The Granite and its Satellites in Mount Hiei Environs

By

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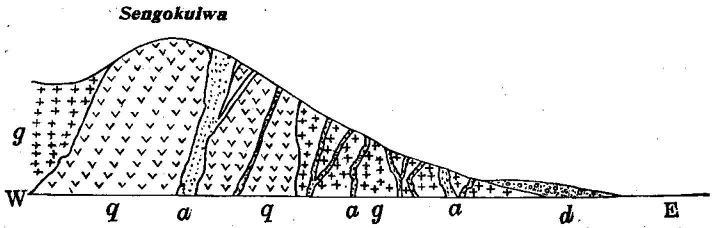
In central Japan, the extensive Chichibu paleozoic formation occupies an enormous area composed of multifarious alternations of graywackesand-stone, clay slate, hornstone, quartzite, limestone and others. Through this complex, many varieties of granite found their way here and there, forming batholiths, stocks and even dikes. A great techtonic disturbance arose at the time of the tertiary era; and, as a result, the area was exceedingly deformed and many depressions and horsts were produced in the whole region. Among these, the chief depressions are Nara, Osaka, Kyoto plain and Lake Biwa; while Mount Ikoma, Mount Hiei, and the Higashiyama range are the chief horsts. We find a typical example of a horst between Lake Biwa and the Kyoto plain, which consists essentially of a granite stock and the paleozoic strata. The granite stock is bounded by Mount Hiei on the north and by Mount Nioi on the south, both of them consisting of the paleozoic formation, while the eastern and western bounds are the ends of Lake Biwa and Kyoto plain respectively. This area is now ruggy hills, partly barren; and the existing surface, due to the removal of masses of rock by denudation, is lower than the adjoining mountains.

By this intrusion of granitic magma into the paleozoic strata, the rock suffered contact metamorphism, so that the limestone, especially rich in carbonaceous material, converted into a white crystalline marble, producing many contact minerals such as garnet, wollastonite, egeran and pyroxene; the clay slate changed to the more or less compact hornfels, and the cordierite and the biotite were newly constructed; the sandstone hardened into a flinty hornfels with many biotite spots; the hornstone increased its crystallization and converted into the quartzite. This phenomenon of metamorphism is clearly observable in the circle of the granite stock.

Through this metamorphosed belt, sills and dikes of granite, granite porphyry and other crystalline compounds are abundant, most numerous near the stock. Mumerous basic and acidic dikes are also found, cut through the granite itself. The basic dikes are lamprophyric especially exposed on the western periphery of the mass, though a few acidic dikes also found there. On the eastern side, the mass is traversed by acidic types such as aplites and quartz or quartz feldspar segregation veins, while pegmatite veins are very few in this area.

In the present paper the writer desires to consider the granite satellites, particularly of an acidic nature, occurring in this area, in their actual manners of association, and the order in which the associated and presumably consanguineous types made their appearance.

