HOKKAIDO UNIVERSITY

Title	The Chemical Composition of the Granitic Rocks of Japan
Author(s)	Suzuki, Jun; Nemoto, Tadahiro
Citation	Journal of the Faculty of Science, Hokkaido Imperial University. Ser. 4, Geology and mineralogy, 3(1), 1-48
Issue Date	1935-07
Doc URL	https://hdl.handle.net/2115/35765
Type	departmental bulletin paper
File Information	3(1)_1-48.pdf

Hokkaido University Collection of Scholarly and Academic Papers : HUSCAP

THE CHEMICAL COMPOSITION OF THE GRANITIC ROCKS OF JAPAN.

By

Jun SUZUKI and Tadahiro NEMOTO.

With 9 Text-Figures.

Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaidô Imperial University, Sapporo, No. 108.

Introduction 1
The Chemical Composition 2
Methods of Averaging 9
The General Average 11
List of Chemical Analyses and Niggli Values 16
Localities of Granitic Rocks 43
Literatures 46

INTRODUCTION

Granitic rocks are the most widely distributed plutonics in Japan, and occupy about one-eighth of the total area of the principal islands, including Honsyû, Hokkaidô, Kyûsyû and Sikoku. Among these regions, they have an especially great development in the inner zone of Southwest Japan, as is indicated on the accompanying map showing their distributions (Fig. 1).

The commonest type of the rocks is biotite-granite; there can, however, be seen many modifications of it, such as muscovite-biotite-granite, hornblende-biotite-granite, hornblende-granite, etc. In some parts they associate with pyroxene-granite, though the association is of comparatively rare occurrence. It is not seldom that the granitic masses show a gradual transition mostly to diorite or to a more basic type, and one can in various places observe the hybrid rocks in the contaminated zone along the outer shell of the batholithic mass.

The texture of the granitic rocks varies from medium to coarse-grained, being often porphyritic, microgranitic or gneissose in the special bodies or in the marginal facies of igneous masses.

With regard to the age of their intrusions it is generally believed[1] that most of the granitic rocks of Japan are decidedly post-Jurassic but pre-Tertiary in age, some of them, however, may be of Late Palaeozoic or Early Mesozoic or even post-Miocene.

THE CHEMICAL COMPOSITION

The chemical analyses of the granitic rocks of Japan shown in the annexed list have been collected from many published sources,[2] though most of the analyses for Hokkaidô and some of the other regions were specially made for this investigation.

In the list, 135 analyses were classified into 25 groups, each group representing a definite geographical area which is arranged in zones running from north to south. At any locality the analyses are arranged in the order of decreasing abundance in silica. The geographical divisions now in consideration and the numbers of analyses of granitic rocks from these areas are shown immediately below.

		Number of analysis
1.	Karahuto (Japanese Saghalin)	0
2.	Hokkaidô and Tisima	12
3.	The Kitakami District	2
4.	The Akita District	1
5.	The Abukuma District	4
6.	The Uetu District	0
7.	The Hitati District	11
8.	The Tukuba District	15
9.	The Zyôetu District	0
10.	The Awa District	2
11.	The Tanzawa District	2
12.	The Kôhu District	1
13.	The Suwa District	3
14.	The Hida District	2

(1) T. Katô: The Periods of Igneous Activity in Japan, with Special Reference to Metallogeny. Proc. 2nd Pan-Pacif. Sci. Congr. Vol. I, 1923, p. 810, and F. Homma: Problems Concerning the Igneous Geology of Japan (in Japanese). Commemoration Volume Dedicated to Prof. T. Ogawa, 1930, p. 391., etc.

(2) Bulletines, Reports and Explanatory Texts of the Geol. Sheet Map. from Imp. Geol. Surv.; Journals of the Geological Society of Tokyo; Jour. Jap. Ass. Petr. Min. and Econ. Geol.; "Building Stones of Japan", 1921, published from Ôkurasyô (The Finance Department), etc.

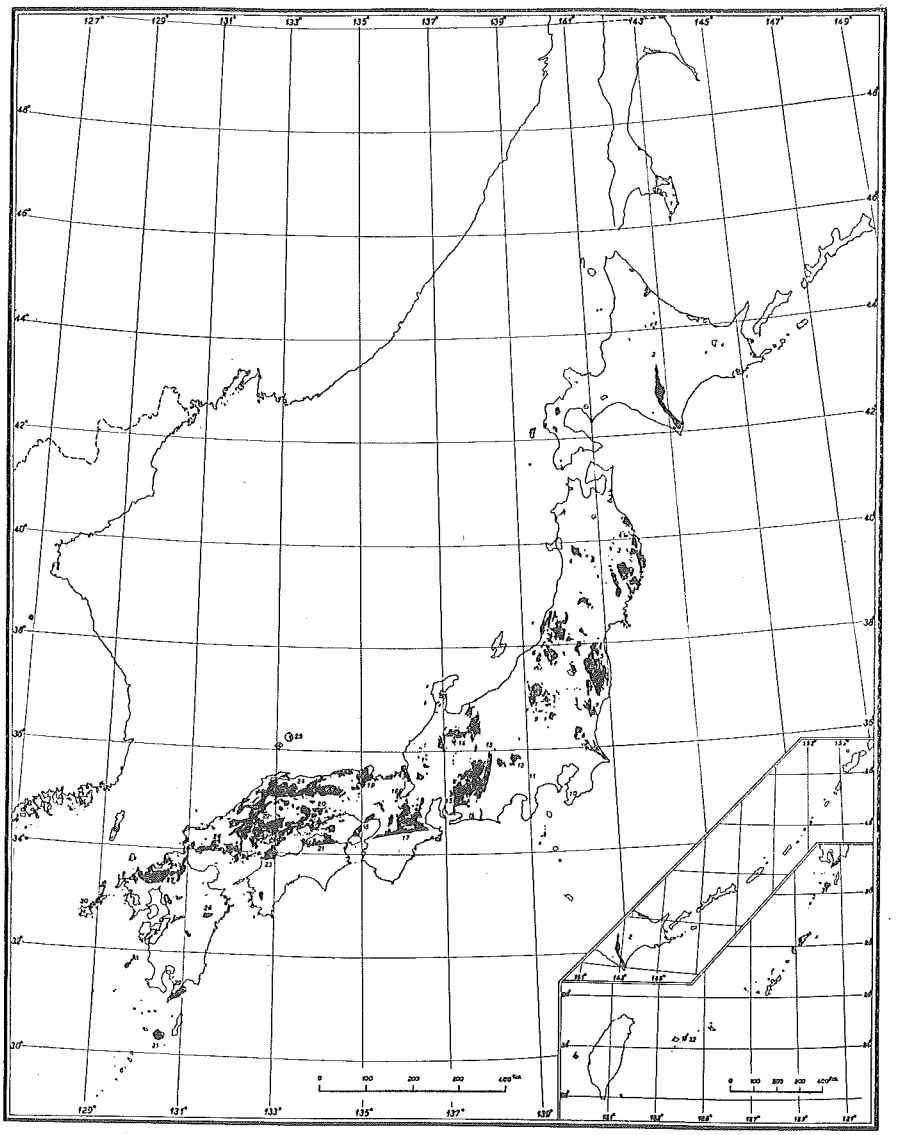


Fig. 1. Distribution of the granitic rocks of Japan.

1. Karahuto (Japanese Saghalin); 2. Hokkaidô and Tisima; 3. The Kitakami District; 4. The Akita District; 5. The Abukuma District; 6. The Uetu District; 7. The Hitati District; 8. The Tukuba District; 9. The Zyôetu Disirict District; 10. The Awa District; 11. The Tanzawa District; 12. The Kôhu District; 13. The Suwa District; 14. The Hida District; 15. The Kiso District; 16. The Hiei District; 17. The Yamato District; 18. The Rokkô-Awazi District; 19. The Tango District; 20. The Okayama District; 21. The Sanuki District; 22. The Hirosima District; 23. The Iyo District; 24. The San'in District; 25. The Oki District; 26. The Yamaguti District; 27. Northern Kyûsyû; 28. Middle Kyûsyû; 29. Southern Kyûsyû; 30. The Gotô Islands; 31. The Satunan Islands; 32. The Ryûkyû Islands.

15.	The Kiso District	6
16.	The Hiei District	3
17.	The Yamato District	0
18.	The Rokkô-Awazi District	2
19.	The Tango District	3
20.	The Okayama District	19
21.	The Sanuki District	9
22.	The Hirosima District	11
23.	The Iyo District	3
24.	The San'in District	1
25.	The Oki District	1
26.	The Yamaguti District	15
27.	Northern Kyûsyû	0
28.	Middle Kyûsyû	1
29.	Southern Kyûsyû	3
30.	The Gotô Islands	3
31.	The Satunan Islands	0
32.	The Ryûkyû Islands	0
	Total	135

Owing to petrological and comagmatic reasons, some of these areas might be separated into smaller subdivisions, and more detailed treatment is highly desirable. But, as the analyses of each area are not sufficient, it is better to follow a practicable division at present.

Many localities of granitic rocks are widespread in the areas along the coast of the Sea of Japan, including Ôu province, Hokuriku, San'in and North Kyûsyû, and partly in islands of South Kyûsyû and Ryûkyû, Formosa, and Urup in Kurile islands. The rocks from these regions have been so little analysed, however, that our present knowledge of the chemical character of them is largely conjectural.

The areal average of the typical granitic rocks of representative localities are shown in Table I and Fig. 2.

The analyses for the Okayama-Kagawa and Tukuba districts are comparatively so numerous and cover so many localities that the averages given may be regarded as fully representative of these regions. But the averages for the other districts are probably not quite satisfactory, for the analyses are too few and represent rocks that are not widely scattered over the areas, which need much further study.

TABLE I.

Areal average of the granitic rocks of the representative localities in Japan.

	I	II	III	IV	V	VI	VII	VIII	IX
SiO_2	70.74	70.16	71.75	71.93	72.51	72.95	74.60	72.67	74.09
TiO_2	0.38	—	0.30	0.32	—	0.32	0.25	0.20	0.41
Al_2O_3	14.06	15.66	14.06	14.51	14.11	13.81	13.69	14.76	13.51
Fe_2O_3	0.78	3.71	0.65	0.26	2.79	0.64	0.22	1.06	0.73
FeO	2.70	—	3.35	2.28	—	1.75	1.40	1.51	2.41
MnO	0.07	0.11	—	0.15	0.24	0.25	0.15	0.28	0.30
MgO	0.96	0.79	1.48	0.45	0.37	0.55	0.47	0.46	0.43
CaO	2.29	2.43	1.77	2.16	2.02	1.97	2.07	2.09	2.02
Na_2O	3.45	3.13	3.54	3.51	3.20	3.65	3.45	3.13	2.98
K_2O	3.64	3.66	1.80	3.58	4.38	3.22	2.98	3.20	2.48
P_2O_5	0.23	—	—	0.22	—	0.33	0.22	0.05	0.15
$H_2O(\pm)$	0.70	0.35	1.30	0.63	0.38	0.56	0.50	0.59	0.49
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
si	340	329	352	368	376	387	419	383	410
al	40	43.5	41	44	43	43	45.5	45.5	44
fm	20.5	19	27	15	14.5	16	12	15.5	19.5
c	12	12	9.5	12	11.5	11.5	12.5	12	12
alk	27.5	25.5	22.5	29	31	29.5	30	27	24.5
k	0.41	0.43	0.25	0.40	0.47	0.37	0.36	0.40	0.35
mg	0.33	0.29	0.40	0.23	0.19	0.28	0.33	0.22	0.19
al-alk	12.5	18	18.5	15	12	13.5	15.5	18.5	19.5
c/fm	0.59	0.63	0.35	0.80	0.79	0.72	1.04	0.77	0.62
ti	1.36	—	1.09	1.23	—	1.28	1.05	0.79	1.70
p	0.46	—	—	0.46	—	0.73	0.51	0.10	0.37

I. Granite (Hokkaidô), average of 6 analyses.
II. Granite (The Abukuma District), average of 4 analyses.
III. Granite (The Hitati District), average of 5 analyses.
IV. Granite (The Tukuba District), average of 13 analyses.
V. Granite (The Kiso District), average of 4 analyses.
VI. Granite (The Okayama-Kagawa District), average of 18 analyses.
VII. Granite (Kitagi Island), average of 7 analyses.
VIII. Granite (The Hirosima-Ehime District) average of 6 analyses.
IX. Granite (The Yamaguti District), average of 7 analyses.

As is shown in the Table I and Fig. 2, the averages for many districts are alike in their general features, though there are some notable differences especially in silica. On comparing the compositions, the averages for four districts in Southwest Japan, including VI–IX, are characterized by a rather high content of silica, SiO_2=72.67–74.60%, but the averages for districts in Northeast Japan and Hokkaidô, including I–V, are decidedly low in silica, SiO_2=70.16–72.51%.

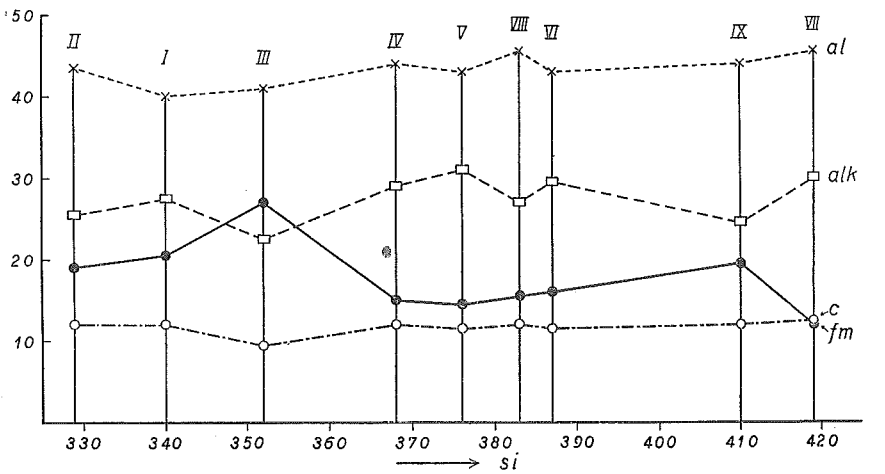


Fig. 2. Variation diagram of the areal averaged granitic rocks of 9 districts.

