmatites is nearly normal to the general trend of what has been called the modal plutonic field by the writer which is expressed by the variation of common plutonic rocks.

According to M. HUNAHASHI, Y. SOTOZAKI and others, the migmatites in the Hidaka metamorphic zone are divided into two main types: cordierite migmatite and granitic migmatite. (HUNAHASHI & HASHIMOTO, 1951; KIZAKI, 1953; HUNAHASHI et al, 1956; SOTOZAKI, 1956) Examining the modal analyses by Y. SOTOZAKI, it is very remarkable that the distinction of the two is clearly shown by the color index, especially the existence of cordierite is controlled by total salic contents, and the cordierite occurs in the rocks until the content of the (100-color index) of them has reached about 80% of total.

Summary

1) When considering the various kinds of granitic rocks in Hokkaido, they may be essentially at least classified into the following four types according to the modes of occurrence and petrographical characters, though always the exact age of these granitic masses is not established for most of them. (Fig. 1)

a) The young granitic rocks intruded in the Tertiary formation in southwestern Hokkaido.

b) The granodiorites intruded in the areas of the so-called Paleozoic in southwestern Hokkaido.

c) The granitic rocks intruded in the so-called Hidaka formation of the central part of main Hokkaido. These rocks may be rather divided from their characteristic features into two sub-groups:

(i) The rocks in the northern half, and

(ii) Those of the southern half.

d) The migmatite in the Hidaka metamorphic zone.

2) The results of modal analyses of these granitic rocks from many localities are shown in Tables 2 and 3, and the data are set forth in detail by a suitable method of graphical representation.

3) The quartz-potash felspar, plagioclase and mafic minerals triangules show the respective characters of each plutonic mass (Fig. 2 (a-e)). Especially the natures of migmatite are seen to be quite different to those of the other intrusives, and some of it is out of the modal plutonic field in the triangular diagram (Fig. 2f).

4) The relations between salic minerals and color index are shown in the other diagrams, which will clearly express the inclination of the diminishing and increasing of each essential mineral (Fig. 3 (a-g)).

5) In this diagram, the variation lines of the essential minerals are respectively peculiar to the rocks and show that the migmatite has a quite different nature compared with the other intrusives (Fig. 3h).

6) Regarding the granitic rock series in the axial zone of central Hokkaido, as a whole it seems quite particular in that the antipathy of potash felspar and plagioclase is much more marked in the rock series of the northern districts than in those of the southern districts, which fact may be connected with their depth of formation.

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