The exposed form of the granite stock, is nearly elliptical, and the rock texture is phanerocrystalline, inclined to be coarse in the centre and fine in peripherial parts. This rock is a normal biotite granite and composed of quartz, biotite, and orthoclase, with plagioclase as subordinate composition. A few allanite crystals are always present in the whole area as a primary constituent, which is a peculiarity of this granite. The ingredients are comparatively fresh, and the manner of occurrence is quite the same as in other granite. Microscopically, quartz, colorless and transparent, with many inclusions; orthoclase and plagioclase turbid, the latter distinguishable by lamellar twinning; biotite, brown, strongly pleochroic, appear with common inclusions of crystals of apatite, (Pl. I. fig. 1). The granite porphyry (quartz porphyry) consists either of a granite texture with a tolerably large phenocrysts of quartz and orthoclase in varying proportions, or entirely of a quartz porphyry texture, having quartz and orthoclase imbedded in the felsitic groundmass. The former case, it is rather reddish, of coarse granular texture, with porphyritic phenocrysts of quartz, pink orthoclase, and black mica always well developed in the granitic groundmass which also consists of a median grained mixture of the same minerals. The quartz crystals always assume well defined bipyramidal forms of more than two millimeters, enclosing liquid bubbles or minerals; and the orthoclase always undergoes decomposition and the isolated crystals present are in simple forms or carlsbad twins of the type found in Carlsbad, Bohemia. The orthoclase is sometimes large, ranging from one to three centimeters. The biotite present is in the form of small prismatic crystals, partly altered to chloritic substances, (Pl. II. fig. 1). In the latter case the rock is white and the structure is apparently quite different, the porphyritic phenocrysts being imbedded in a compact groundmass; but under the microscope, the groundmass also proves to consist of granular aggregate of fine quartz, orthoclase and a few biotite which are quite identical with the former. Microscopically, the groundmass is hypidiomorphic, even grained, and composed chiefly of quartz and orthoclase, (Pl. II. fig. 2). The boundary of the granite and granite porphyry is always very sharp. The manner of intrusion to the granite stock takes the form of a long chain consisting of many batholithic masses, chiefly exposed on the eastern side of the stock, extending from north to south, and even to the paleozoic strata on the south, while on the western side only a very few narrow veins of such porphyritic acidic rocks can be found. Thus it appears that this rock intruded next to the granite, and filled up the fissures producing in the granitic stock. Moreover, there are most notable occurrences of aplites on the eastern side, while on western side such acidic dikes hardly observable. The aplites, properly called microgranite, intrude in form of stringers, sills, or dikes through the granite, granite porphyry and paleozoic formation. It is brown in color and consists of a fine grained crystalline groundmass with small amount of quartz, orthoclase, biotite and pink garnet. The phenocrysts appear of the same character as in the two rocks already mentioned, the quartz always well defined with liquid and mineral inclosures, the orthoclase and plagioclase always decomposed, and the garnet presenting an icositetrahedral habit. Microscopically, the groundmass also shows the same structure and mineral constituents as the granite and granite porphyry, so that we can assume that the groundmass is the same as the latter type of the granite porphyry, (Pl. I. fig. 2). The thickness of the dikes ranges from ten centimeters to twenty centimeters, and rarely in greater thickness. The aplite dikes must of coarse be regarded as latter than the rocks which they traversed, and may represent still liquid portions of residual granitic magma which were forced into rents in the partially or wholly solidified granite and granite porphyry.



The ideal profile from Sengokuiwa to the lake shore.
g=granite. q=granite porphry.
a=aplite dike.
d=diluvium.

Their resemblances to each other is also proved by the following chemical analysis kindly made at the chemical laboratory of the Geological Survey of Japan;

	Granite.	Granite Porphyry.	Aplite.
SiO_2	72.43	73.86	75.93
TiO_2	0.28	trace	trace
Al_2O_3	14.11	13.49	13.73
Fe_2O_3	0.23	0.38	0.23
FeO	2.39	2.46	0.82
MnO	0.22	0.32	0.53
MgO	0.77	0.10	0.15
CaO	2.08	1.17	0.87
Na_2O	3.12	3.37	2.91
K_2O	3.13	3.53	4.80
P_2O_5	0.27	0.24	trace
Ignition loss	1.22	1.23	0.37
	100.25	100.15	100.34

From this table of composition we judge that these rocks are chemically nearly identical, and that, as a rule, the amount of silica increases slightly, consequently decreasing the basicity from granite to aplite.

Thus we may conclude that these various rocks, erupted in the environs of Mount Hiei successively, resulted from differentiations of the same kind in different degrees from the granitic magma chamber. It is also clear that the rocks of this group differ in only megascopic character and geological relation, but not in composition, or in general community of character.

