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28. *Pumice-flow Deposits of Komagatake Volcano, Southern Hokkaido.*

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Introduction

Komagatake Volcano, situated in the eastern part of the Oshima Peninsula in Southern Hokkaido, is one of the noted active volcanoes in Japan. This volcano seems to have been active scince prehistorical ages, and violent eruptions have occurred repeatedly in historic times, that is, great eruptions took place in 1640, 1856 and 1929. During the course of the 1926 eruption, a large quantity of pumice-blocks and ash-materials effused from the crater descended the mountain-slope in a state of pumice-flow, and the deposits consisting of fragmentary materials of all grades occupied a wide area on the lower slope of the volcano. Similar fragmentary deposits consisting of pumice-blocks and ash-materials are distributed widely on the mountain-slope of the volcano, which may be the products of pumice-flows of the former eruptions. Besides these, mud-flow deposits caused by disruption of the apical part of the volcanic cone constructed in the earlier stage occupied the southern and eastern skirts of the volcano, forming the characteristic topography of flowed-mounds.

The writer studied these deposits of pumice-flows and mud-flows on the spot. He collected several specimens and carried out mechanical analyses of them. The results will be presented in this paper. The writer wishes to express his gratitude to Prof. Hiromichi Tsuya of the Earthquake Research Institute, Tokyo University, for constant guidance in the course of the work. He is also indebted to Mr. Yoshichi Hosoya of the Komoro Branch of the Earthquake Research Institute, for his aid in the work as well as for preparation of figures in this paper.

General Structure of the Volcano

Komagatake Volcano is composed of repeated layers of lava flows and fragmentary materials of two-pyroxene-andesite. Some of the fragmentary deposits are the products of pyroclastic flows. A conical volcano had been built up by accumulation of lava flows and fragmentary materials in the earlier period. The apical part of the cone was destroyed by explosions to result in formation of a horseshoe-shaped caldera. The disrupted materials, descending down the mountain-side, occupied the southern and eastern skirts of the volcano, forming flowed-mounds (Horseshoe-shaped crater mud-flow). Subsequently, a large quantity of fragmentary materials was effused and descended down the northern, eastern and southern moutain-slope (Horseshoe-shaped crater pumice-flow). The horseshoe-shaped caldera is surrounded on its north, west and south sides with a ring-wall, while on its east side there is a great gap in the ring-wall. A small central cone is built up in the caldera, only the eastern side of which is developed, and the other sides are absent. The ring-wall of the somma and the crest of the central cone embrace an oval crater, the major and minor diameters of which are 1 *km* from *NNE* to *SSW* and 0.7 *km* from *WNW* to *ESE* respectively. Several active pit-craters are opened in the oval crater. The configuration of the inside of this oval crater has changed from time to time. On the flanks of the somma, there are several knobs, one on the northwestern flank may be a parastic cone consisting of fragmentary materials of quartz-bearing hypersthene-andesite effused in the earlier period, while the other on the southeastern flank are the mounds composed of pumice-flow deposits of two-pyroxene-andesite descended repeatedly from the oval crater in the later period. The northwestern part of the ring-wall was blown away by a side-explosion to result in formation of Oshidashizawa explosion-crater, and the disrupted materials caused a mud-flow, simultaneously a cloud of scoria, pumice and ash descended down to the northwestern skirt in a state of pyroclastic flow (Oshidashizawa mud-flow and scoria-flow). During the eruptions in the latest period, perhaps in historic times, lava-flow and pumice-flow discharged from the oval crater descended the eastern side through the eastern gap of the ring-wall (Kurumizaka lava-flow and pumice-flow). In the 1929 eruption, new pumice-flows discharged from the crater, spreading down to the skirts in all directions.

The Eruption of 1929

Komagatake Volcano seems to have been active from ancient ages, although noting about its activity has been recorded but the eruptions since 1640. In historic times the eruptive activity has been repeated frequently in the oval crater. Eruptions took place in the years: 1640, 1765, 1784, 1856, 1888, 1905, 1919, 1929, 1937 and 1942. Among them, the eruptions of 1640, 1856 and 1929 were the most violent.

On June 17, 1929, a great eruption took place. The volcano had continued its solfataric activity before the eruption, and steam and solfataric gas had been issued from several vents in the oval crater. Many reports were written of the eruption, founded on accounts by eyewitnesses.[1] According to them, the course of eruption was as follows:

The eruption began with an earthquake and rumbling noises. At about 0 *h*. 30 *m*. *a.m.*, June 17, a slight earthquake occurred and rumbling noises from the volcano were heard at Ônuma. Volcanic ashes began to fall in Shikabe district at about 3 *h*. *a.m.* The activity had gradually become violent, the amount of volcanic ashes discharged from the crater had increased and rumblings had grown worse before about 10 *h*. *a.m.*, when a great explosion came accompanied by an earthquake. Volcanic ashes and lapillis began to fall heavily in Shikabe district. After that, emission of dark ash-laden cloud and ejection of pumice-blocks continued almost uninterruptedly, increasing in violence. At about 0 *h*. 20 *m*. *p.m.*, a mass of pumice-laden cloud ran over the southern saddle in the ring-wall, descending down the mountain-slope. This was the first pumice-flow. The ash-cloud attained an enormous height, at 2 *h*. *p.m.* measuring about 13,200 *m*. Ejected materials were borne southeastward by the upper atmospheric current, falling on the wide area southeast of the volcano. At 2 *h*. to 3 *h*. *p.m.*, the second pumice-flow ran over the northwestern saddle in the ring-wall, pouring into the Oshidashizawa gully. After that, great masses of pumice-flow successively descended the mountain-slope in all directions. Thus, discharging of pumice-flows continued till at about 10 *h*. *p.m.* of the same day. Ejection of incandescent pumice, lapilli and ash continued almost steadily till about 11 *h*. 30 *m*. *p.m.*, when the eruption subsided. At about 1 *h*. 30 *m*. *a.m.* in the next morning, showers of the ejected materials in Shikabe district ceased entirely. Emission of ash-laden cloud continued for the next several days.

1) Hiromichi TSUYA *etc.* 7, "*The Eruption of Komagatake, Hokkaido, in* 1929" *Bull. Earthq. Res. Inst.*, **8** (1930), 237–319.

Shukusuke KOZU, "*The great activity of Komagatake in* 1929" *Min. Petr. Mitt.*, **45** (1934), 133–174.