It is noticeable that some alkaline granites or allied rocks have been reported from Isino, Aiti prefecture, the southwest bank of Kizaki Lake and the central part of the Setouti district. The petrographical and geological natures of these rocks have not yet been noted, except the soda-granite porphyry from Kizaki Lake and the aegirine-augite quartz monzonite from Iwaki Island described by T. TOMITA[1] and Y. MITSUCHI[2] respectively. The analyses of the rocks show that they are quite distinct from most of the surrounding normal granite, on account of their high content of alkalies, especially soda, as shown in the Table II.

Of 135 granitic rocks which are tabled in the annexed list, two analyses, No. 129 (granite porphyry) and No. 133 (dioritic granite), in which alkalies have not been separately determined, are omitted in the construction of the next diagrams. The other analyses are all plotted in Fig. 3 in order to show the mutual relation of al, fm, c and alk to si.

(1) T. TOMITA: An Alkali Rock from the Southern Bank of Lake Kizaki, Prov. Shinano (Nagano Pref.). Jour. Geol. Soc. Tôkyô, Vol. XXXV (1927) pp. 256–259.

(2) T. MITSUCHI: Explanatory Text to the Onomiti-Sheet, Imp. Geol. Surv. Japan, 1930, pp. 18–20.

TABLE II.

Chemical composition of the alkaline granite and allied rocks.

	I	II	III	IV	V	VI
SiO_2	76.34	68.44	74.23	74.16	72.20	70.60
TiO_2	0.10	0.05	—	—	—	—
Al_2O_3	10.43	17.68	13.73	12.86	13.29	12.65
Fe_2O_3	0.60	1.04	0.71	1.70	2.71	3.12
FeO	1.40	1.00	—	—	—	—
MnO	0.02	0.07	0.21	0.03	0.05	0.54
MgO	0.05	0.40	0.29	0.16	0.38	0.09
CaO	1.03	0.97	0.71	0.80	1.58	2.11
Na_2O	3.87	8.53	4.80	5.90	5.61	5.29
K_2O	4.84	1.94	5.32	4.21	3.91	5.48
P_2O_5	0.04	tr.	—	—	—	—
$H_2O(+)$	0.67	—	—	—	—	—
$H_2O(-)$	0.20	—	—	—	—	—
Ig. loss	—	—	0.36	0.28	0.42	0.12
Total	99.59	100.12	100.36	100.10	100.15	100.00
si	485	293	410	403	357	331
al	39	44.5	44.5	41.5	39	35
fm	10.5	10	6.5	8	13	14
c	7	4.5	4.5	4.5	8.5	10.5
alk	43.5	41	44.5	46	39.5	40.5
k	0.45	0.13	0.43	0.32	0.32	0.40
mg	0.64	0.26	0.37	0.16	0.20	0.04
al-alk	-4.5	3.5	0	-4.5	-0.5	-5.5
c/fm	0.67	0.45	0.69	0.56	0.65	0.75
ti	0.46	0.16	—	—	—	—
p	0.11	—	—	—	—	—

I. Soda granite porphyry.(1) SW Bank of Kizaki Lake, Nagano Prefecture.
II. Aegirite-augite quartz monzonite.(2) Iwakisima, Ehime Prefecture.
III. Biotite granite.(3) Momosima, Hirosima Prefecture.
IV. Biotite granite.(4) Inusima, Okayama Prefecture.
V. Biotite granite.(5) Magi, Nisikataoka, Okayama Prefecture.
VI. Granite.(6) Isino, Nisikamo, Aiti Prefecture.

(1) T. TOMITA: Op. cit., p. 258.
(2) J. SUZUKI and T. NEMOTO: On the Chemical Composition of the Granite from Japan (in Japanese). Jour. Jap. Ass. Min. Petr. and Econ. Geol., Vol. VIII (1932) p. 60.
(3) ÔKURASYÔ: Building Stones from Japan (in Japanese), 1921, p. 233.
(4) and (5) Ibid., p. 231.
(6) I. OYAMA: On the Selection of Granitic Rocks for Building of the House of the Imperial Diet (in Japanese). Jour. Geogr., Vol. XXXVIII (1926) p. 395.

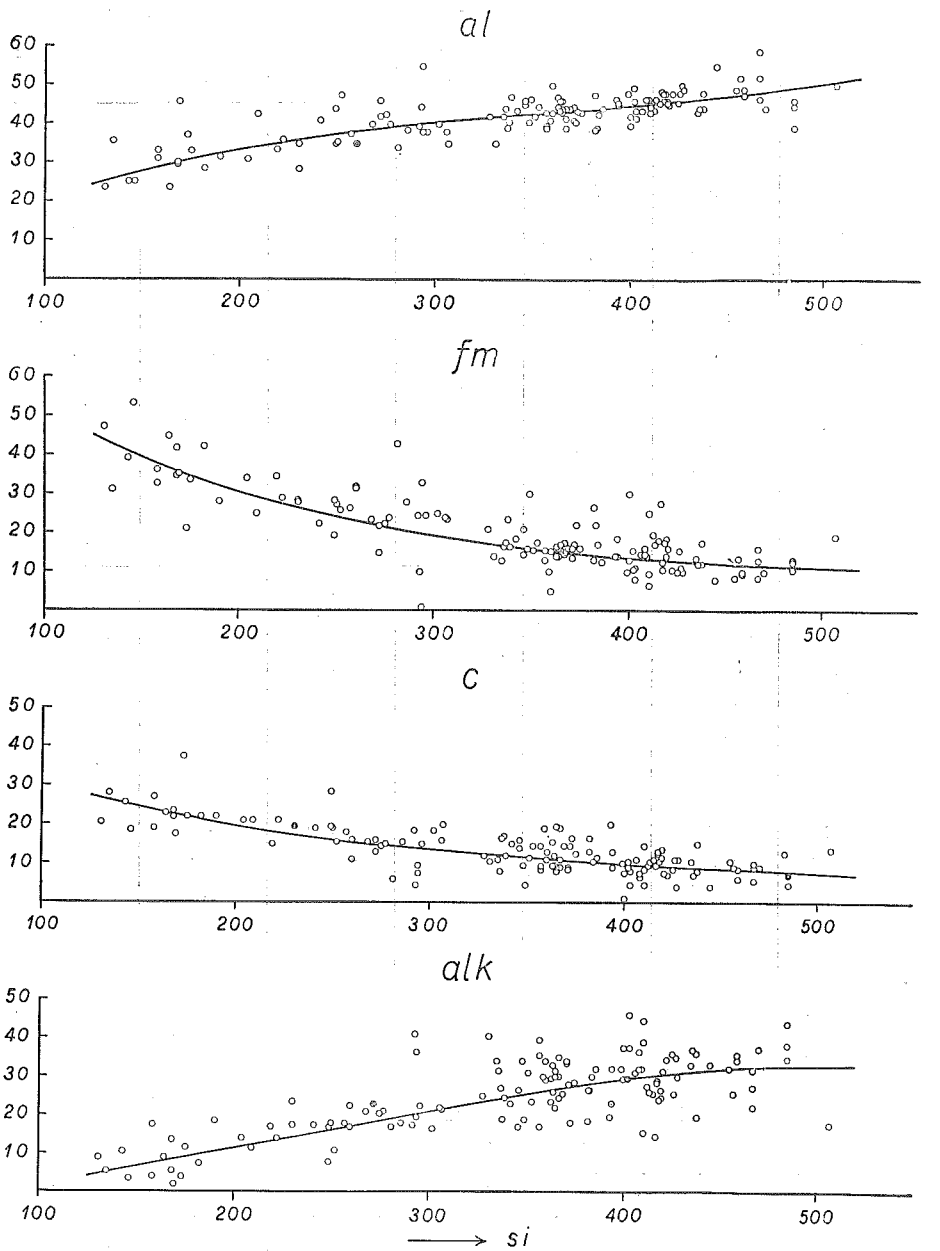


Fig. 3. Variation diagram of 133 granitic rocks of Japan.

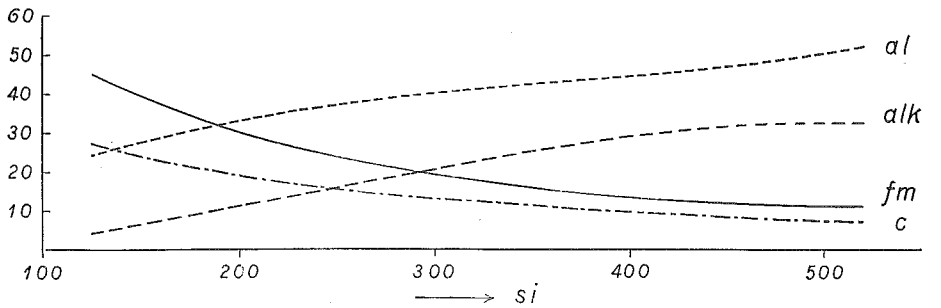


Fig. 4. Variation diagram of the granitic rocks of Japan.

These variation diagrams of al, fm, c and alk are brought together in Fig. 4.

METHODS OF AVERAGING

It will be convinient to note the methods of averaging adopted before the average computed is given.

As is described by F. W. CLARKE and H. S. WASHINGTON,(1) there are three methods of averaging each constituent. In the first method, the sum of the percentages of any given constituent is divided by the whole number of analyses, it being assumed that a constituent is not present if it is not reported. This assumption, however, is not justified, and the method will give results too low for the minor constituents which in some analyses, have not been determined and results relatively too high for the major ones which have been determined in all analyses.

In the second method, the sum of the percentages of each constituent is divided by the number of analyses in which it was determined. The only assumption made in this method is that the average amount of any constituent represents the amount of this constituent in all the analyses in which it has not been determined.

In the third method, the average amount of any constituent is the mean between those determined by the above two methods. This method is based on the justifiable assumption that the first method yields results that are too low and the possibly justifiable assumption that the second method yields or may yield results that are too high, so that a mean between them will probably be nearer the truth than either of them.

(1) F. W. CLARKE and H. S. WASHINGTON: The Composition of the Earth's Crust, U. S. G. S. Prof. Paper 127, 1924, pp. 10–12.

Of the above three methods, it would appear that the second method, that of dividing the sum of the percentages by the number of determinations, in which we use only data actually known and avoid the introduction of the unknown and the arbitrary, is the most logical and the safest and the one which should give the most reliable averages.

The method of averaging which is adopted by the authors is in principle similar to the second method above, and the average value of each constituent is calculated in the following manner.

1. The mean values of the major constituents, such as SiO_2, MgO, CaO, Na_2O and K_2O, which were always determined in all the analyses, are immediately calculated from the known data as they are.

2. In many analyses some or all of FeO, TiO_2, MnO and P_2O_5 were not determined and therefore the average values of these constituents are obtained by dividing the sum of the percentages of each constituent by the number of analyses in which it was determined.

3. There are also many analyses in which the iron oxides have not been separately determined. So the average value of Fe_2O_3 should be calculated by the following method.

In the analyses in which the iron oxides have been separately determined, FeO is recalculated to Fe_2O_3 by multiplying its percentage weight by 1.11136. Then the recalculated value of Fe_2O_3 is added to that of Fe_2O_3 which has been given in the analysis, the value of total Fe_2O_3 thus being obtained. After all the iron oxides are thus converted into Fe_2O_3, the average value of total Fe_2O_3 is calculated. Then the mean value of FeO which has been obtained in 2 is recalculated to Fe_2O_3. If the difference of the average value of total Fe_2O_3 and the recalculated one of Fe_2O_3 which is obtained from the mean value of FeO are determined, it denotes the average value of Fe_2O_3.

4. The average value of Al_2O_3 is obtained by the following method.

In many analyses the minor constituents, such as TiO_2, MnO and P_2O_5 were not determined. All the analyses may be divided into two kinds: one in which these minor constituents were determined, and the other in which they were not determined. When these two kinds of analyses are given, it is not rational in the light of our knowledge of the chemical analysis of rock to average the known values of Al_2O_3 as they are. In many analyses, in which some or all of these minor

constituents were not determined, the total of some or all of mean values of TiO_2, MnO, and P_2O_5 which have been obtained in 2 is deducted from the given value of Al_2O_3, the true value of Al_2O_3 being thus determined. The average value of Al_2O_3 is then calculated from the above true values obtained from the analyses in which these minor constituents were not determined and the given values of the other analyses in which they were all determined.

5. The average value of $H_2O(-)$ is obtained by dividing the sum of the amounts of the constituent by the number of its determinations and that of $H_2O(+)$ is calculated, by the above method, from the values of $H_2O(+)$ and ignition loss in some analyses.

6. The less common minor constituents, such as ZrO_2, SO_3, CuS, FeS and S are so rarely determined that they are all omitted from the above calculation, though in some analyses they are given.

THE GENERAL AVERAGE

To compute the general average for the chemical composition of the granitic rocks of the whole of Japan, we selected 94 analyses of rocks which are believed to have typical granitic features, characterized by showing a holocrystalline equigranular structure and by containing more than 65 per cent of silica. The analyses of granite porphyry, granite aplite and granitic gneiss are not included in the

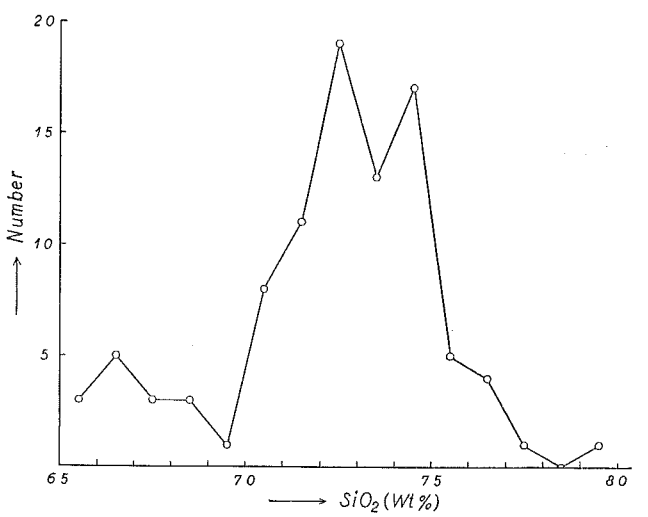


Fig. 5. Curve of frequency based on silica percentage of granite in Japan.

general average, though they contain as high a proportion of silica as that of typical granite.