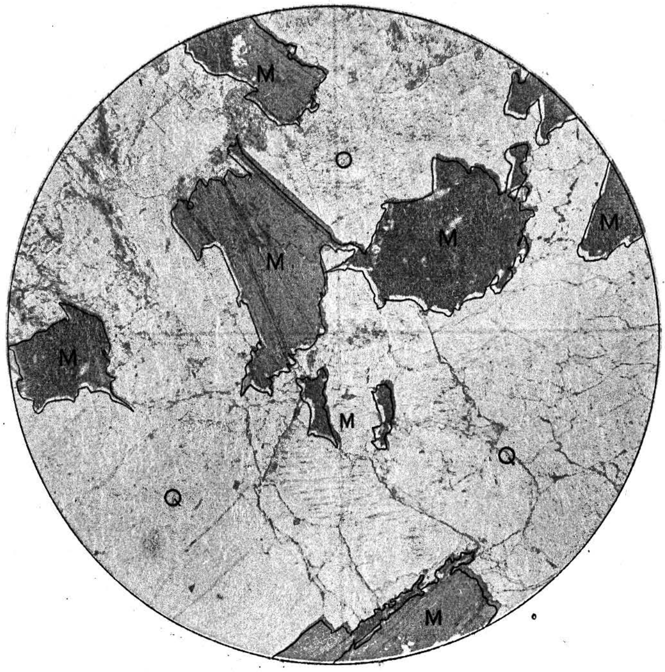


Fig. 1. Biotite granite.
× 35.

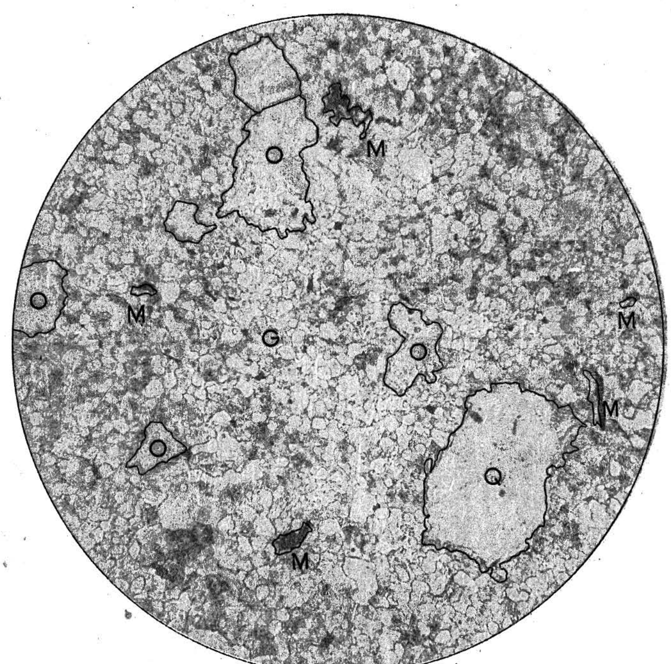
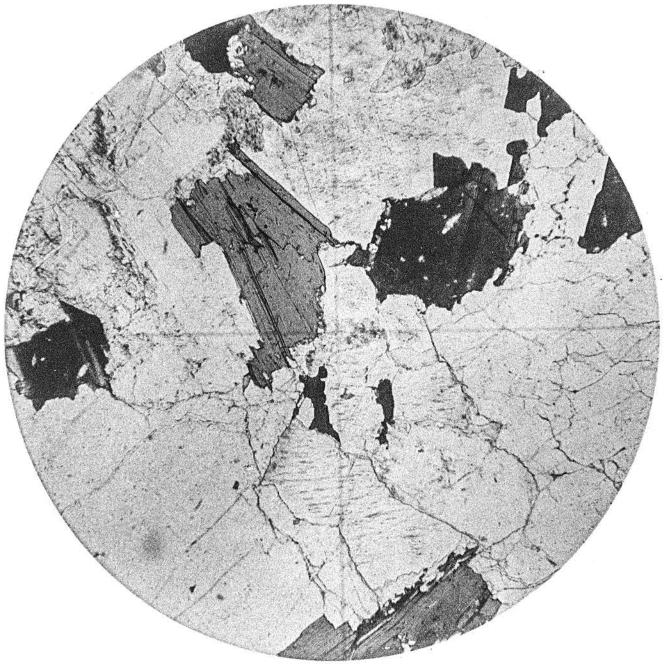


Fig. 2. Aplite.
× 35.