Pumice-flows were discharged during the paroxysmal phase of the activity, running over the ring-wall and descended the mountain-slope with surprising speed, still retaining hot gas. The deposits, occupying most of the lower slope of the volcano, maintained a high temperature for a fairly long time after deposit. Temperatures as high as 300° to 560°C were measured with thermometer and electric pyrometer in the interior of the deposits, several days after the eruption. Constituents of the deposits were oxidized by circulating air for their high temperature. Secondary solfataras developed on the surface of the deposits. Trees

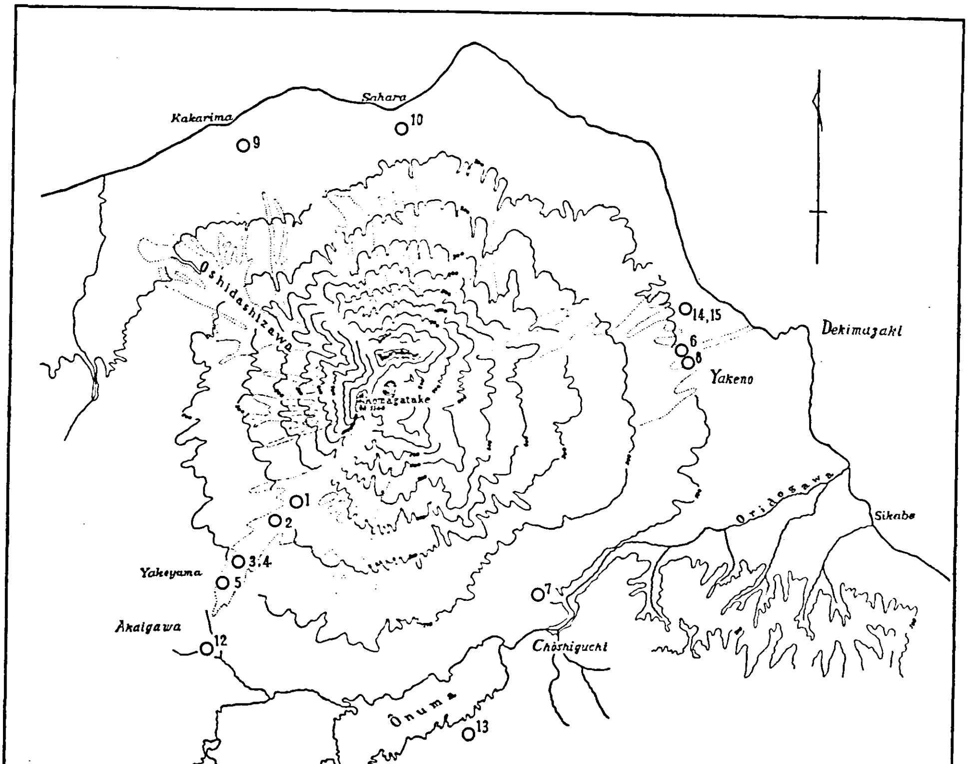

Fig. 1. Map of Komagatake Volcano, showing the distribution of the pumice-flow deposits discharged by the 1929 eruption and localities of specimens collected for mechanical analyses.

buried in the deposits were turned into natural charcoal.

A large quantity of fragmentary materials was projected and covered not only the ground around the crater but also the wide area of south-eastern skirts of the volcano. The whole area covered with the projected materials was estimated at about 400 to 500 km^2, and the volume of the projected materials was estimated at about 0.4 km^3. The area covered with pumice-flow deposits was estimated at about 27 to 30 km^2. Assuming that the thickness of the deposits is 5 m on the average, the volume of the deposits is calculated at about 0.15 km^3.

Mechanical Characteristics of the Pumice-flow Deposits discharged by the 1929 Eruption

A large number of pumice-flows were discharged, spreading down to the skirts of the volcano, in the 1929 eruption. The pumice-flow deposits occupy a vast area on the mountain-slope. Their distribution is shown in Fig. 1. The farthest front of the flows reaches about 6 km from the crater.

The writer collected 5 specimens from the Akaigawa pumice-flow deposits, extending southwestward from the crater, and collected one specimen from the front of the Yakeno pumice-flow deposits, extending eastward from the crater. Localities where the specimens were collected are shown in Fig. 1. Specimens of about 1 kg weight were collected for mechanical analyses. Mechanical analyses were carried out by means of the decantation, sieving and pipette methods in sequence. Then, all the results obtained through such steps of laboratory work were corrected for the coarser fractions by referring to the photographs of the outcrops from which the specimens were picked up. Detailed description of such steps of the mechanical analyses will be omitted here. The final results of the mechanical analyses are shown in Table 1, where figure listed in the column represents the weight per cent of each fraction sized out by the mechanical analyses. Fig. 2 and Fig. 3 show the particle size distribution of the specimens by cumulative curves and histograms respectively. The diameters of particles in millimeters ξ are replaced here by ϕ as expressed $\phi = -\log_2 \xi$ for convenience. The phi values of the percentiles ϕ_5, ϕ_{16}, ϕ_{25}, ϕ_{50}, ϕ_{75}, ϕ_{84} and ϕ_{95} were read on the cumulative curves, and the approximate values of every sort of parameter of the particle size distribution were calculated from the following relations. The values of these parameters are listed in Table 2.

$$Md_\phi=\phi_{50}\ , \qquad M_\phi=(\phi_{16}+\phi_{84})/2\ ,$$

$$Q'=|\ \phi_{75}-\phi_{25}\ |/2\ , \qquad Q''=(\phi_{75}+\phi_{25}-2\phi_{50})/Q'\ ,$$

$$\sigma_\phi=|\ \phi_{84}-\phi_{16}\ |/2\ , \qquad \alpha_\phi=(M_\phi-\phi_{50})/\sigma_\phi\ ,$$

$$\alpha_{2\phi}=\frac{(\phi_5+\phi_{95})/2-\phi_{50}}{\sigma_\phi}\ , \qquad \beta_\phi=\frac{(\phi_{95}-\phi_5)/2-\sigma_\phi}{\sigma_\phi}$$

Md_ϕ, Q' and Q'' are median, deviation and skewness respectively, obtained by the quartile method, while M_ϕ, σ_ϕ, α_ϕ and $\alpha_{2\phi}$, and β_ϕ are mean, deviation, skewness and kurtosis of the INMAN's phi measure system.