The curve of frequency based on the silica percentage of 94 granitic rocks is shown in Fig. 5. The interval of the silica percentage which was used to construct the curve is 1 per cent. As a result of the above statistic study the highest peak of silica percentages appears to be between 72–73% and closely coincides with the average of the whole rocks, 72.25%.

The general average of whole compositions of the 94 granites is given in company with the calculated values, in the column I of the following table. Column II in the same table shows the composition and calculated values of the averaged granites of Europe, America, etc., as computed by R. A. DALY[1] from 236 analyses.

TABLE III.

Average and Niggli values, and norm for granitic rocks.

Wt. %			Niggli Value			Norm		
	I	II		I	II		I	II
SiO_2	72.25	69.92	si	373	332	Q	33.60	29.46
TiO_2	0.35	0.39	al	42.5	41.5	Or	18.90	23.91
Al_2O_3	14.04	14.78	fm	18	20	Ab	28 82	27.77
Fe_2O_3	0.38	1.62	c	12	11	An	8.90	8.90
FeO	2.32	1.67	alk	27.5	27.5	C	1.73	1.73
MnO	0.19	0.13	k	0.38	0.45	Hy	5.53	3.72
MgO	0.67	0.97	mg	0.30	0.34	Mt	0.46	2.32
CaO	2.13	2.15	al-alk	15	14	Il	0.61	0.76
Na_2O	3.43	3.28	c/fm	0.67	0.55	Ap	0.62	0.62
K_2O	3.17	4.07	ti	1.37	1.40			
P_2O_5	0.22	0.24	p	0.47	0.49			
$H_2O(+)$	0.64	0.78						
$H_2O(-)$	0.21							
Total	100.00	100.00				Symbol	I″. (3) 4. 2.3 (4).	I″. ″4. 2.3.

I. Granite (Japan), average of 94 analyses (J. Suzuki and T. Nemoto).
II. Granite (Europe, America, etc.), average of 236 analyses (R. A. Daly).

(1) R. A. DALY: Igneous Rocks and Their Origin, 1914, p. 19.

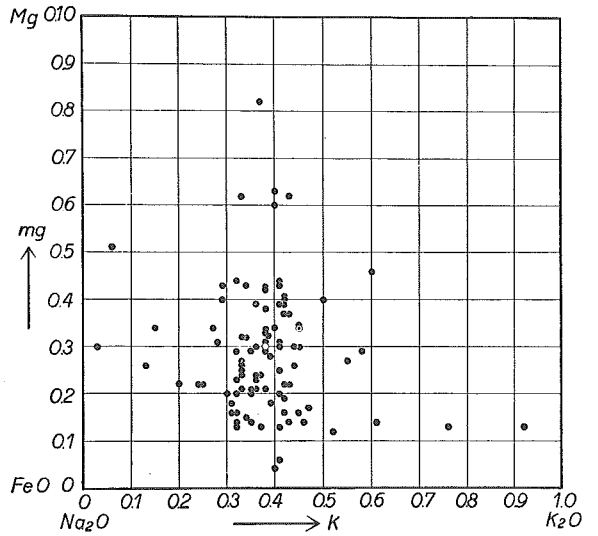


Fig. 6. mg-k diagram of 94 granitic rocks of Japan.

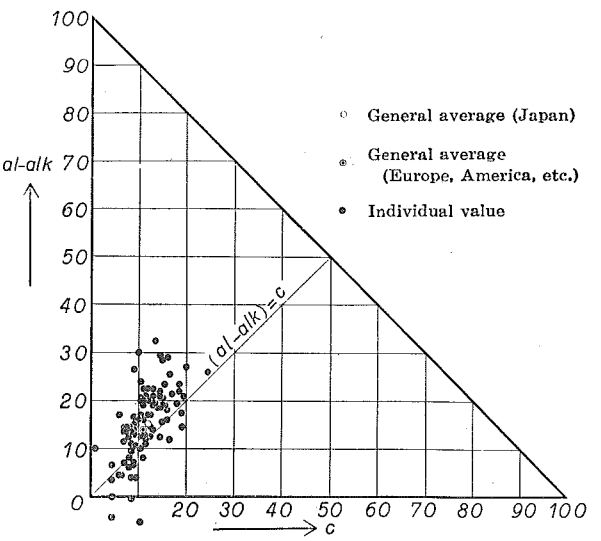


Fig. 7. (al-alk)-c diagram of 94 granitic rocks of Japan.

Figs. 6 and 7 illustrate mg–k and (al–alk)–c diagrams, obtained by plotting the calculated values of 94 analyses and the general average of the Japanese granitic rocks together with that of DALY's average for comparison.

As is shown in the Table III, and Figs. 6, 7 and 8, the average for Japan is characterized by rather high si and c values, but especially by low fm, k and mg values. It is also obvious that the ratio of alk to al in the average of the Japanese rocks is comparatively small. Comparing both general averages in Table III and Fig. 9, it is noticeable that the Japanese granite is rich in normative quartz and poor in normative potash feldspar and is also characterized by the comparatively high content of plagioclase in the norm for the silica relations.

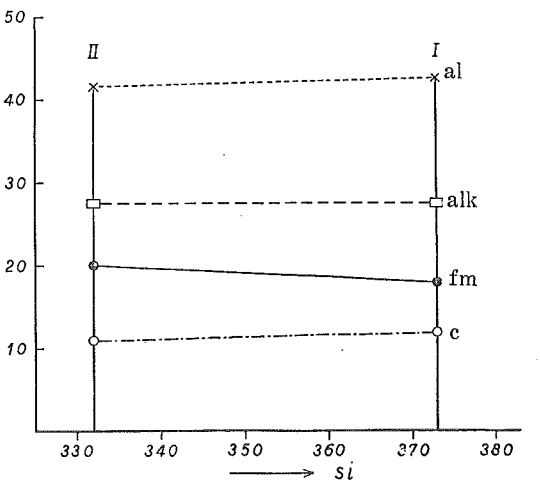
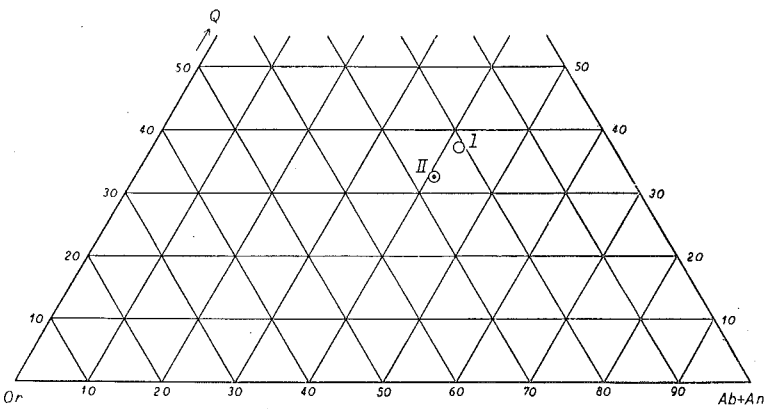


Fig. 8. Comparison diagram of both average granites, Japan (I) and Europe, America, etc. (II).

It would be expected that the proportion of the normative minerals may be paralleled with that of their modal mineral composition, at least so far as groups of minerals are concerned. It is remarkable that the general peculiarities of the chemical and mineralogical composition of the Japanese rocks are seen not only in the



I. General average (Japan).
II. General average (Europe, America, etc.)

Fig. 9. Quartz-orthoclase-albite+anorthite diagram illutrating the difference of both averaged granites in normative minerals.

granitic rocks but in the volcanic rocks(1) or whole igneous rocks themselves(2), as has already been pointed out by many petrologists.

---

(1) J. P. IDDINGS: Igneous Rocks, Vol. II, (1913), p. 111.

S. TSUBOI: Notes on Miharite. Jour. Geol. Soc. Tôkyô, Vol. XXV, 1918, p. 56.

S. TSUBOI: Volcano Ôshima, Idzu. Jour. Coll. Sci. Imp. Univ. Tôkyô, Vol. XLIII, 6 (1920), p. 87.

S. KÔZU: Optical, Thermal and Chemical Properties of Anorthite from Miyake-jima (in Japanese). Chikyû (The Globe), Vol. VII, 1927, p. 447.

S. KÔZU and M. WATANABE: Distribution of Volcanic Rocks in Japan, with Subordinate Notes on the Korean Rocks. Proc. Third Pan-Pacific Sci. Congr. Tôkyô (1926), p. 775 and Jour. Jap. Ass. Min. Petr. and Econ. Geol. Vol. I (1929), p. 80.

S. TSUBOI and H. KUNO: On the So-called "Pyroxene-Andesite", the Commonest Volcanic Rocks in Japan (In Japanese). Bull. Volc. Soc. Japan, Vol. I (1932), p. 24.

S. TSUBOI: Some Remarks on the Petrology of the Common Volcanic Rocks of Japan. Proc. Fifth Pacific Sci. Congr. Canada, (1933) p. 2271.

(2) F. W. CLARKE and H. S. WASHINGTON: The Composition of the Earth's Crust. Prof. Pap. 127, U. S. G. S. (1924), p. 64.

LIST OF CHEMICAL ANALYSES AND NIGGLI VALUES[1]

	(1)*	(2)*	(3)*	(4)	(5)
SiO_2	75.68	74.85	72.00	70.45	69.22
TiO_2	0.06	0.20	0.41	0.10	0.48
Al_2O_3	12.94	13.58	13.93	16.43	13.38
Fe_2O_3	0.56	0.38	0.41	0.37	2.16
FeO	0.86	0.97	1.92	0.71	2.08
MnO	0.07	0.06	0.03	0.03	0.04
MgO	0.62	0.42	0.76	1.53	1.21
CaO	1.05	1.38	2.26	3.11	4.20
Na_2O	3.91	3.62	3.28	4.43	4.17
K_2O	4.16	4.45	3.56	1.07	1.35
P_2O_5	tr.	0.15	0.31	0.58	0.25
$H_2O(+)$	—	0.15	1.00	1.27	1.85
$H_2O(-)$	—	0.15	0.21	0.27	0.10
Ig. loss	0.28	—	—	—	—
Total	100.19	100.29	100.08	100.35	100.49
si	436	425	375	333	307
al	44	45.5	43	46	35
fm	12	10	16	15	23.5
c	7	8.5	12.5	15.5	20
alk	37	36	28.5	23.5	21.5
k	0.41	0.45	0.42	0.13	0.17
mg	0.43	0.34	0.37	0.72	0.34
al–alk	7	9.5	14.5	22.5	13.5
c/fm	0.58	0.85	0.78	1.03	0.85
ti	0.24	0.86	1.60	0.28	1.60
p	—	0.38	0.69	1.14	0.53

HOKKAIDÔ AND TISIMA

(1) Biotite granite. Simizu, Kamikawa, Tokati Prov., Hokkaidô. Anal., A. KAN'NARI. Lit. J. SUZUKI (1934 (B)) p. 326.

(2) Biotite granite. Otyube, Esasi, Kitami Prov., Hokkaidô. Anal., T. NEMOTO. New analysis.

(3) Biotite granite. Kamisibetu, Kamikawa, Tesio Prov., Hokkaidô. Anal., T. NEMOTO. New analysis.

(4) Trondhjemitic rock. Horonari, Uryu, Isikari Prov., Hokkaidô. Anal., T. NEMOTO. New analysis.

(5) Biotite bearing augite hornblende granodiorite. Kamo-gawa, Urup Island, the Tisima Islands. Anal., T. NEMOTO. New analysis.

(1) Molecular proportions adopted in the calculation of Niggli values are all found in H. von Eckermann's table " Molecular Proportions " (1925).

* Indicates an analysis selected to compute the general average.

	(6)*	(7)*	(8)	(9)*	(10)
SiO_2	68.75	67.61	66.82	65.87	65.68
TiO_2	0.59	0.64	tr.	0.36	—
Al_2O_3	14.48	14.67	15.17	15.13	13.31
Fe_2O_3	1.09	1.19	0.83	1.02	1.62
FeO	3.30	3.35	5.45	5.82	5.91
MnO	0.11	0.07	0.30	—	tr.
MgO	1.11	1.24	1.88	1.61	1.88
CaO	3.28	3.15	3.87	2.64	5.14
Na_2O	3.11	3.27	3.84	3.48	4.02
K_2O	2.92	3.06	1.06	3.66	1.33
P_2O_5	0.34	0.36	tr.	—	—
$H_2O(+)$	0.61	0.90	0.42	—	—
$H_2O(-)$	0.20	0.21	0.28	—	—
Ig. loss	—	—	—	0.56	0.64
Total	99.89	99.72	99.92	100.15	99.53
si	306	296	260	258	243
al	38	38	35	35	29
fm	24	24.5	32	31.5	33
c	16	15	16	11	20
alk	22	22.5	17	22.5	18
k	0.38	0.38	0.15	0.41	0.18
mg	0.31	0.33	0.34	0.30	0.32
al–alk	16	15.5	18	12.5	11
c/fm	0.67	0.61	0.50	0.35	0.61
ti	1.99	2.11	—	1.18	—
p	0.65	0.66	—	—	—

(6) Hornblende and muscovite bearing biotite granite. Osirabetu, Biro, Tokati Prov., Hokkaidô. Anal., T. NEMOTO. Lit. J. SUZUKI (1934 (B)) p. 326.

