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The Chemical Composition of the Granitic Rocks in Hiroshima Prefecture, Japan.*

By

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Dedicated to the Memory of the late Dr. Jitsutarô TAKUBO.

Contents

I Introduction

A considerably broad area of the inner zone of southwestern Japan is occupied by granitic rocks which are recently being studied by a few of geologists. Many valuable reports[1,2] concerning these granitic rocks have been made for the last some years. These rocks are divided into two main types; that is, the older and the younger. The former is a sort of gneissose granite belonging to the so-called "Ryôke-type", while the latter was formerly called "Chūgoku-granite", which is furthermore classified into two types, i. e., "Hiroshima-type" and "San-in-type". Geologically, the granite in question is believed to have intruded at a certain stage from the later Cretaceous to the earlier Tertiary. Since the research[3] perfomed by J. SUZUKI and T. NEMOTO, 1935, no outstanding ones regarding the chemical characters of these granitic rocks have been done.

The author thus believes that it would be of value to report on the chemical compositions of the granite of Hiroshima-type and quartz-porphyry in Hiroshima Prefecture.

Many thanks must be stated to the late Dr. J. TAKUBO for his kind

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guidance, to the members of his institute and to Dr. Y. UMEGAKI, Professor of Hiroshima University for their great help.

Finally, particular thanks are due to the Ministry of Education for grant in aid which has rendered possible the field and laboratory work for the author.

II Localities and Brief Petrographical Notes

Granite of Hiroshima-type, located vastly in the southern part of Chūgoku District, is cropped out typically in Hiroshima prefecture. It is usually biotite-granite, equicoarse-grained and leucocratic. The localities and brief petrographical notes of the specimens, which were analysed by the author, are as follows:

No. 1. Biotite-granite (Fig. 3)

Locality: At the quarry of Mizujiri, Yasuura-chô, Kamo-gun, Hiroshima prefecture. (広島県賀茂郡安浦町水尻石切場)

This is a typical specimen of the biotite-granite of Hiroshima-type. Under the microscope, it is coarse and equigranular. The essential minerals are as follows:

Quartz: Abundant.
Perthite: Abundant.
Plagioclase: Common. An_{4-18}. Somewhat sericitized.
Biotite: Scarce. Dark brown to pale yellow.
Accessory minerals: Apatite, etc.

No. 2. Biotite-granite (Fig. 4)

Locality: At the opposite mountain-foot of Mihara Fluorite Mine, Sôgô-chô, Mihara-shi, Hiroshima prefecture. (広島県三原市宗郷町三原鉱山向山麓)

This is a part of the biotite-granite which is widely distributed around Mihara-shi and is thought by the author to have been the bringer of fluorite and copper ores in the environs of Sôgô-chô.

The specimen examined is megascopically a equicoarse-granular biotite-granite with pinkish feldspar and rather leucocratic. Under the microscope, the essential minerals are as follows:

Quartz: Abundant. Sometimes showing undulatory extinction but uniaxial.
Perthite: Usually abundant. Orthoclase including patch-shaped albite.
Microcline and orthoclase: Common.

Biotite: Scarce.

Albitic plagioclase: Less common. Occurred as idiomorphic shape of small size. Partly sericitized in the core.

Accessory minerals: Apatite, sphene, zircon and rarely a few fluorite.

No. 3. Porphyritic biotite-granite (Fig. 5 and 6)

Locality: At the foot of the Yawata Bridge, Gôbara-mura, Kamo-gun, Hiroshima prefecture. (広島県賀茂郡郷原村八幡橋)

This is megascopically medium-grained, porphyritic and somewhat different from the former biotite-granite. Under the microscope, the essential minerals are as follows:

Quartz: Abundant.

Orthoclase and microcline-perthite: Abundant in matrix and frequently as large phenocrysts.

Albitic plagioclase: Common. Partly sericitized.

Biotite: Less common. Yellowish green-colored and enclosing many inclusions with pleochroic haloes.

Accessory minerals: Apatite, sphene, zircon, etc.