The results of the mechanical analyses of 6 specimens of the pumice-flow deposits discharged by the 1929 eraption are summarized as follows:

1) The median diameters Md_ϕ of specimens Nos. 1, 2, 3, 4 and 5

Table 1. The results of the mechanical analyses. The result of the mechanical analysis of a given specimen is noted in the column beneath its specimen number with weight per cent of each fraction.

a: pumice-flow deposits and mud-flow deposits,

ϕ \ sp. no	1	2	3	4	5	6	7	8	9	10	11	12	13
−10∼ −9											1.2		
−9 ∼ −8	2.0	1.2				1.5					1.4	2.0	2.7
−8 ∼ −7	2.8	1.8		1.6	1.6	6.8		1.4	1.4		2.6	3.6	4.4
−7 ∼ −6	3.1	3.0	0.4	3.2	4.1	8.1	1.8	2.4	3.5	3.2	4.0	3.8	5.3
−6 ∼ −5	3.5	3.6	2.9	6.7	8.1	7.9	3.9	3.9	4.6	4.8	4.8	5.3	6.7
−5 ∼ −4	4.4	4.7	7.5	12.8	9.2	8.6	5.6	7.6	5.7	6.8	5.3	5.8	10.1
−4 ∼ −3	7.2	6.7	6.8	7.4	6.2	6.8	6.5	8.2	5.2	6.4	6.3	6.3	10.1
−3 ∼ −2	6.1	5.8	5.6	3.5	4.5	3.9	5.5	6.1	4.6	4.0	7.5	6.4	8.0
−2 ∼ −1	3.1	3.5	3.8	3.8	3.3	2.7	4.7	4.0	5.0	3.1	9.1	6.4	6.4
−1 ∼ 0	12.3	11.5	9.8	9.5	8.7	8.3	12.2	11.8	15.6	9.0	13.5	8.5	7.6
0 ∼ 1	26.0	26.7	27.8	22.3	22.3	19.0	27.6	22.2	23.8	25.0	17.6	13.6	9.0
1 ∼ 2	13.2	13.8	15.7	12.3	13.9	10.9	16.3	14.5	12.9	14.0	10.9	11.6	7.8
2 ∼ 3	5.0	5.5	6.1	4.8	5.3	4.2	5.9	5.7	6.8	6.3	6.7	9.0	5.1
3 ∼ 4	2.1	2.7	2.8	1.8	2.4	2.4	1.3	2.5	3.3	2.7	3.4	6.2	3.9
4 ∼ 5	1.7	1.9	1.9	1.5	1.7	1.3	1.4	1.9	3.1	1.8	2.4	4.5	4.1
5 ∼ 6	2.3	1.9	1.7	2.3	2.8	1.3	1.2	2.0	2.2	4.1	1.1	2.3	3.3
6 ∼ 7	2.5	2.8	3.5	3.5	2.8	3.0	2.2	2.8	1.5	4.6	1.0	1.9	2.9
7 ∼ 8	2.2	2.0	2.4	1.7	1.9	2.6	2.2	1.7	0.5	2.2	0.5	1.4	1.3
8 ∼ 9	0.3	0.7	1.1	1.0	0.8	0.6	0.5	1.0	0.1	1.1	0.3	1.0	0.3
9 ∼	0.2	0.2	0.2	0.3	0.4	0.1	1.2	0.3	0.2	0.9	0.4	0.4	1.0

b: pumice-fall deposits.

ϕ \ sp. no	14	15
−6 ∼ −5.5	15.0	
−5.5∼ −5	22.4	24.5
−5 ∼ −4.5	24.8	19.7
−4.5∼ −4	21.6	15.0
−4 ∼ −3	10.1	18.0
−3 ∼ −2	1.8	8.4
−2 ∼ −1	1.0	5.7
−1 ∼ 0	1.0	4.3
0 ∼ 1	1.0	2.7
1 ∼ 2	0.5	1.1
2 ∼ 3	0.3	0.2
3 ∼ 4	0.2	0.2
4 ∼	0.2	0.2

(Akaigawa pumice-flow deposits) stay exclusively in a narrow range of 0.06 to 0.47, and systematic variation of Md_ϕ values with distauce from the crater as in the case of pumice-fall deposits can not be found. The value of Md_ϕ of specimen No. 6 (Yakeno pumice-flow deposits) is the same order, −0.30.

2) The particle size distribution of all specimens is quite similar to each other. There are two distinct modes as shown in the histograms (Fig. 3). The main-mode always lies in the fraction of 0 to 1 in ϕ scale, and the sub-mode is found in the tailing-out part of the coarser fractions, whose position varies in each specimen. In the tailing-out part of the finer fractions, there is another weak sub-mode.

3) In spite of the fact that the size distribution has a surpassing main mode, the sorting is fairly bad, as the values of Q' are in a range of 1.6 to 3.0, and the values of σ_ϕ are 2.9 to 4.0. This is due to the appearance of a distinct sub-mode in the coarser fractions. The values of α_ϕ, which represent the degree of skewness of particle size distribution, stay in a negative range of −0.4 to −0.3. The values of β_ϕ, the parameter of kurtosis, are in a range of 0.5 to 1.2.

Such features of the particle size characteristics as mentioned above are typical ones of the pumice-flow deposits, being in striking contrast to the normal projected pumice-fall deposits. The writer collected 2 specimens of pumice-fall deposits, one from the deposits of the 1929 eruption and the other of a former eruption, and carried out mechanical analyses of them. The results are shown in Table 1b. Table 2, Fig. 2 and Fig. 4. The size characteristics of the pumice-fall deposits show better sorting, lack of tailing-out of the coarser fractions, regular variation of coarseness with distance from the crater, values of α_ϕ tend to fall in a positive range and the other features.[2]

The pumice-flow deposits of the 1929 eruption are two-pyroxene-andesite petrologically and identical with the projected materials. The deposits consist of several different constituents. The coarser fractions

[2] Hisashi KUNO, "Characteristics of Deposits formed by Pumice Flows and Those by Ejected Pumice" *Bull. Earthq. Res. Inst.*, **19** (1941), 144–149.