(7) Muscovite bearing hornblende biotite granite. Itinohasi, Kamikawa, Tesio Prov., Hokkaidô. Anal., T. NEMOTO. New analysis.

(8) Granodiorite. Pirika, Sedana, Siribesi Prov., Hokkaidô. Anal., Y. SASAKI. New analysis.

(9) Granodiorite. Mizutare, Hutoro, Siribesi Prov., Hokkaidô. Anal., S. YAMAGUCHI. Lit. S. YAMAGUCHI (1932).

(10) Hornblende biotite granodiorite. Yaemon-zaki, Okujiri-Island, Siribesi Prov., Hokkaidô. Anal., B. SONOKI. Lit. B. SONOKI (1935) p. 55.

	(11)	(12)	(13)	(14)	(15)
SiO_2	57.22	54.49	63.86	58.91	69.19
TiO_2	—	0.63	0.64	0.08	—
Al_2O_3	17.30	16.04	16.41	16.50	15.66
Fe_2O_3	1.19	2.97	1.27	6.83	3.56
FeO	7.24	5.80	4.40	—	1.32
MnO	—	0.09	tr.	0.24	—
MgO	3.25	5.09	2.08	2.27	1.45
CaO	7.01	9.06	5.11	6.39	0.83
Na_2O	3.28	3.28	3.66	4.46	1.89
K_2O	2.18	1.21	2.01	2.04	2.91
P_2O_5	—	0.42	0.14	0.44	—
$H_2O(+)$	} 1.30	0.59	—	0.97	} 2.81
$H_2O(-)$		0.19	0.84	0.38	
Ig. loss	—	—	—	—	—
Total	99.97	99.86	100.42	99.51	99.62
si	168	143	230	190	349
al	30	25	35	31.5	46.5
fm	34.5	39	28	28	30
c	22	25.5	19.5	22	4.5
alk	13.5	10.5	17.5	18.5	19
k	0.30	0.20	0.26	0.23	0.50
mg	0.41	0.51	0.40	0.39	0.36
al–alk	16.5	14.5	17.5	13	27.5
c/fm	0.64	0.65	0.70	0.79	0.15
ti	—	1.25	1.74	0.19	—
p	—	0.46	0.22	0.60	—

(11) Diorite. Raruisi, Hutoro, Siribesi Prov., Hokkaidô. Anal., Dept. of Agriculture and Commerce. Lit. T. ISHIKAWA (1896) Appendix p. 24.

(12) Quartz bearing hornblende diorite. Otarupen, Esasi, Kitami Prov., Hokkaidô. Anal., T. NEMOTO. Lit. T. NEMOTO (1932) p. 286.

THE KITAKAMI DISTRICT

(13) Granodiorte. Nakano, near Morioka-City, Iwate Pref. Anal., Imp. Geol. Surv. Japan. Lit. S. YAMANE (1915) p. 49.

(14) Hornblende biotite granite. Tenjin-Yama near Morioka-City, Iwate Pref. Anal., T. SEKI. Lit. T. SEKI (1918) p. 3.

THE AKITA DISTRICT

(15) Biotite granite. Ani Mine, Kita-akita, Akita Pref. Anal., R. FUKUDA. Lit. K. NAKAJIMA (1886) Appendix.

	(16)*	(17)*	(18)*	(19)*	(20)*
SiO_2	74.56	71.46	66.88	66.33	74.91
TiO_2	—	—	—	—	tr.
Al_2O_3	13.54	13.90	17.50	17.51	14.38
Fe_2O_3	2.32	3.04	4.80	4.63	0.23
FeO	—	—	—	—	1.32
MnO	0.12	0.14	0.11	0.07	—
MgO	0.53	0.24	1.11	1.22	0.65
CaO	1.89	1.48	3.29	3.01	1.42
Na_2O	3.27	1.31	3.69	4.21	3.03
K_2O	3.90	6.22	2.15	2.34	1.87
P_2O_5	—	—	—	—	—
$H_2O(+)$	—	—	—	—	1.33
$H_2O(-)$	—	—	—	—	—
Ig. loss	0.22	0.32	0.46	0.40	FeS_2 0.56 Others 0.16
Total	100.35	98.11	99.99	100.40	99.86
si	406	402	275	272	457
al	43.5	46	42.5	42	52
fm	14.5	15.5	22.5	22	13.5
c	11	9	14.5	13	9
alk	31	29.5	20.5	23	25.5
k	0.44	0.76	0.28	0.27	0.29
mg	0.30	0.13	0.31	0.34	0.43
al-alk	12.5	16.5	22	19	26.5
c/fm	0.76	0.58	0.64	0.59	0.67
ti	—	—	—	—	—
p	—	—	—	—	—

THE ABUKUMA DISTRICT

(16) Hornblende biotite granite. Yamada, Tateyama, Igu, Miyagi Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(17) Granite. Baba, Sôma, Hukusima Pref. Anal., not stated. Lit. I. OYAMA (1926) p. 395.

(18) Hornblende biotite granite. Takikawa, Hutaba, Hukusima Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(19) Hornblende biotite granite. Hiruzone, Hutaba, Hukusima Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

THE HITATI DISTRICT

(20) Microgranite. Hitati Mine, Ibaraki Pref. Anal., not stated. Lit. FUJITA (1931) p. 672.

	(21)	(22)	(23)*	(24)*	(25)*
SiO_2	73.76	73.44	73.05	71.66	69.49
TiO_2	—	0.25	0.34	0.37	0.24
Al_2O_3	15.48	12.56	12.21	14.37	15.10
Fe_2O_3	0.10	2.29	0.66	1.17	0.44
FeO	1.26	2.83	4.06	3.12	2.83
MnO	—	—	—	—	—
MgO	0.13	0.69	1.04	1.00	1.15
CaO	0.59	2.98	0.18	3.34	2.37
Na_2O	3.60	3.47	3.40	4.05	3.18
K_2O	3.03	0.21	3.17	0.19	3.38
P_2O_5	—	—	—	—	—
$H_2O(+)$	1.15	0.88	1.35	0.12	1.24
$H_2O(-)$	—	—	—	—	—
Others	0.47	0.31	0.28	0.32	0.48
Total	99.57	99.91	99.74	99.71	99.90
si	445	382	400	338	328
al	55	38.5	39.5	40.5	42
fm	8	26.5	30	23.5	21
c	4	16.5	1	17	12
alk	33	18.5	29.5	19	25
k	0.36	0.03	0.38	0.03	0.41
mg	0.14	0.20	0.29	0.30	0.39
al-alk	22	20	10	21.5	17
c/fm	0.50	0.62	0.03	0.72	0.57
ti	—	0.97	1.39	1.31	0.85
p	—	—	—	—	—

(21) Granite aplite. Irisiken near Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 514.

(22) Granophyre. Kamineyama near Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 514.

(23) Granite. Moriyama near Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 514.

(24) Microgranite. Matiya near Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 514.

(25) Biotite granite. Takanuki near Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 514.

	(26)*	(27)	(28)	(29)	(30)
SiO_2	67.70	60.31	58.30	54.37	50.74
TiO_2	0.26	0.79	0.31	0.09	1.18
Al_2O_3	13.82	15.68	14.02	15.85	15.37
Fe_2O_3	0.77	1.37	2.19	5.36	4.37
FeO	5.30	6.18	6.47	8.59	6.93
MnO	—	—	—	—	—
MgO	3.53	2.60	5.87	5.40	6.09
CaO	1.48	5.66	7.63	6.45	7.34
Na_2O	3.94	2.90	2.53	1.31	3.34
K_2O	0.34	2.08	1.00	tr.	0.48
P_2O_5	—	—	—	0.14	—
$H_2O(+)$	2.43	1.50	1.21	1.04	1.96
$H_2O(-)$	—	—	—	—	—
	Others 0.33	Others 0.71	Others 0.42	CO_2 0.51 Cu 0.01 FeS_2 0.21	FeS_2 1.31 Others 0.69
Total	99.90	99.78	99.95	99.65	99.80
si	281	204	164	146	131
al	34	31	23.5	25	23.5
fm	43	34	44.5	53	47
c	6	21	23	18.5	20.5
alk	17	14	9	3.5	9
k	0.06	0.32	0.21	0	0.09
mg	0.51	0.39	0.56	0.41	0.50
al-alk	17	17	14.5	21.5	14.5
c/fm	0.14	0.62	0.52	0.35	0.44
ti	0.80	2.02	0.66	0.18	2.30
p	—	—	—	0.16	—

(26) Granite. Daiyûin, Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 514.

(27) Hornblende biotite granodiorite. Takizawa near Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 514.

(28) Hornblende granodiorite. Sawayama near Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 514.

(29) Epi-micro-granodiorite. Motoyama, Hitati, Ibaraki Pref. Anal., not stated. Lit. T. SUZUKI (1929) p. 520.

(30) Micro-granodiorite. Hitati, Ibaraki Pref. Anal., not stated. Lit. Y. FUJITA (1931) p. 672.

	(31)	(32)*	(33)*	(34)*	(35)*
SiO_2	74.90	74.42	74.38	73.80	73.17
TiO_2	0.13	0.27	0.18	—	0.20
Al_2O_3	16.05	13.97	14.33	13.20	15.24
Fe_2O_3	—	0.30	0.26	2.20	0.28
FeO	1.16	1.80	1.40	—	1.43
MnO	tr.	0.07	0.11	0.30	0.13
MgO	0.30	0.29	0.17	0.34	0.28
CaO	0.78	2.05	1.80	1.29	1.82
Na_2O	1.43	3.05	3.10	4.15	3.15
K_2O	4.64	3.40	3.48	4.40	3.54
P_2O_5	0.14	0.21	0.15	—	0.17
$H_2O(+)$	0.56	0.32	0.65	—	0.49
$H_2O(-)$	0.13	0.20	0.26	—	0.21
		ZrO_2 0.02	ZrO_2 0.05	Ig. loss 0.44	ZrO_2 0.07
		S 0.04	S 0.03		S 0.03
Total	100.22	100.41	100.35	100.12	100.21
si	467	417	428	400	402
al	59	46	49	42	49.5
fm	8.5	12.5	10	13	10.5
c	5.5	12.5	11	7.5	10.5
alk	27	29	30	37.5	29.5
k	0.68	0.42	0.43	0.41	0.43
mg	0.30	0.19	0.14	0.20	0.22
al-alk	32	17	19	4.5	20
c/fm	0.65	1.00	1.10	0.58	1.00
ti	0.60	1.15	0.76	—	0.83
p	0.38	0.51	0.38	—	0.40

THE TUKUBA DISTRICT

(31) Oligoclase aplite. Hirasawa, Tukuba, Ibaraki Pref. Anal., S. TANAKA. Lit. K. SUGI (1930) p. 103.

(32) Hornblende mica granite. Ikegame, Kita-naka, Ibaraki Pref. Anal., T. OHASHI. Lit. INOUYE (1912) p. 42.

(33) Biotite granite. Inada (Hikage), Nisi-ibaraki, Ibaraki Pref. Anal., T. OHASHI. Lit. INOUYE (1912) p. 42.

(34) Biotite granite. Inada, Nisi-ibaraki, Ibaraki Pref. Anal., not stated. Lit. Okurasyo (1921) p. 231.

(35) Biotite granite. Inada (Nisizawa), Nisi-ibaraki, Ibaraki Pref. Anal., N. YOSHIOKA. Lit. INOUYE (1912) p. 42.

	(36)*	(37)*	(38)*	(39)*	(40)*
SiO_2	72.11	72.10	71.85	71.80	71.78
TiO_2	—	—	—	0.34	—
Al_2O_3	15.44	14.63	13.53	15.11	14.66
Fe_2O_3	2.74	2.83	3.36	0.28	2.63
FeO	—	—	—	2.03	—
MnO	0.13	0.09	0.04	0.18	0.11
MgO	0.63	0.50	0.32	0.20	0.60
CaO	2.25	2.04	1.77	2.27	2.33
Na_2O	3.13	3.62	4.12	3.24	3.30
K_2O	3.32	3.83	5.01	2.93	4.07
P_2O_5	—	—	—	0.24	—
$H_2O(+)$	—	—	—	0.77	—
$H_2O(-)$	—	—	—	0.32	—
Ig. loss	0.32	0.47	—	—	0.63
				ZrO_2 0.02	
				S 0.05	
Total	100.07	100.31	100.00	99.78	100.11
si	364	367	357	382	360
al	46	44	39.5	47.5	43
fm	16	15	15.5	13	15
c	12	11	9.5	13	13
alk	26	30	35.5	26.5	29
k	0.41	0.41	0.45	0.37	0.45
mg	0.31	0.25	0.16	0.13	0.30
al-alk	20	14	4	21	14
c/fm	0.75	0.73	0.61	1.00	0.87
ti	—	—	—	1.35	—
p	—	—	—	0.55	—

(36) Biotite granite. Iwama, Nisi-ibaraki, Ibaraki Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(37) Biotite granite. Inada, Nisi-ibaraki, Ibaraki Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(38) Granite. Ôgôdo, Nisi-ibaraki, Ibaraki Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(39) Hornblende mica granite. Obata, Makabe, Ibaraki Pref. Anal., T. ÔHASHI. Lit. INOUYE (1912) p. 42.