No. 4. Quartz-porphyry as marginal facies of Hiroshima-granite (Fig. 7)

Locality: Masatoki, Mihara-shi, Hiroshima prefecture. (広島県三原市正時)

This is exposed as dike-rock in the quartz-porphyry older than Hiroshima-granite and is clearly distinguishable from the latter with the naked eye. Megascopically, it is a porphyritic rock with quartz and pinkish feldspar as phenocryst. Under the microscope, the essential minerals are as follows:

Quartz: Common. Euhedral and single crystal as phenocryst. Rarely showing undulatory extinction. Inclusions are very rare.

Perthite: Common. Pure orthoclase is rare.

Albitic oligoclase: Less common. Frequently sericitized in the core.

Biotite: Rare, as small flake.

The groundmass is cryptocrystalline and felsitic, bearing fine biotite.

No. 5. Quartz-porphyry older than Hiroshima-granite (Fig. 8)

Locality: At the summit of the Sunami Park, 312.9 m. high, Sunami-chô, Mihara-shi, Hiroshima prefecture. (広島県三原市須波町須波公園山頂)

This is a brecciated quartz-porphyry older than Hiroshima-granite and metamorphosed by the latter to hornfels. Geologically, this facies seems to have intruded in the late Cretaceous period. Under the microscope, it is porphyritic. The phenocrysts are as follows:

Quartz: Usually abundant. Irregular-sized, anhedral, sometimes biaxial and occurred as aggregates of 2–3 grains.

Albitic plagioclase: Less abundant, anhedral.

Orthoclase: Common. Small-sized and albitized.

Biotite: Rare. Brownish, euhedral, small-sized, and occurred as a primary mineral.

The groundmass is microcrystalline, felsitic, and filled with aggregates of small grains of secondary biotite.

No. 6. Quartz-porphyry older than Hiroshima-granite

Locality: At the southern hillside of the Sunami Park.

This is the kind of rock same as No. 5 and megascopically an aphanitic quartz-porphyry with fluidal structure and not yet studied under the microscope.

No. 7, 8, 9, 10 and 11 are selected from the list after J. SUZUKI and T. NEMOTO.

III Chemical Composition

The author analysed 4 specimens of Hiroshima-granite and 2 specimens of quartz-porphyry older than the former. They are shown in Table 1 and in Fig. 1 and 2.

Table 1 The chemical composition of Hiroshima-granite and quartz-porphyry.

No.	1	2	3	4	5	6	7	8	9	10	11
SiO_2	75.09	74.34	73.16	75.32	69.44	72.85	75.24	74.23	72.67	72.25	69.92
TiO_2	0.05	0.12	0.08	0.08	0.15	0.34	0.20	—	0.20	0.35	0.39
Al_2O_3	13.24	11.61	12.36	11.49	14.82	11.59	14.25	13.73	14.76	14.04	14.78
Fe_2O_3	0.91	0.66	0.50	1.70	0.82	4.12	0.78	0.71	1.06	0.38	1.62
FeO	0.66	1.21	1.20	—	2.80	—	1.50	—	1.51	2.32	1.67
MgO	0.69	0.23	0.28	0.40	0.24	0.22	0.29	0.29	0.46	0.67	0.97
CaO	0.69	1.59	2.28	0.27	1.93	1.91	1.45	0.71	2.09	2.13	2.15
Na_2O	4.03	5.22	4.10	7.10	3.71	3.80	2.10	4.80	3.13	3.43	3.28
K_2O	3.62	4.38	4.07	3.83	4.04	4.69	2.32	5.32	3.20	3.17	4.07
MnO	0.04	tr.	0.07	—	0.11	—	0.36	0.21	0.28	0.19	0.13
P_2O_5	0.09	0.59	0.12	—	0.64	—	0.05	—	0.05	0.22	0.24
H_2O+	0.53	0.61	0.69	—	0.88	0.57	0.34	0.36	0.59	0.64	0.78
H_2O-	0.13	0.32	0.33	—	0.48	0.23	0.26			0.21	
Total	99.77	100.88	99.24	100.19	100.06	100.31	99.21	100.36	100.00	100.00	100.00

The Chemical Composition of the Granitic Rocks in Hiroshima Prefecture. Japan.