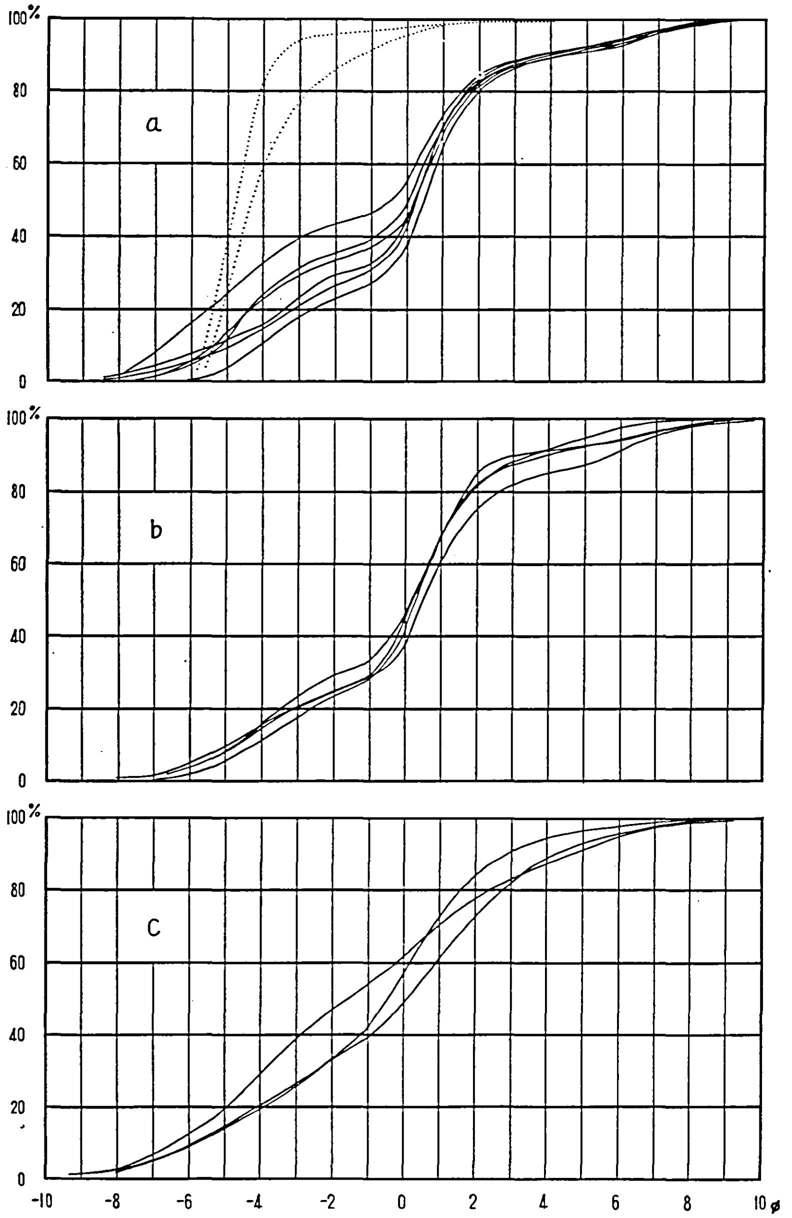

Fig. 2. Cumulative curves of particle size distribution.
a: dotted lines; pumice-fall deposits (Sp. Nos. 14 and 15), solid lines; pumice-flow deposits of the 1929 eruption (Sp. Nos. 1, 2, 3, 4, 5 and 6),
b: pumice-flow deposits of the former eruption (Sp. Nos. 7, 8, 9 and 10),
c: mud-flow deposits (Sp. Nos. 11, 12 and 13).

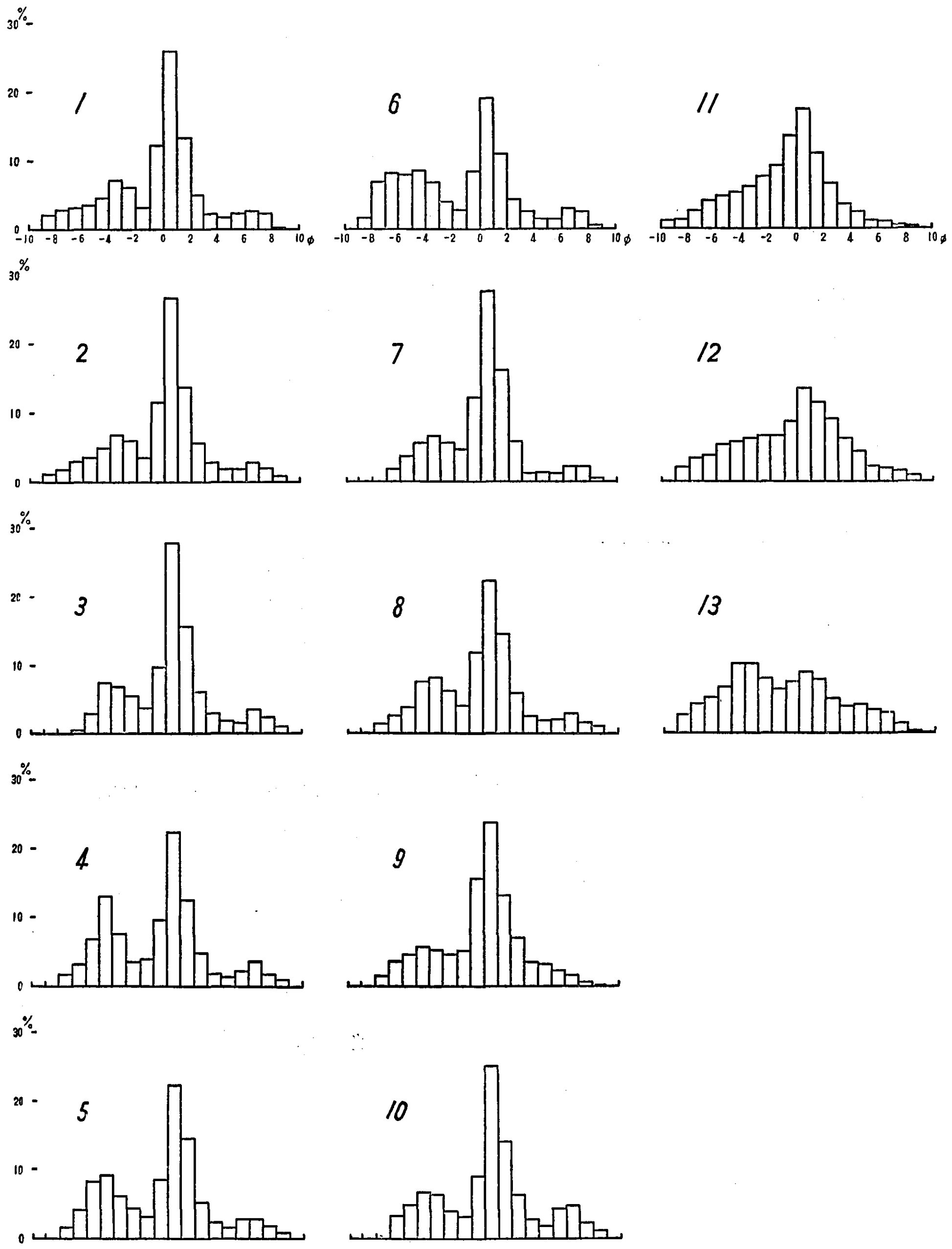

Fig. 3. Histograms of particle size distribution. The number of specimen is noted on the left of each histogram.