(40) Biotite granite. Kamiobata, Makabe, Ibaraki Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

	(41)	(42)*	(43)*	(44)*	(45)*
SiO_2	71.58	70.91	70.39	70.07	66.63
TiO_2	0.33	0.36	—	—	0.58
Al_2O_3	14.23	14.36	16.50	14.93	16.28
Fe_2O_3	0.86	0.40	3.09	2.63	0.15
FeO	1.53	2.54	—	—	4.47
MnO	0.01	0.30	0.07	0.30	0.09
MgO	0.90	0.28	0.67	0.34	1.24
CaO	1.80	2.60	2.28	2.20	3.33
Na_2O	4.33	3.30	3.36	4.40	3.53
K_2O	4.30	2.59	2.96	4.30	2.59
P_2O_5	0.12	0.32	—	—	0.21
$H_2O(+)$	0.48	0.89	—	—	0.66
$H_2O(-)$	0.35	0.25	—	—	0.12
Ig. loss	—	—	0.64	0.56	—
		ZrO_2 0.02			
		S 0.11			
Total	100.82	99.23	99.96	99.73	99.88
si	348	369	339	335	277
al	40.5	44	47	42	40
fm	16	16	16.5	13	24
c	9.5	14.5	12	11	15
alk	34	25.5	24.5	34	21
k	0.40	0.35	0.36	0.39	0.33
mg	0.41	0.14	0.30	0.18	0.32
al-alk	6.5	18.5	22.5	8	19
c/fm	0.59	0.91	0.73	0.85	0.63
ti	1.20	1.41	—	—	1.80
p	0.23	0.69	—	—	0.38

(41) Biotite granite. Minederayama near Tukuba, Ibaraki Pref. Anal., Y. KAWANO. Lit. Y. KAWANO (1933) p. 132.

(42) Biotite granite. Sirai, Makabe, Ibaraki Pref. Anal., T. OHASHI. Lit. INOUYE (1912) p. 42.

(43) Biotite granite. Otuka, Niihari, Ibaraki Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(44) Biotite granite. Kitayamauti, Nisi-ibaraki, Ibaraki Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(45) Biotite granite. Hirasawa near Tukuba, Ibaraki Pref. Anal., S. TANAKA. Lit. K. SUGI (1930) p. 103.

	(46)	(47)	(48)	(49)	(50)*
SiO_2	66.41	60.53	56.20	55.48	66.07
TiO_2	—	—	—	—	—
Al_2O_3	20.92	16.24	20.56	19.61	16.35
Fe_2O_3	0.26	0.27	8.55	4.06	5.03
FeO	—	4.88		6.05	—
MnO	—	—	0.16	—	0.09
MgO	tr.	6.44	0.20	3.06	2.00
CaO	1.63	6.77	11.34	8.75	4.25
Na_2O	8.49	2.55	0.92	0.15	3.22
K_2O	tr.	0.12	0.56	1.94	2.38
P_2O_5	—	—	—	—	—
$H_2O(+)$	1.93	1.80	—	—	—
$H_2O(-)$			—	—	—
Ig. loss	—	—	0.92	1.18	0.72
Total	99.64	99.60	99.41	100.28	100.11
si	294	182	173	158	257
al	55	28.5	37	33	37.5
fm	1	42	21	36	26.5
c	7.5	22	37.5	27	18
alk	36.5	7.5	4	4	18
k	0	0.02	0.29	0.91	0.32
mg	0	0.69	0.04	0.36	0.44
al-alk	18.5	21	33.5	29	19.5
c/fm	7.50	0.52	1.79	0.75	0.68
ti	—	—	—	—	—
p	—	—	—	—	—

THE AWA DISTRICT

(46) Quartz diorite (?) Hutoo, Mineoka, Tiba Pref. Anal., FUKUDA. Lit. T. KOCHIBE (1888) p. 26.

(47) Diorite. Isikoyama, Mineoka, Tiba Pref. Anal., FUKUDA. Lit. T. KOCHIBE (1888) p. 27.

THE TANZAWA DISTRICT

(48) Quartz diorite. Hôkizawa, Nakagawa, Kanagawa Pref. Anal., not stated. Lit. H. MURAKAMI (1909) p. 331.

(49) Quartz diorite. Hôkizawa, Nakagawa, Kanagawa Pref. Anal., not stated. Lit. T. HARADA (1890) p. 118.

THE KÔHU DISTRICT

(50) Biotite granite. Takasiba, Jingane, Higasiyamanasi, Yamanasi Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

	(51)	(52)	(53)	(54)*	(55)
SiO_2	74.225	64.48	62.435	77.27	76.34
TiO_2	0.265	0.57	0.772	—	0.10
Al_2O_3	14.846	15.22	16.114	11.96	10.43
Fe_2O_3	0.263	2.25	2.230	1.87	0.60
FeO	0.389	3.04	6.052	—	1.40
MnO	0.021	0.13	0.117	—	0.02
MgO	0.765	2.05	1.977	0.47	0.05
CaO	0.659	4.71	4.019	0.68	1.03
Na_2O	5.456	3.05	4.269	3.74	3.87
K_2O	1.089	2.27	1.071	3.80	4.84
P_2O_5	0.035	0.13	0.212	—	0.04
$H_2O(+)$	1.736	1.19	2.007	—	0.67
$H_2O(-)$	0.532	0.68	0.924	—	0.20
Ig. loss	—	—	—	0.27	—
Total	100.281	99.77	102.199	100.06	99.59
si	427	249	219	485	485
al	50	35	33.5	44.5	39
fm	11	28.5	34.5	13	10.5
c	4	19.5	15	4.5	7
alk	35	17	17	38	43.5
k	0.14	0.33	0.14	0.40	0.45
mg	0.61	0.41	0.30	0.34	0.64
al-alk	15	18	16.5	6.5	−4.5
c/fm	0.36	0.68	0.43	0.35	0.67
ti	1.15	1.65	2.03	—	0.46
p	0.10	0.21	0.32	—	0.11

THE SUWA DISTRICT

(51) Granophyre. Karasawa, Tiisagata, Nagano Pref. Anal., U. USHIJIMA. Lit. F. HOMMA (1931) p. 198.

(52) Granodiorite. Karasawa, Tiisagata, Nagano Pref. Anal., U. USHIJIMA. Lit. F. HOMMA (1931) p. 191.

(53) Quartz diorite. Takenoyu, Buseki, Tiisagata, Nagano Pref. Anal., U. USHIJIMA. Lit. F. HOMMA (1931) p. 192.

THE HIDA DISTRICT

(54) Biotite granite. Koumaya, Minamiazumi, Nagano Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(55) Soda granite porphyry. SW Bank of Kizaki Lake, Nagano Pref. Anal., E. MINAMI. Lit. T. TOMITA (1927) p. 258.

	(56)*	(57)*	(58)*	(59)*	(60)
SiO_2	74.05	72.54	72.18	70.60	63.81
TiO_2	—	—	—	—	—
Al_2O_3	14.26	13.51	15.88	12.65	19.09
Fe_2O_3	1.86	3.44	2.68	3.12	2.63
FeO	—	—	—	—	1.83
MnO	0.12	0.15	0.16	0.54	—
MgO	0.67	0.28	0.42	0.09	1.01
CaO	1.28	1.80	2.87	2.11	6.81
Na_2O	3.46	0.37	3.63	5.29	tr.
K_2O	3.80	6.42	1.78	5.48	3.14
P_2O_5	—	—	—	—	—
$H_2O(+)$	—	—	—	—	1.33
$H_2O(-)$	—	—	—	—	
Ig. loss	0.62	0.28	0.51	0.12	—
Total	100.12	98.79	100.11	100.00	99.65
si	408	415	363	331	249
al	46.5	45.5	47	35	44
fm	14	18	14	14	19.5
c	7.5	11	15.5	10.5	28.5
alk	32	25.5	23.5	40.5	8
k	0.42	0.92	0.24	0.40	1.00
mg	0.40	0.13	0.22	0.04	0.30
al–alk	14.5	20	23.5	−5.5	36
c/fm	0.54	0.61	1.11	0.75	1.46
ti	—	—	—	—	—
p	—	—	—	—	—

THE KISO DISTRICT

(56) Two mica granite. Tokiwa, Nukada, Aiti Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(57) Granite. Takahasi, Nisikamo, Aiti Pref. Anal., not stated. Lit. I. OYAMA (1926) p. 395.

(58) Two mica granite. Tokiwa, Nukada, Aiti Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(59) Granite. Isino, Nisikamo, Aiti Pref. Anal., not stated. Lit. I. OYAMA (1926) p. 395.

(60) So-called Kasio-gneiss. Tôyamagawa, Simoina, Nagano Pref. Anal., not stated. Lit. T. HARADA (1890) p. 42.

	(61)	(62)	(63)*	(64)*	(65)*
SiO_2	58.97	75.93	73.86	72.43	76.71
TiO_2	—	tr.	tr.	0.28	0.14
Al_2O_3	20.37	13.73	13.49	14.11	12.81
Fe_2O_3	1.25	0.23	0.38	0.23	0.80
FeO	6.88	0.82	2.46	0.39	1.72
MnO	—	0.53	0.32	0.22	0.27
MgO	0.21	0.15	0.10	0.77	0.40
CaO	5.47	0.87	1.17	2.08	1.90
Na_2O	1.32	2.91	3.37	3.12	1.76
K_2O	3.11	4.80	3.53	3.13	1.48
P_2O_5	—	tr.	0.24	0.27	0.48
$H_2O(+)$	1.01	—	—	—	0.77
$H_2O(-)$		—	—	—	0.33
Ig. loss	—	0.37	1.23	1.22	—
					ZrO_2 0.03
					S 0.06
Total	98.59	100.34	100.15	100.25	99.66
si	209	459	420	417	507
al	42.5	49	45	48	50
fm	25	9.5	16	10.5	19
c	21	6	7.5	13	13.5
alk	11.5	35.5	31.5	28.5	17.5
k	0.61	0.52	0.41	0.40	0.36
mg	0.04	0.15	0.06	0.63	0.21
al-alk	31	13.5	13.5	19.5	32.5
c/fm	0.84	0.63	0.47	1.24	0.71
ti	—	—	—	1.22	0.68
p	—	—	0.58	0.66	1.35

(61) So-called Kasio-gneiss. Yôkaiti, Simoina, Nagano Pref. Anal., not stated. Lit. T. HARADA (1890) p. 42.

THE HIEI DISTRICT

(62) Granite aplite. Yamagami, near Kyôto. Anal., Imp. Geol. Surv. Lit. T. HIKI (1917) p. 255.

(63) Granite porphyry. Yamagami near Kyôto. Anal., Imp. Geol. Surv. Lit. T. HIKI (1917) p. 256.

(64) Biotite granite. Sengokuiwa, Yamagami near Kyôto. Anal., Imp. Geol. Surv. Lit. T. HIKI (1917) p. 255.

THE ROKKÔ-AWAZI DISTRICT

(65) Pyroxene bearing granite. Kôzinsan, Sumiyosi, Hyôgo Pref. Anal., Imp. Geol. Surv. Lit. S. SHIMIZU (1911) p. 32.

	(66)*	(67)*	(68)*	(69)*	(70)*
SiO_2	74.07	74.05	73.20	72.41	76.41
TiO_2	—	—	—	—	—
Al_2O_3	12.56	14.26	14.23	14.82	13.40
Fe_2O_3	2.98	1.86	2.81	2.58	1.85
FeO	—	—	—	—	—
MnO	0.09	0.12	0.07	0.09	—
MgO	0.45	0.67	0.30	0.44	0.19
CaO	1.09	1.28	1.49	1.50	1.26
Na_2O	3.98	3.46	4.02	4.48	4.04
K_2O	4.32	3.80	3.22	3.39	2.71
P_2O_5	—	—	—	—	—
$H_2O(+)$	—	—	—	—	0.34
$H_2O(-)$	—	—	—	—	
Ig. loss	0.43	0.62	0.29	0.36	—
Total	99.97	100.12	99.63	100.07	100.20
si	408	409	394	371	459
al	41	46.5	45	44.5	47.5
fm	16	14	14	13.5	10
c	6.5	7.5	9	8.5	8.5
alk	36.5	32	32	33.5	34
k	0.42	0.42	0.34	0.33	0.31
mg	0.22	0.40	0.16	0.25	0.18
al–alk	4.5	14.5	13	11	13.5
c/fm	0.41	0.54	0.64	0.63	0.85
ti	—	—	—	—	—
p	—	—	—	—	—

(66) Biotite granite. Sumiyosi, Hyôgo Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

THE TANGO DISTRICT

(67) Biotite granite. Musôyama, Kunta, Yosa, Kyôto Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 94.

(68) Hornblende granite. Yura, Kasa, Kyôto Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(69) Biotite granite. Odazyukuno, Kunta, Yosa, Kyôto Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

THE OKAYAMA DISTRICT

(70) Granite. Kitagi Island, Oda, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

	(71)*	(72)*	(73)*	(74)*	(75)*
SiO_2	76.28	76.07	75.74	74.78	74.77
TiO_2	—	—	—	0.13	—
Al_2O_3	13.85	12.16	12.78	13.66	14.45
Fe_2O_3	1.18	2.01	2.02	0.30	1.72
FeO	—	—	—	0.96	—
MnO	0.09	0.08	0.06	0.33	0.06
MgO	0.31	0.29	0.53	1.34	0.31
CaO	1.64	1.03	1.66	1.90	1.14
Na_2O	3.42	3.69	3.67	2.74	4.22
K_2O	3.16	2.83	3.40	2.75	3.18
P_2O_5	—	—	—	0.19	—
$H_2O(+)$	—	—	—	0.55	—
$H_2O(-)$	—	—	—	0.15	—
Ig. loss	0.40	0.53	0.52	—	0.32
				ZrO_2 0.02	
				S 0.08	
Total	100.33	98.69	100.38	99.88	100.17
si	455	485	435	419	422
al	49	46	43	45.5	48
fm	8.5	12.5	13.5	18.5	10.5
c	10.5	7	10.5	11.5	7
alk	32	34.5	33	24.5	34.5
k	0.38	0.33	0.38	0.40	0.33
mg	0.33	0.21	0.33	0.60	0.26
al–alk	17	11.5	10	21	13.5
c/fm	1.24	0.56	0.78	0.62	0.67
ti	—	—	—	0.54	—
p	—	—	—	0.44	—

(71) Biotite granite. Dônoue, Kitagi Island, Oda, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(72) Hornblende biotite granite. Tangazima, Sikama, Hyôgo Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(73) Biotite granite. Kitagi Island, Noda, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(74) Biotite granite. Inusima, Oku, Okayama Pref. Anal., N. Yoshioka. Lit. S. Shimizu (1911) pp. 32–33.