No.	1	2	3	4	5	6	7	8	9	10	11
Q	35.94	30.30	30.06	21.30	30.00	30.30	49.92	25.08	36.60	33.36	27.42
C	2.14	—	—	—	4.28	—	5.92	—	2.65	1.33	1.22
or	21.68	26.13	23.91	22.24	23.91	27.80	13.34	31.14	18.90	14.90	24.46
ab	34.06	35.11	34.58	38.25	31.44	31.96	17.82	40.35	26.20	28.82	27.77
an	1.39	—	3.34	—	—	0.83	6.67	0.28	9.73	9.73	10.01
ac	—	1.85	—	4.62	—	—	—	—	—	—	—
ns	—	1.59	—	3.42	—	—	—	—	—	—	—
Wo	—	—	2.20	0.58	—	3.60	—	1.39	—	—	—
En	1.70	0.60	0.70	1.00	0.60	0.60	2.51	0.70	1.20	1.70	2.40
Fs	0.26	1.98	1.85	—	4.36	—	0.70	—	1.98	3.56	1.32
mt	1.39	—	0.70	—	1.16	—	1.16	—	1.62	0.70	2.32
il	0.15	—	0.15	—	0.30	—	0.46	—	0.46	0.76	0.76
hm	—	—	—	—	—	3.52	—	7.04	—	—	—
ap	0.48	2.14	0.69	—	2.56	—	0.34	—	0.34	0.34	0.34
Class	1	1	1	1	1	1	1	1	1	1	1
Order	3	4	4	4	4	4	3	4	3	4	3
Rang	1	1	1	1	1	1	2	1	2	2	2
Subrang	3	3	3	4	3	3	3	3	3	3	3

No. 1. Biotite-granite of Hiroshima-type, Yasuura-chô, Kamo-gun, Hiroshima Pref., Anal., M. MUKAE.
No. 2. Biotite-granite of Hiroshima-type, Mihara-shi, Hiroshima Pref., Anal., M. MUKAE.
No. 3. Biotite-granite of Hiroshima-type, Gôbara-mura, Kamogun, Hiroshima Pref.,Anal., M. MUKAE.
No. 4. Quartz-porphyry as a marginal facies of Hiroshima-granite, Mihara-shi, Hiroshima Pref., Anal., M. MUKAE.
No. 5. Quartz-porphyry older than Hiroshima-granite, Mihara-shi, Hiroshima Pref., M. MUKAE.
No. 6. Quartz-porphyry older than Hirosima granite, Mihara-shi, Hiroshima Pref., Anal., M. MUKAE.
No. 7. Biotite-granite, Kurahashi Island, Aki-gun, Hiroshima Pref., Anal., N. YOSHIOKA.
No. 8. Biotite-granite, Momoshima, Numakuma-gun, Hiroshima Pref., Anal., not stated.
No 9. Granite (The Hiroshima-Ehime District), average of 6 analyses (after J. Suzuki and T. Nemoto).
No. 10. Granite (Japan), average of 94 analyses (after J. Suzuki and T. Nemoto).
No. 11. Granite (Europe, America, etc.), average of 236 analyses (after R. A. Daly).

From the table of the chemical compositions and diagrams, the author interprets the character of Hiroshima-granite as follows:

1. The content of SiO_2 in Hiroshima-granite is much higher than the average value in the Japanese granites as well as in those throughout the world.