Table 2. Data on parameters of particle size distribution.

	Md_ϕ	M_ϕ	Q'	Q''	σ_ϕ	α_ϕ	$\alpha_{2\phi}$	β_ϕ
1	0.20	−0.97	1.97	−0.93	3.00	−0.39	−0.21	1.17
2	0.29	−0.77	1.86	−0.84	3.00	−0.35	−0.10	1.10
3	0.47	−0.36	1.55	−0.58	2.88	−0.29	0.16	0.98
4	0.06	−1.26	2.60	−1.07	3.39	−0.39	0.33	0.53
5	0.17	−1.26	2.55	−1.02	3.56	−0.40	−0.03	0.73
6	−0.30	−2.06	3.02	−1.08	3.99	−0.44	0.05	0.67
7	0.33	−0.65	1.48	−0.62	3.64	−0.37	−0.16	1.21
8	0.20	−0.83	2.11	−0.82	3.09	−0.33	0.05	0.91
9	0.22	−0.77	1.72	−0.58	3.09	−0.32	−0.20	0.80
10	0.50	−0.23	1.94	−0.61	3.60	−0.20	0.03	0.74
11	−0.37	−1.30	2.10	−0.06	3.28	−0.30	−0.31	0.73
12	0.15	−0.76	2.72	−0.05	3.99	−0.23	−0.21	0.62
13	−1.53	−1.09	3.96	0.09	4.29	0.10	0.21	0.58
14	−4.73	−4.73	0.53	−0.10	0.73	0.00	0.89	1.23
15	−4.32	−3.70	0.87	0.59	1.47	0.42	1.12	0.85

consist of pumice-blocks and rock fragments, both accessory and accidental, which come out in distinct sub-mode of particle size distribution. The medium fractions consist dominantly of crystal grains and less amount of pumice fragments and rock fragments, which represent the surpassing main mode of the fraction of 0 to 1 in ϕ scale. The finer fractions consist of vesicular glass flakes and crystal fragments.

Pumice-blocks in the pumice-flow deposits are composed of phenocrysts of plagioclase, hypersthene and augite, and vitreous groundmass. The bulk densities of them are in a range of 0.7 to 1.4, and 0.9 on the average. These are the same values as in the cases of the pumice-flow deposits of Asama Volcano (0.7 to 1.0, 0.85 on the average), Nantai Volcano (0.8 to 1.1, 0.9 on the averange), and of Tokachidake Volcano (0.5 to 1.2, 0.9 on the average), but somewhat heavier than the values (0.5 on the average) of the pumice-flow deposits of Towada Caldera, Kutcharo Caldera, Shikotsu Caldera, Akan Caldera, and of the Shirasu deposits.

Pumice-blocks consist of 45 per cent phenocrysts and 55 per cent vesicular glass in weight percentage, while, in the pumice-flow deposits, crystals form a greater percentage than vesicular glass flakes. Crystals were concentrated especially in the medium fraction as in the case of the crystal-ricn glowing avalanche deposits of St. Vincent.[3] The surpassing main mode in the fraction of 0 to 1 in ϕ scale is due to the concentration of crstals. The bulk densities of the pumice-flow deposits are about 1.5 and twice those of pumice blocks in them. This is partly due to the concentration of crystals in the deposits. Pumice-blocks are also concentrated in the deposits, as represented by the distinct sub-mode in the coarser fractions. Concentration of pumice-blocks is remarkable especially in the upper part and in the front of the pumice-flow deposits.

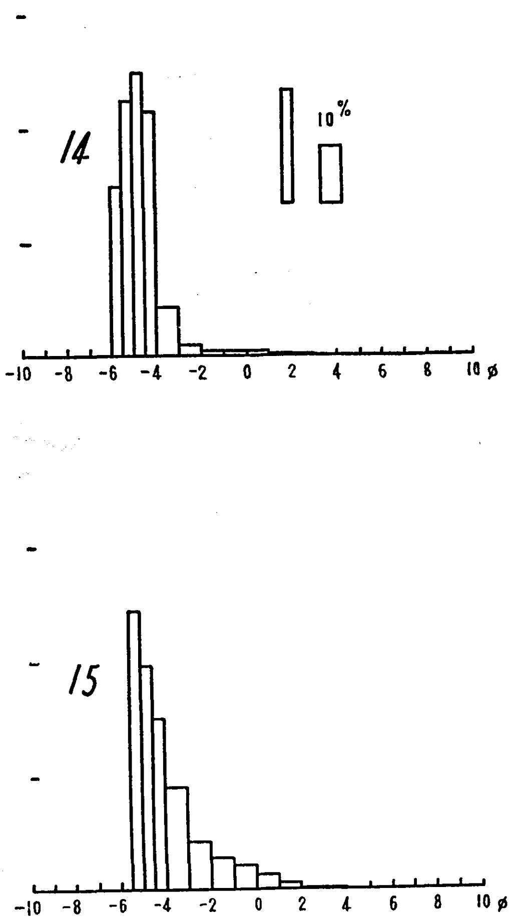

Fig. 4. Histograms of pumice-fall deposits.

3) RICHARD L. HAY, "Formation of the Crystal-rich Glowing Avalanche Deposits of St. Vincent, B. W. I." *Journ. Geol.*, **67** (1959), 540–562.