(75) Biotite granite. Kitagi Island, Oda, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

	(76)*	(77)*	(78)*	(79)*	(80)*
SiO_2	74.41	74.16	73.94	73.64	73.62
TiO_2	0.20	—	—	—	0.21
Al_2O_3	13.81	12.86	13.06	14.91	14.86
Fe_2O_3	0.75	1.70	1.97	1.85	0.29
FeO	1.19	—	—	—	1.24
MnO	0.18	0.03	0.01	—	0.18
MgO	0.83	0.16	0.17	0.32	0.75
CaO	2.38	0.80	1.40	1.76	3.45
Na_2O	2.08	5.90	3.92	3.43	2.26
K_2O	2.01	4.21	5.10	4.05	2.39
P_2O_5	0.36	—	—	—	0.19
$H_2O(+)$	0.68	—	—	0.37	0.71
$H_2O(-)$	0.22	—	—		0.16
Ig. loss	—	0.28	0.64		—
	ZrO_2 0.05 S 0.12				ZrO_2 0.08 S 0.06
Total	99.27	100.10	100.21	100.33	100.45
si	438	403	410	399	393
al	48	41.5	43	48	46.5
fm	17.5	8	9.5	10	14
c	15	4.5	8.5	10	20
alk	19.5	46	39	32	19.5
k	0.38	0.32	0.46	0.44	0.41
mg	0.42	0.16	0.14	0.26	0.44
al–alk	28.5	—4.5	4	16	27
c/fm	0.86	0.56	0.89	1.00	1.43
ti	0.89	—	—	—	0.84
p	0.89	—	—	—	0.42

(76) Hornblende mica granite. Iesima, Sikama, Hyôgo Pref. Anal., Imp. Geol. Surv. Lit. S. SHIMIZU (1911) pp. 32–33.

(77) Biotite granite. Inusima, Oku, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(78) Biotite hornblende granite. Yosimune, Mitu, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(79) Granite. Turuisi, Kitagi Island, Oda, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(80) Pyroxene bearing granite. Kitagi Island, Oda, Okayama Pref. Anal., N. YOSHIOKA. Lit. S. SHIMIZU (1911) pp. 32–33.

	(81)*	(82)*	(83)*	(84)*	(85)*
SiO_2	72.79	72.75	72.65	72.55	72.31
TiO_2	—	0.42	0.29	0.40	—
Al_2O_3	13.68	14.39	14.55	13.40	13.92
Fe_2O_3	3.34	0.41	0.37	0.68	3.15
FeO	—	2.43	1.55	2.02	—
MnO	0.09	0.18	0.36	0.33	0.05
MgO	0.33	1.21	0.85	0.51	0.30
CaO	1.64	2.95	3.57	2.65	1.67
Na_2O	4.80	2.21	3.15	3.62	4.63
K_2O	3.16	2.08	2.02	2.98	3.66
P_2O_5	—	0.51	0.25	0.18	—
$H_2O(+)$	—	0.37	0.48	0.65	—
$H_2O(-)$	—	0.13	0.17	0.20	—
Ig. loss	0.33	—	—	—	0.38
		ZrO_2 0.07	ZrO_2 0.07	ZrO_2 0.07	
		S 0.09	S 0.07	S 0.11	
Total	100.16	100.20	100.40	100.35	100.07
si	371	373	365	372	367
al	41	43.5	43	40.5	41.5
fm	16	22	15.5	17	14.5
c	9	16.5	19.5	14.5	9
alk	34	18	22	28	35
k	0.31	0.38	0.29	0.36	0.34
mg	0.16	0.42	0.40	0.24	0.15
al-alk	7	25.5	21	12.5	6.5
c/fm	0.56	0.75	1.26	0.85	0.62
ti	—	1.60	1.09	1.55	—
p	—	1.11	0.55	0.40	—

(81) Biotite granite. Man'nari, Mitu, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(82) Biotite granite. Siou, Kozima, Okayama Pref. Anal., N. YOSHIOKA. Lit. S. SHIMIZU (1911) pp. 32–33.

(83) Biotite granite. Kitagi Island, Oda, Okayama Pref. Anal., N. YOSHIOKA. Lit. S. SHIMIZU (1911) pp. 32–33.

(84) Hornblende mica granite. Man'nari, Mitu, Okayama Pref. Anal., N. YOSHIOKA. Lit. S. SHIMIZU (1911) pp. 32–33.

(85) Biotite granite. Man'nari, Mitu, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

	(86)*	(87)*	(88)	(89)*	(90)*
SiO_2	72.20	71.67	55.16	74.60	74.11
TiO_2	—	—	—	0.21	—
Al_2O_3	13.29	14.65	25.02	13.87	13.45
Fe_2O_3	2.71	2.56	10.14	0.15	1.99
FeO	—	—	—	1.55	—
MnO	0.05	0.10	—	0.72	0.10
MgO	0.38	0.48	2.52	0.34	0.34
CaO	1.58	1.76	5.25	2.25	1.42
Na_2O	5.61	3.03	0.68	3.14	4.46
K_2O	3.91	5.52	tr.	2.51	3.97
P_2O_5	—	—	—	0.41	—
$H_2O(+)$	—	—	} 0.25	0.73	—
$H_2O(-)$	—	—		0.12	—
Ig. loss	0.42	0.31	—	—	0.34
			CO_2 tr.	ZrO_2 0.06	
			S tr.	S 0.06	
Total	100.15	100.08	99.02	100.72	100.18
si	357	364	169	419	403
al	39	43.5	45.5	46	43.5
fm	13	14	35	14	11
c	8.5	9.5	17.5	13.5	8
alk	39.5	33	2	26.5	37.5
k	0.32	0.55	0	0.35	0.37
mg	0.20	0.27	0.33	0.20	0.24
al-alk	−0.5	10.5	43.5	19.5	6
c/fm	0.65	0.68	0.50	0.96	0.78
ti	—	—	—	0.88	—
p	—	—	—	0.98	—

(86) Biotite granite. Nisikataoka, Oku, Okoyama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(87) Biotite granite. Mugusima, Simotuwi, Okayama Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(88) Diorite. Yanahara Mine. Okayama Pref. Anal., K. MURAKAMI. Lit. M. KUHARA (1920) p. 170.

THE SANUKI DISTRICT

(89) Biotite granite. Hukuda, Syôdo Island, Kagawa Pref. Anal., Imp. Geol. Surv. Lit. S. SHIMIZU (1911) pp. 32–33.

(90) Biotite granite. Kitaura, Syôdo Island, Kagawa Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

	(91)*	(92)*	(93)*	(94)*	(95)*
SiO_2	73.60	72.18	72.00	71.67	71.17
TiO_2	—	—	—	—	—
Al_2O_3	14.25	14.75	15.30	14.59	15.78
Fe_2O_3	2.77	2.99	2.29	3.21	2.71
FeO	—	—	—	—	—
MnO	—	0.40	0.53	0.08	0.08
MgO	0.20	0.53	0.39	0.50	0.57
CaO	2.00	1.66	1.51	2.21	2.64
Na_2O	4.29	3.92	4.18	4.39	3.85
K_2O	2.98	3.26	3.42	3.07	2.72
P_2O_5	—	—	—	—	—
$H_2O(+)$	0.29	—	—	—	—
$H_2O(-)$		—	—	—	—
Ig. loss	—	0.36	0.40	0.43	0.52
Total	100.38	100.05	100.02	100.15	100.04
si	386	365	365	351	346
al	44	44	46	42	45
fm	12.5	17	14.5	15.5	14.5
c	11.5	9	8	11.5	14
alk	32	30	31.5	31	26.5
k	0.32	0.36	0.35	0.32	0.32
mg	0.13	0.23	0.21	0.23	0.29
al–alk	12	14	14.5	11	18.5
c/fm	0.92	0.53	0.55	0.74	0.97
ti	—	—	—	—	—
p	—	—	—	—	—

(91) Granite. Yosima, Nakatado, Kagawa Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 231.

(92) Hornblende biotite granite. Hirosima, Nakatado, Kagawa Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(93) Biotite granite, Yosima, Nakatado, Kagawa Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(94) Biotite granite. Tonosyo Town, Syodo Island, Kagawa Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(95) Biotite granite. Adi, Kida, Kagawa Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

	(96)*	(97)*	(98)*	(99)*	(100)*
SiO_2	70.70	70.13	75.24	74.23	74.12
TiO_2	0.57	—	0.20	—	—
Al_2O_3	15.96	15.51	14.25	13.73	13.17
Fe_2O_3	0.17	3.28	0.78	0.71	3.76
FeO	2.37	—	1.50	—	—
MnO	0.62	0.37	0.36	0.21	0.20
MgO	1.12	0.47	0.29	0.29	0.34
CaO	2.98	1.49	1.45	0.71	1.64
Na_2O	2.31	4.20	2.10	4.80	1.97
K_2O	2.02	3.90	2.32	5.32	4.70
P_2O_5	0.31	—	0.05	—	—
$H_2O(+)$	0.92	—	0.34	—	—
$H_2O(-)$	0.13	—	0.26	—	—
Ig. loss	—	0.76	—	0.36	0.44
	ZrO_2 0.09 S 0.07		ZrO_2 0.07 S 0.12		
Total	100.34	100.11	99.33	100.36	100.34
si	346	336	467	410	412
al	46	44	52	44.5	43.5
fm	21	16.5	16	6.5	19.5
c	16	8	10	4.5	9.5
alk	17	31.5	22	44.5	27.5
k	0.36	0.38	0.42	0.43	0.61
mg	0.39	0.21	0.16	0.37	0.14
al–alk	29	12.5	30	0	16
c/fm	0.76	0.48	0.63	0.69	0.49
ti	2.09	—	0.94	—	—
p	0.65	—	0.11	—	—

(96) Hornblende granite. Adi, Kida, Kagawa Pref. Anal., Imp. Geol. Surv. Lit. S. SHIMIZU (1911) pp. 32–33.

(97) Biotite granite. Adi, Kida, Kagawa Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

THE HIROSIMA DISTRICT

(98) Biotite granite. Kurahasi Island, Aki, Hirosima Pref. Anal., N. YOSHIOKA. Lit. S. SHIMIZU (1911) pp. 32–33.

(99) Biotite granite. Momosima, Numakuma, Hirosima Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(100) Granite. Otate, Kurahasi Island, Aki, Hirosima Pref. Anal., not stated. Lit. I. OYAMA (1926) p. 395.

	(101)*	(102)*	(103)*	(104)*	(105)
SiO_2	71.43	70.95	68.18	65.04	64.78
TiO_2	—	—	0.48	0.27	0.44
Al_2O_3	16.74	14.84	15.26	16.45	14.72
Fe_2O_3	0.26	3.21	1.28	1.59	1.04
FeO	—	—	2.94	2.16	3.23
MnO	—	0.27	0.70	0.31	0.34
MgO	0.55	0.37	1.09	1.66	1.71
CaO	2.07	1.74	3.95	3.48	3.29
Na_2O	4.32	3.12	2.47	3.47	2.40
K_2O	3.86	4.26	2.05	2.70	2.65
P_2O_5	—	—	0.20	—	0.16
$H_2O(+)$	—	—	} 1.54	—	} 5.18
$H_2O(-)$	—	—		—	
Ig. loss	0.80	0.36	—	3.06	—
Total	100.03	99.12	100.14	100.19	99.94
si	360	363	302	268	286
al	50	44.5	40	40	38.5
fm	5	16.5	25	23.5	28
c	11	9.5	18.5	15.5	15.5
alk	34	29.5	16.5	21	18
k	0.37	0.47	0.35	0.34	0.42
mg	0.82	0.17	0.29	0.43	0.40
al-alk	16	15	23.5	19	20.5
c/fm	2.20	0.58	0.74	0.66	0.55
ti	—	—	1.60	0.84	1.47
p	—	—	0.37	—	0.29

(101) Biotite granite. Higasi-nômi Island, Saeki, Hirosima Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(102) Biotite granite. Mukai Island, Mituki, Hirosima Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(103) Biotite granite. Tamori, Hiba, Hirosima Pref. Anal., Imp. Geol. Surv. Lit. T. OGURA (1922) p. 19.

(104) Quartz diorite. Tozyo Town, Hirosima Pref. Anal., Imp. Geol. Surv. Lit. T. OGURA (1922) p. 22.

(105) Quartz diorite. Niizaka, Kamiisi, Hirosima Pref. Anal., Imp. Geol. Surv. Lit. T. OGURA (1922) p. 15.

	(106)	(107)	(108)	(109)*	(110)*
SiO_2	61.65	56.73	50.23	71.50	71.10
TiO_2	0.59	0.64	0.83	—	—
Al_2O_3	16.95	18.14	22.33	15.33	15.38
Fe_2O_3	1.99	0.64	1.20	3.17	3.45
FeO	3.95	6.67	7.96	—	—
MnO	0.42	0.80	0.48	0.18	0.39
MgO	1.91	2.70	2.33	0.64	0.55
CaO	5.38	6.57	9.67	2.67	2.89
Na_2O	2.65	2.68	1.30	3.26	3.93
K_2O	2.07	1.91	1.08	2.44	1.53
P_2O_5	0.19	0.24	tr.	—	—
$H_2O(+)$	} 2.55	} 2.46	} 2.56	—	—
$H_2O(-)$				—	—
Ig. loss	—	—	—	0.64	0.69
Total	100.30	100.18	99.97	99.83	99.91
si	222	175	135	353	342
al	36	33	35.5	44.5	43.5
fm	29	33.5	31	17.5	18.5
c	21	22	28	14.5	15
alk	14	11.5	5.5	23.5	23
k	0.34	0.32	0.36	0.33	0.20
mg	0.35	0.37	0.30	0.27	0.22
al–alk	22	21.5	30	21	20.5
c/fm	0.72	0.66	0.90	0.83	0.81
ti	1.61	1.49	1.69	—	—
p	0.28	0.32	—	—	—

(106) Hornblende quartz diorite. Moriwaki, Tamori, Hiba, Hirosima Pref. Anal., Imp. Geol. Surv. Lit. T. OGURA (1922) p. 19.