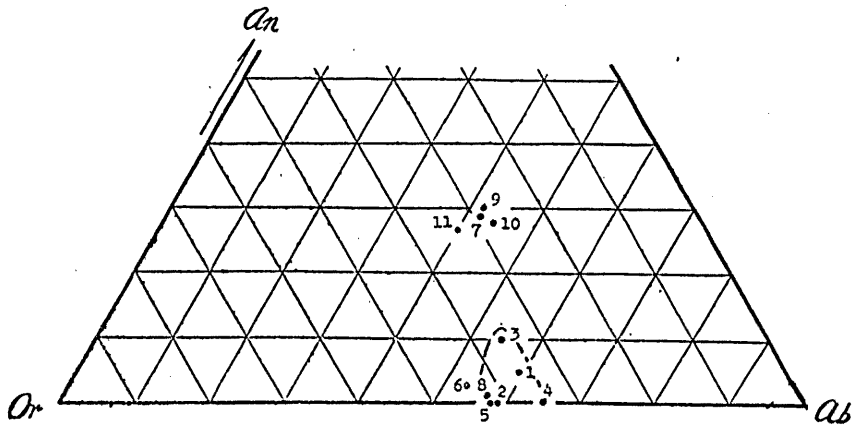

Fig.1 The Or-Ab-An diagram. Mol.% of Norm.
The Hiroshima-granite is found within the indicated circle.

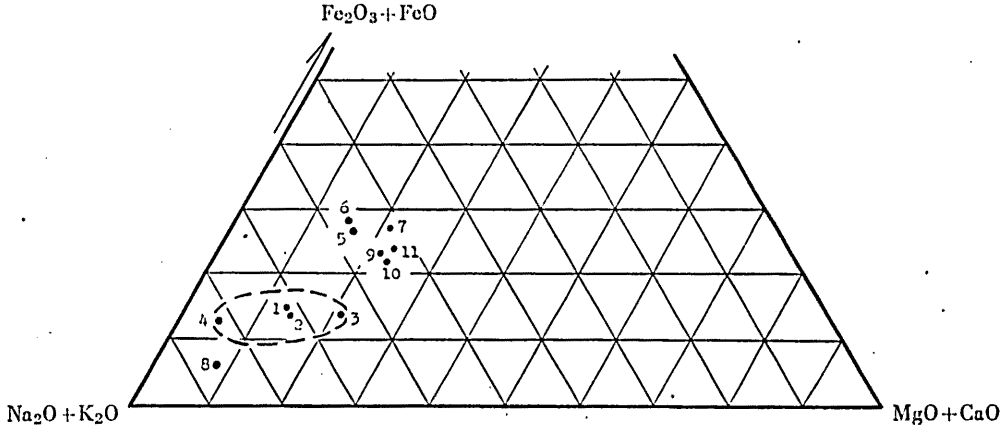

Fig. 2 The alkali–alkali earth–iron diagram.
Wt.% of oxides. The Hiroshima-granite is found within the indicated circle.

2. The contents of the alkali-earth, especially lime, and total iron of the former are much lower than those of the latter two.
3. The alkali contents of the former are much higher than those of the latter two. It is very surprising that Hiroshima-granite is similar to the biotite-granite of Momoshima (No. 8) which was stated to be alkali-granite by J. SUZUKI.
4. From the two diagrams (Fig.1 and 2), Hiroshima-granite is recognized to be chemically located within a limited area different from the other granitic rocks.

5. It is thought that Hiroshima-granite is leucocratic and seems to be rather similar to alaskite.
6. Quartz-porphyry is somewhat different from Hiroshima-granite.

III Summary

Four specimens of Hiroshima-granite and two specimens of quartz-porphry older than the former are chemically analysed by the author and these chemical compositions are compared to the average values of the Japanese granites and the granites throughout the world. From the results, it is thought that Hiroshima-granite is rich in alkali and poor in alkali-earth and iron. It is leucocratic and quite similar to alaskite.

IV Bibliography

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3. SUZUKI, J., and T. NEMOTO. (1935): The Chemical Composition of the Granitic Rocks of Japan. Jour. Sci. Hokkaido Uuiv. Ser. 4, Vol. 3, No. 1.

The Microphotographs of the Analysed Specimens.

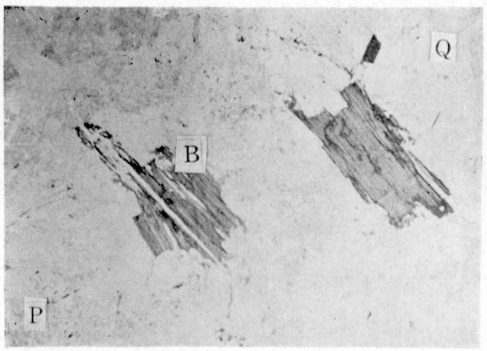

Fig. 3 Biotite-granite (No. 1). Yasuura-chô, Kamo-gun. // nicol, × 20.
B:Biotite, P:Perthite, Q:Quartz.