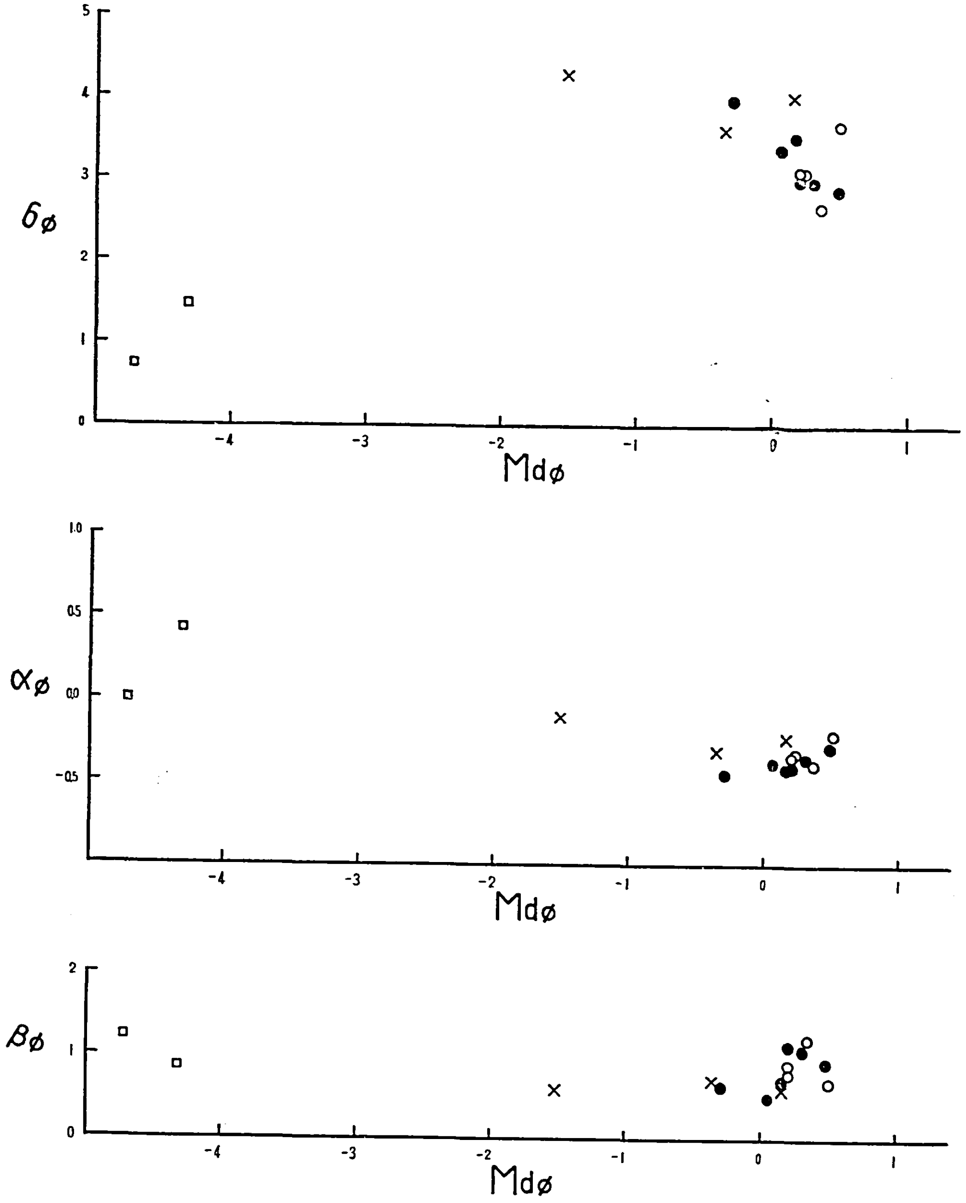

Fig. 5. The relation of the values of σ_ϕ, α_ϕ and β_ϕ to the values of Md_ϕ.

Solid circles; pumice-flow deposits of the 1929 eruption, open circles; pumice-flow deposits of the former eruption, crosses; mud-flow deposits, opon squres; pumice-fall deposits.

Mechanical Characteristics of the Pumice-flow Deposits and the Mud-flow Deposits of the former Eruptions

Pumice-flows were discharged repeatedly by the former eruptions. They are distributed widely on the mountain-slope of the volcano. The writer collected 4 specimens of the pumice-flow deposits, and carried out the mechanical analyses of them. The results are summarized as follows:

1) All specimens have quite similar size characteristics to those of the pumice-flow deposits of the 1929 eruption. The values of all sorts of parameters of the particle size distribution in both are the same. The median diameters Md_ϕ stay exclusively in a narrow range of 0.2 to 0.5. The values of Q' are in a range of 1.5 to 2.1, and the values of σ_ϕ are 3.1 to 3.6. The values of α_ϕ stay in a negative range of -0.4 to -0.2. The values of β_ϕ are in a range of 0.7 to 1.2.

2) There are two distinct modes in the particle size distribution as shown in the histograms, as in the case of the pumice-flow deposits of the 1929 eruption. The main mode always lies in the fraction of 0 to 1 in ϕ scale, which represents concentration of crystals in this fraction. The sub-mode also lies in the tailing-out part of the coarser fractions, which represents concentration of pumice-blocks. Another weak sub-mode is found in the tailing-out part of the finer fractions. All of these features are just the same as those of the 1929 pumice-flow deposits. Both of these deposits of the former eruptions and the 1929 eruption are petrologically the same.

Mud-flow deposits resulted by disruption of the apical part of the volcanic cone constructed in the earlier stage are distributed on the southern and eastern skirts of the volcano. The writer collected 3 specimens of these deposits in the flowed-mound reagion on the southern skirts, and carried out mechanical analyses of them. The results are summarized as follows:

1) The size characteristics of the mud-flow deposits are somewhat different from those of the pumice-flow deposits. The values of Md_ϕ vary in a wide range of -1.5 to 0.2. The sorting is worse than in the case of the pumice-flow deposits, as the values of Q' is in a range of 2.1 to 4.0 and the values of σ_ϕ are 3.3 to 4.4. The values of α_ϕ in a range of -0.3 to 0.1, and the values of β_ϕ are 0.5 to 0.7.

2) The shape of the particle size distribution is very flat as shown in the histograms. Tailing-out of both in the coarser and the finer fractions are found. A main mode lies in the fraction of 0 to 1 in ϕ scale as in the case of the pumice-flow deposits. A sub-mode in

the coarser fractions disappears on one occasion, and surpasses on another occasion. Size characteristics of 3 specimens are unstable and show disparity with each other.