O. Orthoclase. Q. Quartz. M. Biotite.
G. Groundmass.



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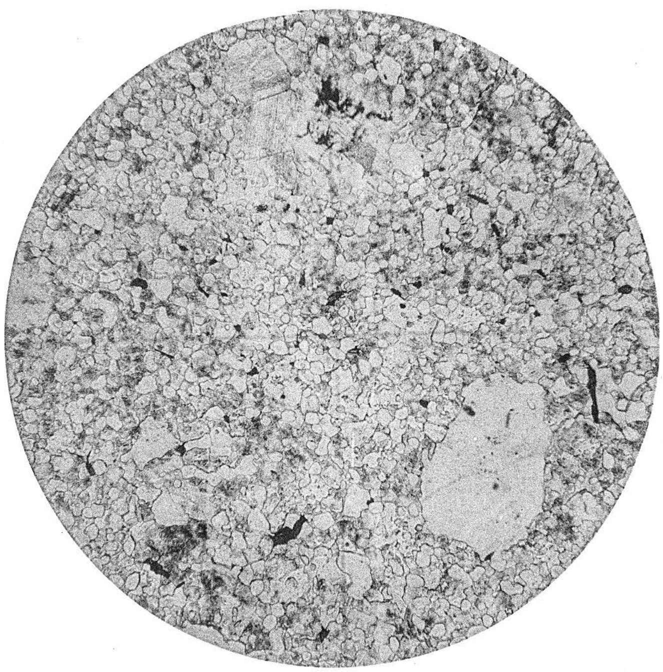

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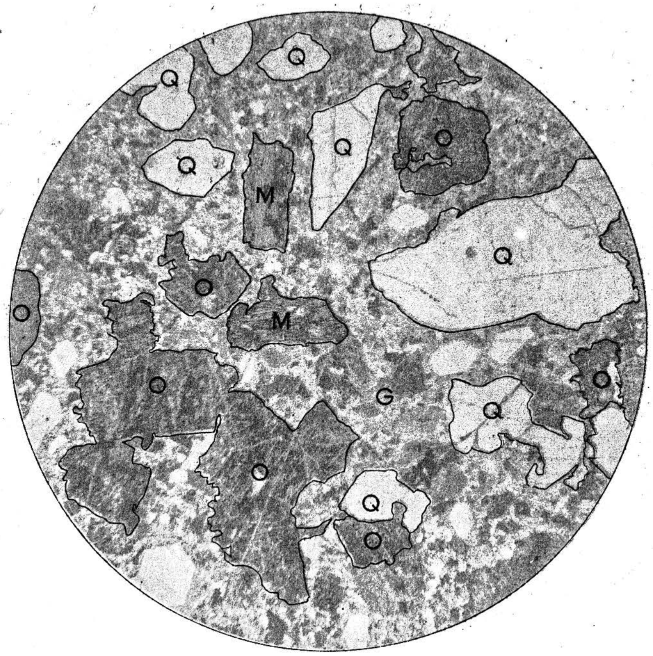


Fig. 1. Granite porphyry with granitic groundmass.
× 35.