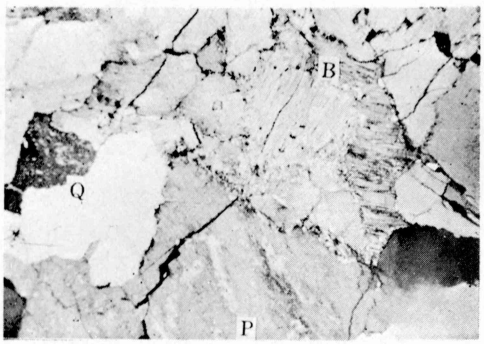

Fig. 4 Biotite-granite (No. 2). Mihara-shi. + nicol, × 20.
B:Biotite, P:Perthite, Q;Quartz.

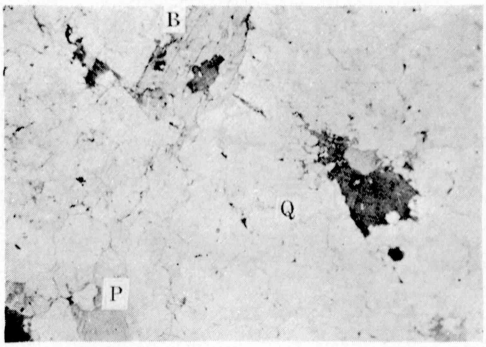

Fig. 5 Porphyritic biotite-granite (No.3). Gôbara-mura, Kamo-gun. // nicol, × 20.
B:Biotite, P:Perthite, Q:Quartz.

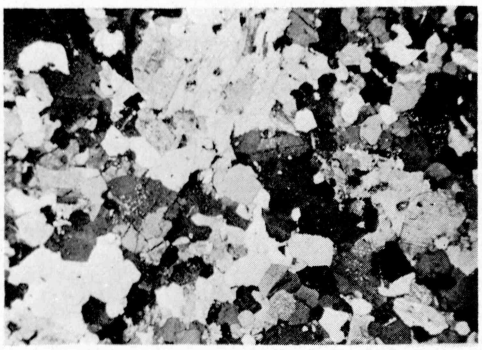

Fig. 6 Porphyritic biotite-granite (No.3). Gôbara-mura, Kamo-gun. + nicol, × 20.

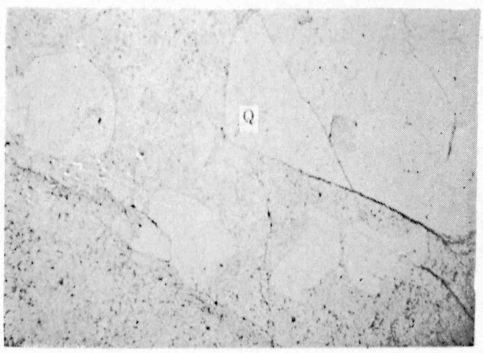

Fig. 7 Quartz-porphyry (No. 4). Mihara-shi. // nicol, × 20. Q:Quartz.

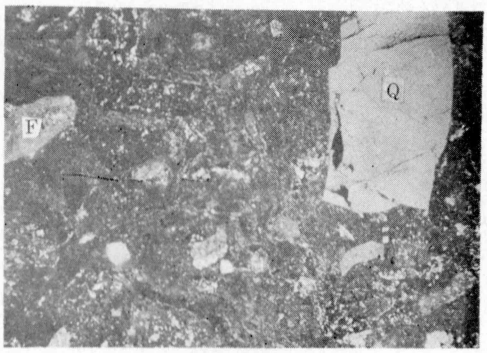

Fig. 8 Quartz-prorphyry (No. 5). Sunami-chô, Mihara-shi. + nicol, × 20.
Q:Quartz, F:Feldspar.