(107) Biotite hornblende quartz diorite. Sitihuku Mine, Hirosima Pref. Anal., Imp. Geol. Surv. Lit. T. OGURA (1922) p. 20.

(108) Pyroxene quartz diorite. Sikahuka Pass, Hirosima Pref. Anal., Imp. Geol. Surv. Lit. T. OGURA (1922) p. 21.

THE IYO DISTRICT

(109) Hornblende biotite granite. Yosyokuni, Ôsima, Ehime Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(110) Hornblende biotite granite. Miyanokubo, Ôsima, Ehime Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

	(111)*	(112)	(113)*	(114)	(115)*
SiO_2	68.44	53.42	66.35	75.96	75.64
TiO_2	0.05	1.92	0.96	0.80	0.05
Al_2O_3	17.68	17.68	14.54	12.02	12.87
Fe_2O_3	1.04	1.34	0.39	tr.	0.86
FeO	1.00	6.55	5.61	1.48	0.11
MnO	0.07	0.17	0.03	tr.	0.08
MgO	0.40	2.99	1.60	0.24	0.84
CaO	0.97	5.93	2.03	1.35	1.29
Na_2O	8.53	4.77	2.36	3.56	3.70
K_2O	1.94	1.94	3.27	3.98	4.22
P_2O_5	tr.	0.93	0.17	0.03	tr.
$H_2O(+)$	—	1.72	—	0.20	—
$H_2O(-)$	—	0.68	—	0.20	—
Ig. loss	—	—	2.60	—	0.37
Total	100.12	100.04	99.91	99.82	100.03
si	293	158	294	470	438
al	44.5	31	38	44	44
fm	10	32.5	33	10	12
c	4.5	19	9.5	9	8
alk	41	17.5	19.5	37	36
k	0.13	0.21	0.48	0.42	0.43
mg	0.26	0.40	0.33	0.22	0.62
al–alk	3.5	13.5	18.5	7	8
c/fm	0.45	0.58	0.29	0.90	0.67
ti	0.16	4.28	3.21	3.73	0.35
p	—	1.16	0.32	0.07	—

(111) Aegirine-augite monzonite. Iwaki Island, Ehime Pref. Anal., A. KAN'NARI. Lit. J. SUZUKI and T. NEMOTO (1932) p. 10.

THE SAN'IN DISTRICT

(112) Diorite aplite. Sasako, Simane Pref. Anal., K. YAMAGUCHI. Lit. K. YAMAGUCHI (1929) p. 223.

THE OKI DISTRICT

(113) Schistose granitic rock. Near Huse, Dôgo, Oki Island. Anal., K. YOKOYAMA. Lit. S. KÔZU (1913) p. 35.

THE YAMAGUTI DISTRICT

(114) Granite aplite. The north of Mitaziri, Yamaguti Pref. Anal., W. H. HERDSMAN. Lit. T. OGURA (1928) p. 143.

(115) Biotite granite. Yonokida near Ohuku Mine, Yamaguti Pref. Anal., A. KAN'NARI. Lit. J. SUZUKI (1932) p. 84.

	(116)*	(117)*	(118)*	(119)*	(120)*
SiO_2	74.19	73.38	73.19	73.14	73.02
TiO_2	—	—	—	—	—
Al_2O_3	13.82	14.01	13.81	14.01	12.69
Fe_2O_3	4.29	2.69	2.98	2.85	4.56
FeO	—	—	—	—	—
MnO	0.82	0.15	0.13	0.16	0.14
MgO	0.38	0.38	0.61	0.47	0.39
CaO	2.45	1.71	1.83	1.76	2.19
Na_2O	1.38	3.13	3.55	3.13	3.53
K_2O	2.29	2.07	3.48	2.39	2.58
P_2O_5	—	—	—	—	—
$H_2O(+)$	—	—	—	—	—
$H_2O(-)$	—	—	—	—	—
Ig. loss	0.82	0.34	0.49	0.39	0.08
Total	100.44	97.86	100.07	98.30	99.18
si	410	426	384	413	383
al	45	48	42.5	46.5	39
fm	25	15.5	17	17	22
c	14.5	11	10.5	10.5	12.5
alk	15.5	25.5	30	26	26.5
k	0.52	0.30	0.39	0.33	0.32
mg	0.12	0.20	0.28	0.24	0.14
al-alk	29.5	22.5	12.5	20.5	12.5
c/fm	0.58	0.71	0.62	0.62	0.57
ti	—	—	—	—	—
p	—	—	—	—	—

(116) Biotite granite. Ôtu Island, Yamaguti Pref. Anal., Imp. Geol. Surv. Lit. T. SUZUKI (1907) p. 64.

(117) Biotite granite. Ôtu Island, Yamaguti Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(118) Biotite granite. Kurokami Island, Tuno, Yamaguti Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(119) Granite. Kurokami Island, Tuno, Yamaguti Pref. Anal., not stated. Lit. I. OYAMA (1926) p. 392.

(120) Granite. Kaeru Island, Tuno, Yamaguti Pref. Anal., not stated. Lit. I. OYAMA (1926) p. 395.

	(121)*	(122)*	(123)*	(124)	(125)*
SiO_2	72.86	72.65	72.57	71.83	70.75
TiO_2	—	0.40	0.21	—	0.92
Al_2O_3	14.22	14.20	14.72	14.20	13.92
Fe_2O_3	2.88	0.73	0.32	3.98	tr.
FeO	—	2.38	1.12	—	2.62
MnO	0.21	0.48	—	0.39	tr.
MgO	0.43	0.30	1.28	0.88	0.94
CaO	1.74	2.22	4.65	1.55	3.25
Na_2O	3.25	2.63	2.42	1.05	3.59
K_2O	1.64	2.69	1.76	2.24	3.41
P_2O_5	—	0.15	0.75	0.15	0.07
$H_2O(+)$	—	0.75	—	—	0.30
$H_2O(-)$	—	0.15	—	—	0.20
Ig. loss	0.34	—	0.55	3.40	—
		ZrO_2 0.05			CO_2 nil
		S 0.08			S tr.
Total	97.57	99.86	100.35	99.67	99.97
si	418	394	357	416	337
al	48	45.5	43	48.5	39
fm	17.5	18.5	15.5	27.5	17.5
c	10.5	13	24.5	9.5	16.5
alk	24	23	17	14.5	27
k	0.25	0.41	0.33	0.59	0.38
mg	0.22	0.13	0.62	0.28	0.38
al–alk	24	22.5	26	34	12
c/fm	0.60	0.70	1.58	0.35	0.94
ti	—	1.63	0.77	—	3.30
p	—	0.36	1.57	0.38	0.14

(121) Biotite granite. Ôtu Island, Tuno, Yamaguti Pref. Anal., not stated. Lit. Ôkurasyô (1921) p. 233.

(122) Hornblende biotite granite. Kaeru Island, Tuno, Yamaguti Pref. Anal., N. YOSHIOKA. Lit. S. SHIMIZU (1911) pp. 32–33.

(123) Biotite granite. Hutamatase, Asa, Yamaguti Pref. Anal., Imp. Geol. Surv. Lit. T. OGURA (1922) p. 28.

(124) Granite porphyry. The northwest of Yamaguti Town, Yamaguti Pref. Anal., Imp. Geol. Surv. Lit. T. SUZUKI (1907) p. 67.

(125) Biotite granite. Mt. Tatara near Mitaziri, Yamaguti Pref. Anal., W. H. HERDSMAN. Lit. T. OGURA (1928) p. 143.

	(126)	(127)	(128)	(129)	(130)*
SiO_2	64.40	64.05	57.50	68.20	75.24
TiO_2	1.00	0.38	—	—	0.36
Al_2O_3	18.44	20.42	16.98	15.66	12.71
Fe_2O_3	0.03	1.92	9.95	4.70	0.70
FeO	4.00	2.96	—	—	1.19
MnO	0.18	1.81	0.68	—	0.03
MgO	1.64	0.75	4.03	1.10	0.40
CaO	4.75	3.67	7.56	5.00	1.33
Na_2O	3.10	1.40	1.03	} 3.30	2.19
K_2O	2.60	2.22	1.32		4.63
P_2O_5	0.09	0.41	0.21	—	0.07
$H_2O(+)$	—	—	—	—	0.51
$H_2O(-)$	—	—	—	—	0.20
Ig. loss	0.65	0.21	1.38	0.62	—
				S 0.44	
				Cu tr.	
Total	100.88	100.20	100.64	99.56(?)	99.56
si	241	252	168	—	467
al	41	47.5	29.5	—	46.5
fm	22.5	26	41.5	—	13
c	19	15.5	23.5	—	9
alk	17.5	11	5.5	—	31.5
k	0.36	0.51	0.45	—	0.58
mg	0.41	0.17	0.43	—	0.29
al-alk	23.5	36.5	24	—	15
c/fm	0.84	0.60	0.57	—	0.69
ti	2.82	1.11	—	—	1.69
p	0.14	0.69	0.26	—	0.19

(126) Tonalite. Ohuku Mine, Miné, Yamaguti Pref. Anal., A. KAN'NARI. Lit. J. SUZUKI (1932) p. 83.

(127) Granodiorite. Ono, Asa, Yamaguti Pref. Anal., Imp. Geol. Surv. Lit. T. OGURA (1922) p. 29.

(128) Pyroxene diorite. Sakura-yama, near Isa, Yamaguti Pref. Anal., Imp. Geol. Surv. Lit. T. SUZUKI (1907) p. 71.

MIDDLE KYÛSYÛ

(129) Granite porphyry. Makimine, Miyazaki Pref. Anal., Ikuno Mine. Lit. TSUDA (1925) p. 224.

SOUTHERN KYÛSYÛ

(130) Two mica granite. Tarumi, Kimotuki, Kagosima Pref. Anal., K. YAMAGUCHI. Lit. K. YAMAGUCHI (1929) p. 109.

	(131)*	(132)*	(133)*	(134)	(135)*
SiO_2	67.92	65.94	79.74	72.55	72.35
TiO_2	0.58	0.62	0.54	—	0.42
Al_2O_3	15.57	15.88	14.70	14.13	12.93
Fe_2O_3	1.22	2.39	} 0.46	0.65	1.12
FeO	2.49	2.93		1.79	1.79
MnO	0.06	0.06	—	—	—
MgO	1.73	1.89	0.14	—	0.73
CaO	3.97	4.73	1.49	3.53	3.51
Na_2O	1.65	2.83	} 0.14	4.47	3.29
K_2O	3.84	3.07		2.71	2.56
P_2O_5	0.12	0.13	—	tr.	—
$H_2O(+)$	0.40	0.23	—	0.37	} 1.94
$H_2O(-)$	0.18	0.07	—	—	
Ig. loss	—	—	3.31	—	—
Total	99.73	100.77	100.52	100.20	100.64
si	292	250	—	359	367
al	39.5	35.5	—	41	39
fm	24.5	27.5	—	10	17.5
c	18.5	19	—	19	19
alk	17.5	18	—	30	24.5
k	0.60	0.42	—	0.29	0.34
mg	0.46	0.39	—	0	0.32
al-alk	22	17.5	—	11	14.5
c/fm	0.76	0.69	—	1.90	1.09
ti	1.87	1.76	—	—	1.59
p	0.21	0.21	—	—	—

(131) Biotite granite. Xenolith in volcanic ejecta, Sakihanadaira, Tarumi, Kimotuki, Kagosima Pref. Anal., K. YAMAGUCHI. Lit. K. YAMAGUCHI (1929) p. 113.

(132) Biotite granite. Block in pumice bed, Sakihanadaira, Tarumi, Kimotuki, Kagosima Pref. Anal., K. YAMAGUCHI. Lit. K. YAMAGUCHI (1929) p. 106.

THE GOTÔ ISLANDS

(133) Dioritic granite. Utô-san, Hukae Island. Anal., K. YOKOYAMA. Lit. S. KÔZU (1912) p. 46.

(134) Adamellite porphyry. Okuura, Hukae Island. Anal., K. YOKOYAMA. Lit. S. KÔZU (1917) p. 240.

(135) Dioritic granite. Okuura, Hukae Island. Anal., K. YOKOYAMA. Lit. S. KÔZU (1912) p. 32.