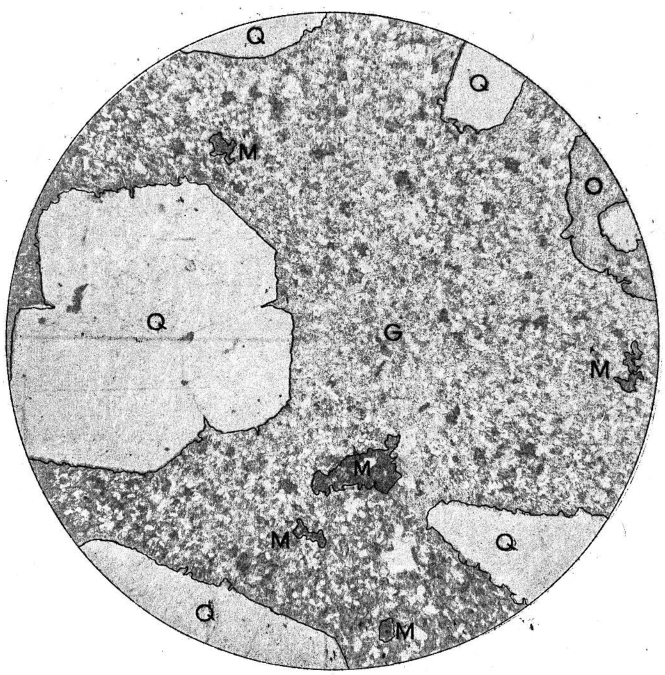
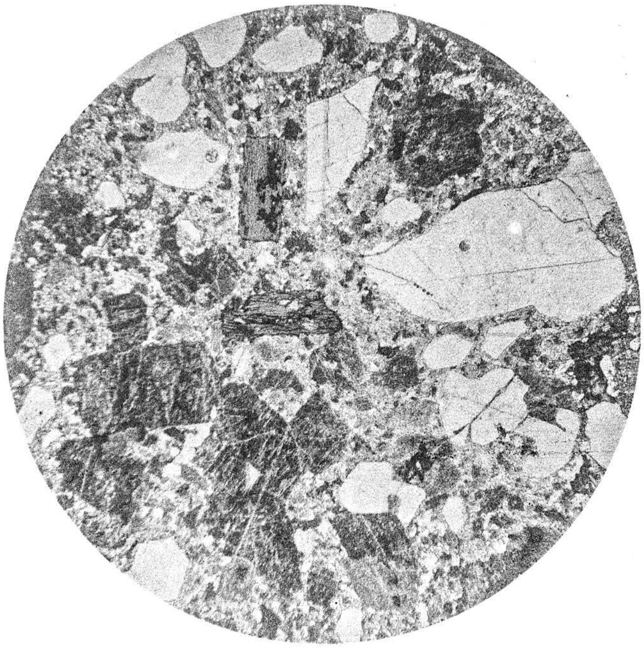


Fig. 2. Granite porphyry with felsitic groundmass.
× 35.