Origin of the Pumice-flows of the 1929 Eruption

Pumice-flows were discharged during the paroxysmal phase of the 1929 eruption. Violent emission of ash-laden cloud succeeded the first explosion, and an ash column rose vertically to an enoumous height. Pumice-laden cloud descended laterally from the lower, and perhaps the outer, part of the ash column, judging from the photographs of the eruption, as they may have became denser than the surrounding atmosphere, although the process cannot be analysed properly here. Initial verocities of gas in the ascending magma at the crater-rim, which may have been no longer an effervescing melt but have had already been disintegrated into frothing clots of pumice and droplets of liquid disrupted into crystals and finely comminuted flakes of vesicular glass, may have been lower than in the case of a major explosion such as that of Asama Volcano. However, the gas content of the magma must have been high, for violent emission of ash-laden cloud continued over a half-day. It may be possible to infer that most of crystals and coarse pumice-blocks may have concentrated in the slowly rising outer part of a column of ash cloud, settling in turbulent currents of gas rising from the crater, lighter particles of vesicular glass have been born vertically in suspension.

When the dense pumice-laden cloud began to descend the mountain-slope, crystals and coarse pumice-blocks separated from the vitric ash and concentraed in the lower layers of the descending cloud. Thus the pumice-flow deposits rich in crystals and coarse pumice-blocks were settled on the lower slope of the volcano. The size characteristics of these deposits were described in the preceding chapter. Concentration of crystals is found distinctly in the lower part of the deposits, while concentration of coarse pumice-blocks is seen in the upper part and especially in the front of the deposits as already mentioned. Fine-grained pumice-flow deposits rich in vesicular glass were settled from the upper layers of the descending cloud, lighter and relatively rich in gas and vitric ash, along the front of the coarse-grained deposits of pumice-flows.

Summary

Pumice-flows discharged from Komagatake Volcano, on June 17, 1929, descended from the lower, and perhaps slowly rising outer part of a vertically rising column of ash-laden cloud, during the paroxysmal phase of the eruption. The outer part of an ash column became denser than the surrounding atmosphere, and pumice-laden dense cloud discharged laterally. Crystals and coarse pumice-blocks were concentrated in the lower layers of descending dense cloud, and crystal-rich pumice-flow deposits were deposited on the mountain-slope of the volcano. Similar pumice-flows were discharged by former eruptions, and their deposits are quite similar to those of the 1929 eruption.

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28. 北海道，駒ケ岳火山の軽石流堆積物

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北海道南端の渡島半島東部に位置する駒ケ岳火山は，活火山として知られ，古くから烈しい噴火を繰返えしてきた．寛永17年 (1640年)，安政3年 (1856年)，昭和4年 (1929年) の噴火は特に烈しかつた．昭和4年の噴火の際には，軽石流の噴出が起つた．噴火は6月17日午前0時30分頃より始まり，午前10時頃に烈しい爆発が起つた．噴煙は空中高く噴き上げられ，軽石や火山礫火山灰が間断なく抛出された．正午を少しすぎた頃，最初の軽石流が噴出した．噴煙はますます烈しさを増し，その高さは午後2時頃には13,200 *m* と測定された．午後2時より3時にかけて，軽石流はあいついで噴出し，北西，南西，南東斜面を流下した．その後も軽石流の噴出は続き，午後10時頃最後の軽石流が南西斜面に流下した．噴火は午後11時30分頃まで続き，そのご衰えて，18日午前1時30分には降灰もおさまつた．軽石流は，北，西，東方の山腹斜面上に拡がり，その面積は 27～30 km^2 におよんだ．堆積物の厚さを平均 5 *m* と仮定すれば，総体積は約 0.15 km^3 となる．筆者はこの軽石流堆積物の試料を数ケ所から採集して機械分析を行つた．その結果は一般の軽石流堆積物と共通の特徴を示した．すなわち，分級が相当悪く，粗粒部および細粒部に長く尾を引き，主モードの位置は ϕ スケールで 0～1 の間に常に現れ，粗粒部に副モードを持ち，採集地点の相異にかかわらず共通の粒度分布を示し，中位粒径の値はほとんど変化がない，等の特徴を示した．駒ケ岳火山の軽石流堆積物の粒度組成の特徴として特に注目すべき点は，結晶粒の集中が著しいことである．すなわち，軽石塊では，斑晶が 45% に対してガラス質が 55% を占めているが，軽石流堆積物では，軽石塊および石質破片を除くと，結晶粒がガラス破片よりもかなり多くの比率を占めている．ヒストグラムで見られるような中粒部の顕著な主モードがこれを表わしている．結晶粒の集中は堆積物の下部において著しく，これに対し，堆物の上部および末端部では粗粒の軽石塊の集中が認められる．軽石流堆積物のこのような特徴は，軽石流の噴出の機構を示唆するもののように考えられる．すなわち，垂直に上昇する噴火雲の中の比較的ゆるやかに上昇する外側部で，比重の大きな結晶粒と粗粒の軽石塊とが分級されて集中し，その部分が周囲の大気よりも比重が大きくなつて，側方に流下して軽石流を生じたと解釈することも可能であろう．いつたん軽石流の流下が始まれば，その流下雲の中で更に結晶粒の分級が続き，堆積物の下部に集中すると考えられる．さらに粗粒の

軽石流は堆積物の上部および末端に集中する．細粒のガラス破片は上層にまい上り，粗粒な堆積物の前面にそつて堆積して，細粒のガラス質の軽石流堆積物となる．

駒ケ岳火山では，古くから火山砕屑流を繰返して噴出した．筆者はこれらの火砕流の堆積物から4個の試料を採集して，機械分析を行つた．その結果は昭和4年の軽石流堆積物と全く同一であつた．駒ケ岳火山では，同じような噴火が古くから繰返えして行われたものと見られる．駒ケ岳火山は，かつて烈しい爆発により，その頂部が破壊され，泥流が発生して南方および東方山麓に流下し，特徴的な流れ山地形を作つた．この泥流堆積物から個の試料を採集して機械分析を行つた．泥流堆積物では，分級が一層悪く，粒度分布の形は不安定で，中位粒径の値も大きく変化する，等の特徴が認められた．

Fig. 6. The outcrop of the Akaigawa pumice-flow deposits, from which Sp. Nos. 3 (middle part) and 4 (upper part) were collected.

Fig. 7. The outcrop of the Yakeno pumice-flow deposits, from which Sp. No. 6 was collected.