分析表中ノ花崗岩質岩石ノ産地

Localities of granitic rocks, cited in the list of chemical analyses. (in Japanese)

北海道及千島

(1) 十勝國上川郡清水村清水石切場
(2) 北見國枝幸郡枝幸村乙忠部
(3) 天鹽國上川郡上士別村上士別
(4) 石狩國雨龍郡多度志村幌成
(5) 千島國得撫島鴨川
(6) 十勝國廣尾郡廣尾村音調津
(7) 天鹽國上川郡下川村一ノ橋
(8) 後志國瀛棚郡利別村美利加
(9) 後志國太櫓郡太櫓村水垂岬
(10) 後志國奥尻郡奥尻島彌右衞門岬
(11) 後志國太櫓郡太櫓村ラルイシ
(12) 北見國枝幸郡枝幸村オタルペン

北上地方

(13) 岩手縣盛岡市外中野村
(14) 岩手縣盛岡市外天神山

秋田地方

(15) 秋田縣北秋田郡水無村阿仁鑛山元澤坑

阿武隈地方

(16) 宮城縣伊具郡館山村山田
(17) 福島縣相馬郡石神村馬場
(18) 福島縣双葉郡上岡村瀧川
(19) 福島縣双葉郡苅野村畫曾根

日立地方

(20) 茨城縣多賀郡日立鑛山附近
(21) 茨城縣久慈郡中里村入四間
(22) 茨城縣多賀郡日立鑛山神峯山
(23) 茨城縣多賀郡坂上村森山
(24) 茨城縣久慈郡河內村町屋
(25) 茨城縣久慈郡機初村高貫
(26) 茨城縣多賀郡日立鑛山大雄院
(27) 茨城縣久慈郡中里村瀧澤
(28) 茨城縣久慈郡譽田村澤山
(29) 茨城縣多賀郡日立鑛山元山
(30) 茨城縣多賀郡日立鑛山元山

筑波地方

(31) 茨城縣筑波郡小田村平澤
(32) 茨城縣西茨城郡北那珂村池龜二號丁場
(33) 茨城縣西茨城郡西山內村稻田日蔭丁場
(34) 茨城縣西城茨郡西山內村稻田
(35) 茨城縣西茨城郡西山內村稻田西澤丁場
(36) 茨城縣西茨城郡岩間村難台山
(37) 茨城縣西茨城郡西山內村稻田
(38) 茨城縣西茨城郡西山內村大鄕戶
(39) 茨城縣眞壁郡樺穗村小幡藤田山丁場
(40) 茨城縣眞壁郡樺穗村上小幡
(41) 茨城縣新治郡柿岡町西方峯寺山
(42) 茨城縣眞壁郡樺穗村白井多喜石丁場
(43) 茨城縣新治郡戀瀨村大塚
(44) 茨城縣西茨城郡西山內村
(45) 茨城縣筑波郡小田村平澤

安房地方

(46) 千葉縣安房郡太尾村不動
(47) 千葉縣安房郡貝渚村石子山

丹澤地方

(48) 神奈川縣足柄上郡中川村箒澤
(49) 神奈川縣足柄上郡中川村箒澤

甲府地方

(50) 山梨縣東山梨郡神金村高芝

諏訪地方

(51) 長野縣小縣郡和田村唐澤
(52) 長野縣小縣郡和田村唐澤
(53) 長野縣小縣郡武石村岳ノ湯

飛彈地方

(54) 長野縣南安曇郡有明村古厩
(55) 長野縣北安曇郡木崎湖西南畔 (平村小熊山)

木曾地方

(56) 愛知縣額田郡常盤村
(57) 愛知縣西加茂郡高橋村
(58) 愛知縣額田郡常盤村
(59) 愛知縣西加茂郡石野村富田
(60) 長野縣下伊那郡大鹽村遠山川
(61) 長野縣下伊那郡八日市

比叡地方

(62) 滋賀縣滋賀郡滋賀村山上
(63) 滋賀縣滋賀郡滋賀村山上
(64) 滋賀縣滋賀郡滋賀村山上

六甲—淡路地方

(65) 兵庫縣武庫郡住吉村荒神山
(66) 兵庫縣武庫郡住吉村

丹後地方

(67) 京都府與謝郡栗田村小田宿野無双山
(68) 京都府加佐郡由良村
(69) 京都府與謝郡栗田村小田宿野

岡山地方

(70) 岡山縣小田郡北木島
(71) 岡山縣小田郡北木島村堂ノ上
(72) 兵庫縣飾磨郡家島村男鹿島
(73) 岡山縣小田郡北木島村巖石
(74) 岡山縣邑久郡朝日村犬島
(75) 岡山縣小田郡北木島村金風呂
(76) 兵庫縣飾磨郡家島村
(77) 岡山縣邑久郡朝日村犬島
(78) 岡山縣御津郡野谷村吉宗
(79) 岡山縣小田郡北木島村鶴石
(80) 岡山縣小田郡北木島
(81) 岡山縣御津郡大野村大安寺萬成山
(82) 岡山縣兒島郡本荘村鹽生
(83) 岡山縣小田郡北木島
(84) 岡山縣御津郡大野村大安寺萬成山
(85) 岡山縣御津郡大野村大安寺萬成山
(86) 岡山縣邑久郡朝日村西片岡眞儀
(87) 岡山縣兒島郡下津井町六口島
(88) 岡山縣久米郡吉岡村柵原鑛山

讃岐地方

(89) 香川縣小豆島福田
(90) 香川縣小豆島北浦村
(91) 香川縣仲多度郡與島村與嶋
(92) 香川縣仲多度郡廣島村
(98) 香川縣仲多度郡與嶋村與島
(94) 香川縣小豆島土ノ庄町
(95) 香川縣木田郡庵治村
(96) 香川縣木田郡庵治村
(97) 香川縣木田郡庵治村

廣島地方

(98) 廣島縣安藝郡倉橋島
(99) 廣島縣沼隈郡百島村
(100) 廣島縣安藝郡倉橋島尾立
(101) 廣島縣佐伯郡東能美島大柿
(102) 廣島縣御調郡向島東村
(103) 廣島縣比婆郡田森村森脇
(104) 廣島縣比婆郡東城町吹矢谷
(105) 廣島縣神石郡新坂村田川瀬
(106) 廣島縣比婆郡田森村森脇
(107) 廣島縣比婆郡西城町竹中市
(108) 廣島縣比婆郡鹿深峠

伊豫地方

(109) 愛媛縣越智郡大島大山村餘所國
(110) 愛媛縣越智郡大島宮窪村
(111) 愛媛縣越智郡岩城島

山陰地方

(112) 島根縣八束郡片江村笹子

隱岐地方

(113) 島根縣隱岐島後布施村卯敷一布施間

山口地方

(114) 山口縣佐波郡三田尻町北方タタラ山
(115) 山口縣美禰郡於福村榎田
(116) 山口縣都濃郡大津島俵石所
(117) 山口縣都濃郡大津島
(118) 山口縣都濃郡富田町黒髪島
(119) 山口縣都濃郡德山町黒髪島
(120) 山口縣都濃郡德山町蛙島
(121) 山口縣都濃郡大津島
(122) 山口縣都濃郡德山町蛙島
(123) 山口縣厚狹郡二俣瀨村山中
(124) 山口縣山口町ノ西北，美禰，吉敷郡界 (美禰郡綾木村大峠)
(125) 山口縣佐波郡三田尻町北タタラ山
(126) 山口縣美禰郡於福村金ケ原
(127) 山口縣厚狹郡小野村下小野
(128) 山口縣美禰郡伊佐南櫻山

中部九州

(129) 宮崎縣東臼杵郡北方村槇峯鑛山

南九州

(130) 鹿兒島縣肝屬郡垂水村垂水
(131) 鹿兒島縣肝屬郡垂水村吹花平 (灰石中ノ包裹物)
(132) 鹿兒島縣肝屬郡垂水村吹花平 (浮石層中ノ岩塊)

五島列島

(133) 長崎縣福江島大濱村翁頭山
(134) 長崎縣福江島奥浦村
(135) 長崎縣福江島奥浦村 (平藏小學校)

LITERATURES

FUJITA, Y. (1931) The Electrical Resistivity of Ores, Rocks, Soils and Underground Water (in Japanese). Suiyôkai-Si (Trans. Min. & Metall. Alumni Assoc.), Vol. VI, No. 8.

HARADA, T. (1890) Die japanischen Inseln ein topographisch-geologische Uebersicht. Imp. Geol. Surv. Japan.

HIKI, T. (1917) A Geologic Guide of the Environs of Kyôto (in Japanese). Jour. Geol. Soc. Tôkyô, Vol. XXIV, No. 284.

HOMMA, F. (1931) Geology of the Central Sinano (in Japanese). Ueda.

IDDINGS, J. P. (1913) Igneous Rocks. Vol. II, New York.

INOUYE, K. (1912) Annual Report for the Year ended March 31, 1913 (in Japanese). Report Imp. Geol. Surv. Japan, No. 34.

ISHIKAWA, T. (1896) The Second Report of Mineral Survey of Hokkaidô (in Japanese). The Hokkaidô Office.

KAWANO, Y. (1933) Preliminary Note on the Chemical Studies of Orbicular Rock from Minédéra-Yama (in Japanese). Jour. Jap. Assoc. Min. Petr. & Econ. Geol., Vol. X, No. 4.

KOCHIBE, T. (1888) Explanatory Text to the Kazusa Sheet (in Japanese). Imp. Geol. Surv. Japan.

KÔZU, S. (1912) Explanatory Text to the Fukae Sheet (in Japanese). Imp. Geol. Surv. Japan.

KÔZU, S. (1913) Petrological Notes on the Igneous Rocks of the Oki Islands. Sci. Rep. Tôhoku Imp. Univ., Ser. II, Vol. I, No. 3.

KUHARA, M. (1920) Iron Ore Deposits of Yanahara Originated from Magmatic Segregation (in Japanese). Jour. Geol. Soc. Tôkyô, Vol. XXVII, No. 319.

MURAKAMI, H. (1909) On the Misaka Series in the Dôsi and Akiyama Districts (in Japanese). Jour. Geol. Soc. Tôkyô, Vol. XVI, No. 191.

NAKAJIMA, K. (1886) Geology of Ani Mine (in Japanese). Bull. Imp. Geol. Surv. Japan, No. 2, Appendix.

NEMOTO, T. (1932) One Some Interesting Igneous Rocks from Hokkaidô (in Japanese). Jour. Geol. Soc. Tôkyô, Vol. XXXIX, No. 465.

OGURA, T. (1921) Explanatory Text to the Syôbara Sheet (in Japanese). Imp. Geol. Surv. Japan.

OGURA, T. (1923) Explanatory Text to the Yamaguti Sheet (in Japanese). Imp. Geol. Surv. Japan.

OGURA, T. (1928) Some Dike-Rocks in Japan. Memoirs Ryojun Coll. Eng., Vol. I, No. 2.

ÔKURASYÔ (The Finance Department). (1921) Building Stones of Japan (in Japanese). Tôkyô.

OYAMA, I. (1911–1912) Miscellaneous Notes on Japanese Building Stones (in Japanese). Jour. Geol. Soc. Tôkyô, Vols. XVIII–XIX, Nos. 217–220.

OYAMA, I. (1920–1921) Building Stones of Japan. Jour. Geol. Soc. Tôkyô, Vols. XXVII–XXVIII, Nos. 327–331.

OYAMA, I. (1926) On the Selection of Granitic Rocks for Building of the House of the Imperial Diet (in Japanese). Jour. Geogr., Vol. XXXVIII. No. 449.

OYAMA, I. (1931) Commentary Notes on the Japanese Building Stones (Nippon-San Sekizai Seigi) (in Japanese). Tôkyô.

SATÔ, D. (1925) Petro-geology (Ganseki-tisitu-gaku), Tôkyô.

SEKI, T. (1918) Chemico-mineralogical Investigation of the Weathering Products of the Granite Occurring near Morioka. Bull. Imp. Coll. Agric. & Forest, Morioka, No. II.

SHIMIZU, S. (1911) Report on the Physical and Chemical Properties of Granite from Tyûgoku (in Japanese). Report Imp. Geol. Surv. Japan, No. 28.

SHIMIZU, S. (1913) Report on the Physical and Chemical Properties of Granite from Ibaraki Prefecture (in Japanese). Report Imp. Geol. Surv. Japan, No. 37.

SONOKI, B. (1935) Geological and Petrological Studies of Okuziri Island, Prov. Siribesi (in Japanese). MS.

SUGI, K. (1930) On the Granitic Rocks of Tsukuba District and Their Associated Injection Rocks. Jap. Jour. Geol. Geogr., Vol. VIII, No. 1.

SUZUKI, J. (1932) The Contact Metamorphic Ore Deposits in the Environs of the Ofuku Mine, Prov. Nagato, Japan. Jour. Fac. Sci. Hokkaidô Imp. Univ., Ser. IV, Vol. II, No. 1.

SUZUKI, J. (1934(A)) Granitic Intrusions and Associated Contact Metamorphosed Rocks in Hokkaidô (in Japanese). Jour. Geol. Soc. Tôkyô, Vol. XLI, No. 489.

SUZUKI, J. (1934(B)) Metamorphosed Calcareous Concretions in the Hornfels at the Southern Coast of Tokati Province, Hokkaidô. Jour. Fac. Sci. Hokkaidô Imp. Univ., Ser. IV, Vol. II, No. 4.

SUZUKI, J. & NEMOTO, T. (1932) On the Chemical Composition of Granite from Japan (in Japanese). Jour. Jap. Ass. Min., Petr. & Econ. Geol., Vol. VIII, No. 2 and Jour. Geol. Soc. Tôkyô, Vol. XXXIX, No. 465.

SUZUKI, Tomi. (1929) Mining in the Hitati Mine (in Japanese). Jour. Mining Inst. Japan, Vol. XLV, No. 531.

SUZUKI, Toshi (1907) Explanatory Text to the Yamaguti Sheet (in Japanese). Imp. Geol. Surv. Japan.

TOMITA, T. (1927) An Alkali Rock from the Southwestern Bank of Lake Kizaki, Prov. Sinano. Jour. Geol. Soc. Tôkyô, Vol. XXXIV, No. 405.

TSUDA, H. (1925) Geology and Ore Deposits of the Makiminé Mine, Prov. Hyûga (in Japanese). Jour. Geol. Soc. Tôkyô, Vol. XXXII, No. 381.

WASHINGTON, H. S. (1917) Chemical Analyses of Igneous Rocks. U. S. G. S. Prof. Pap. 99.

YAMAGUCHI, K. (1928) Diorite-aplite Dike in Diabase at Sasako, Prov. Idumo (in Japanese). Jour. Geogr., Vol. XLI, Nos. 481–482.

YAMAGUCHI, K. (1929) On the Origin of the Granite Blocks in the Pumice Beds on the West Coast of Ôsumi (in Japanese). Jour. Geol. Soc. Tôkyô. Vol. XXXVI, No. 426.

YAMAGUCHI, S. (1932) Geology of the Hutoro District, Prov. Siribesi (in Japanese). MS.

YAMANE, S. (1915) Explanatory Text to the Morioka Sheet (in Japanese). Imp. Geol. Surv. Japan.