O. Orthoclase. Q. Quartz. M. Biotite.
G. Groundmass.



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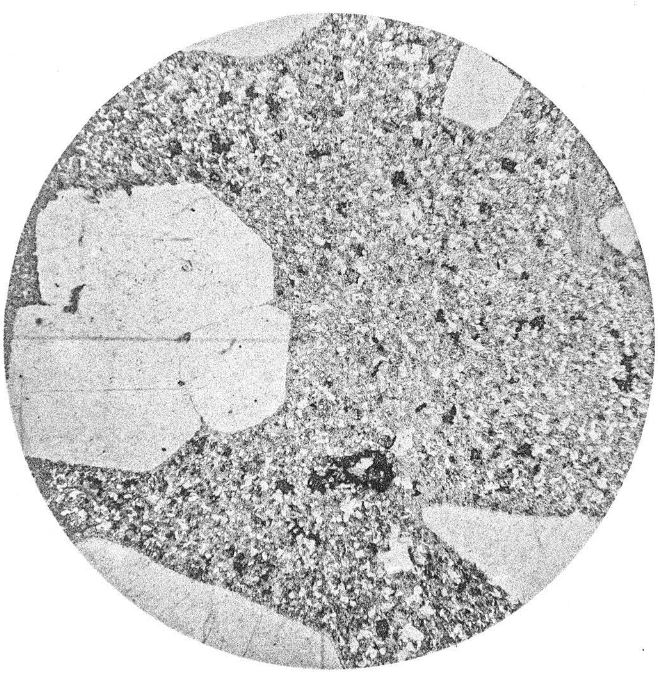
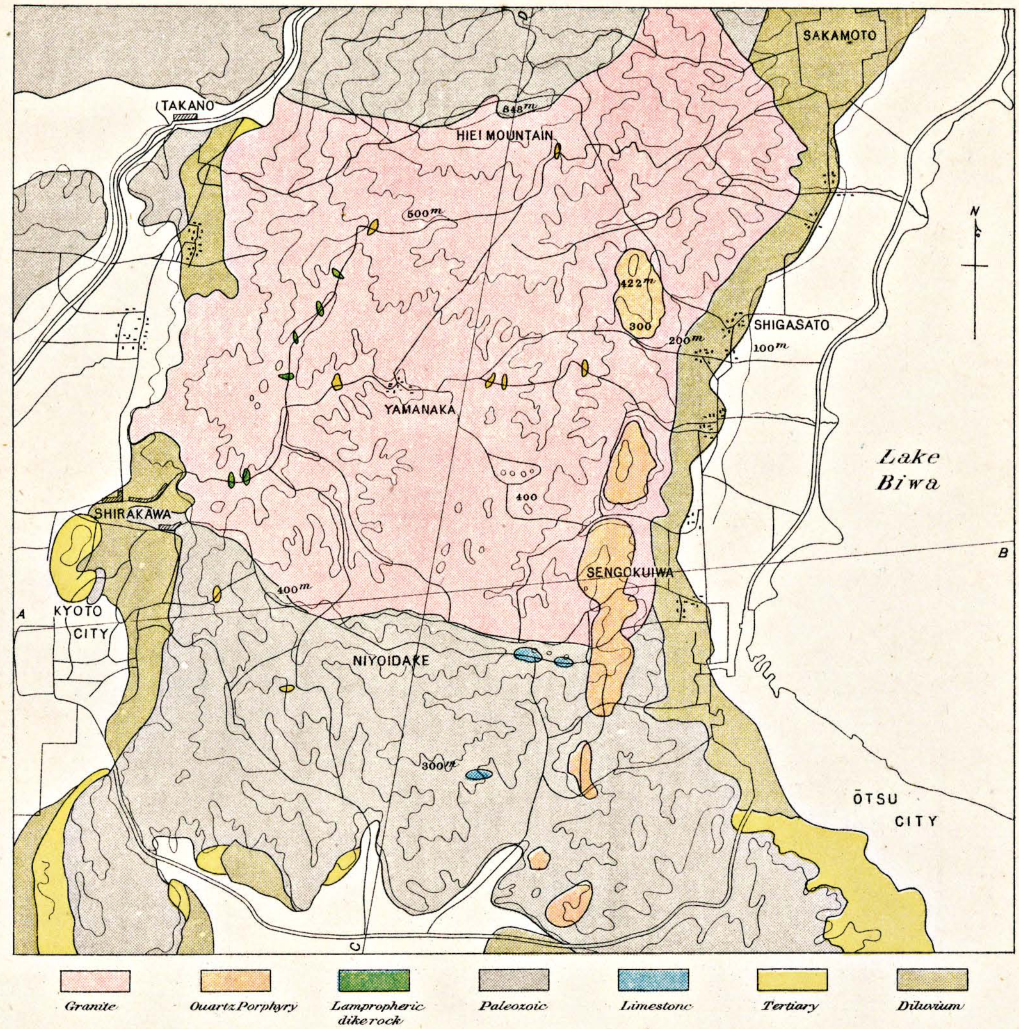
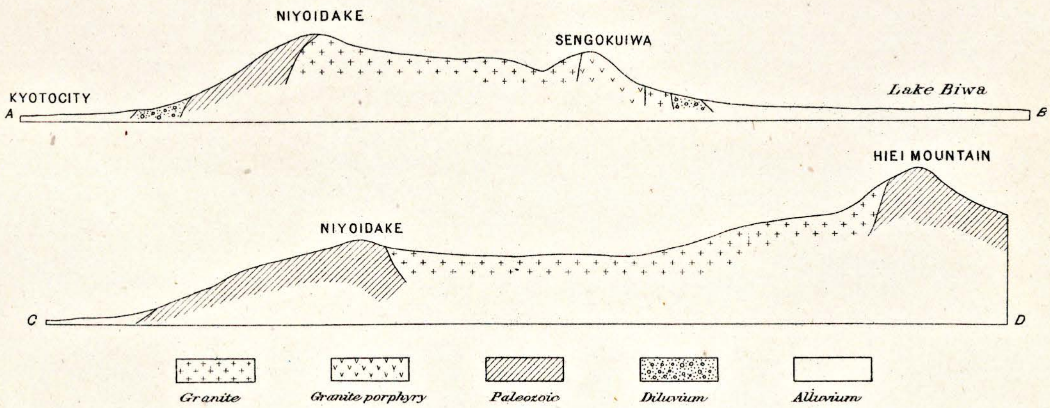


Fig. 2. Granite porphyry with felsitic groundmass.
× 35.

Geological Map of Mount Hiei Environs.



Scale 1 : 75,000



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