Fig. 8. The outcrop of the pumice-fall deposits, from which Sp. Nos. 14 (upper layer) and 15 (lower layer) were collected.

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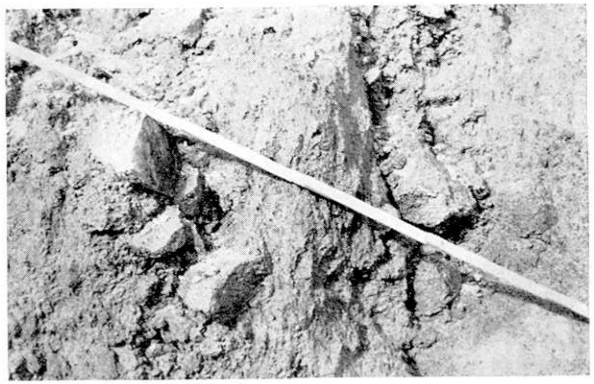

Fig. 9. The outcrop of the Horseshoe-shaped crater mud-flow deposits, from which Sp. No. 13 was collected.

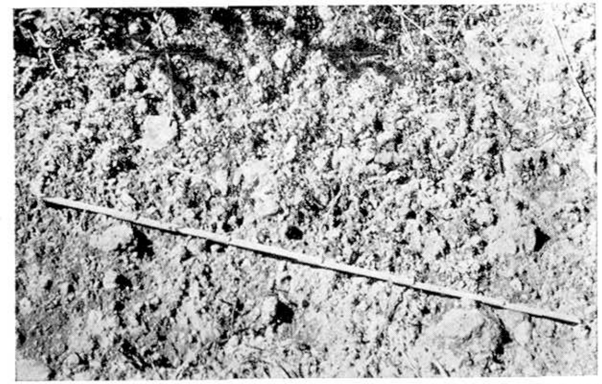

Fig. 11. The outcrop of the Kurumizawa pumice-flow deposits, from which Sp. No. 8 was collected.

Fig. 10. The outcrop of the Akaigawa pumice-flow deposits, from which Sp. No. 4 was collected.

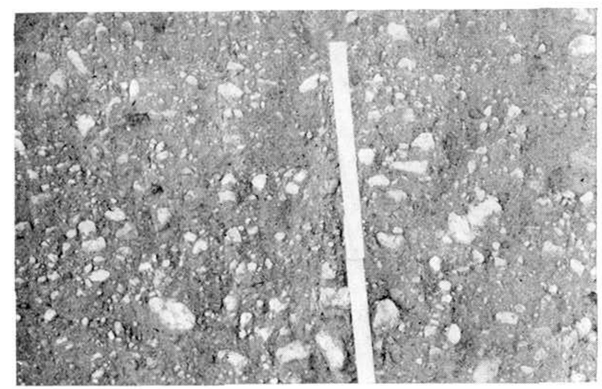

Fig. 12. The outcrop of the Horseshoe-shaped crater pumice-flow deposits, from which Sp. No. 7 was collected.

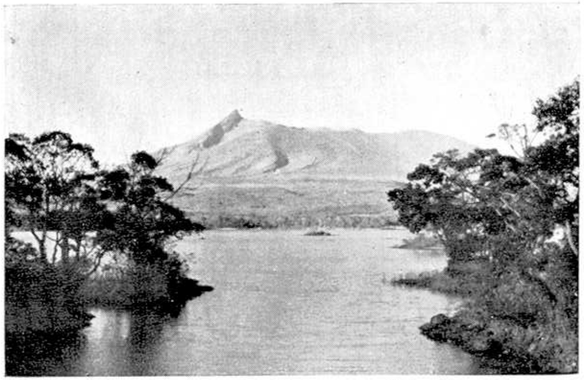

Fig. 13. Komagatake Volcano and the flowed-mounds in Ônuma.

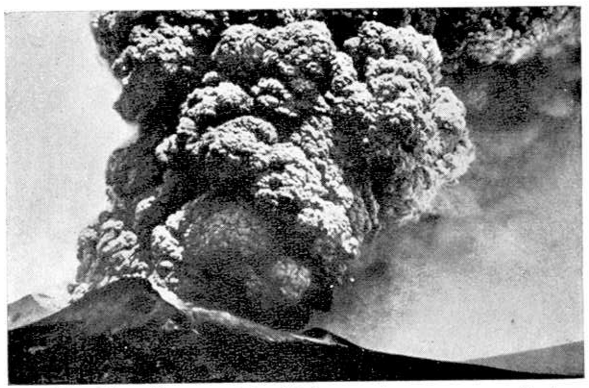

Fig. 14. Komagatake Volcano at a paroxysmal phase of eruption, as seen from Ônuma, June 17, 1929.

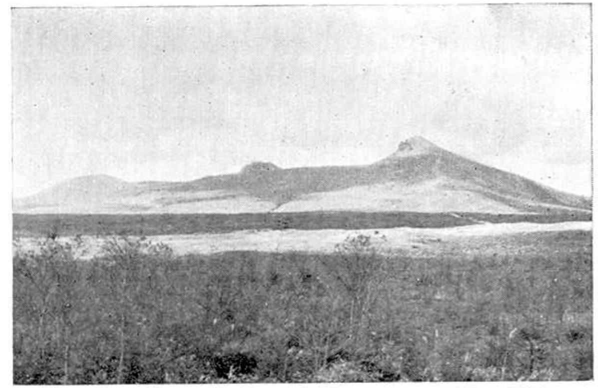

Fig. 15. General view of the eastern side of Komagatake, looking from Yakeno.

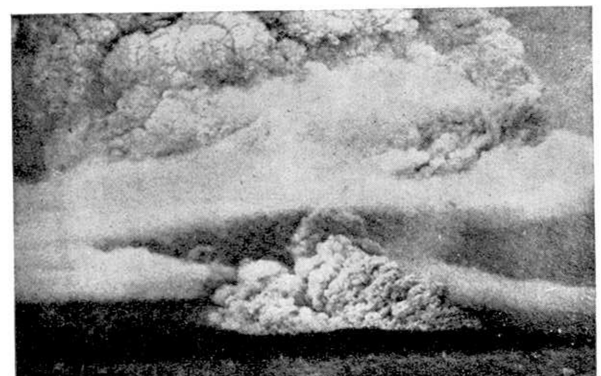

Fig. 16. A flow of pumice-laden cloud descending the southwestern slope of the volcano. About 5h. 30m.p.m., June 17, 1929.

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