18. *Neogene and Quaternary Vulcanism in the Idu*[1] *District.* (*Preliminary report*)

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I. Introduction.

The Idu district, which comprises, in addition to the peninsula of that name, the outlying group of small islands called the Idu Sititô (Idu Seven Islands)[2], is well known for its numerous volcanoes. This whole region is a series of volcanic rocks intercalated with sedimentaries, the oldest of which is a series of volcanics that were erupted during the Tertiary in the peninsula itself, while the youngest is the still active volcano of Ôsima[3], the most northerly member of the Sititô group. This active volcano forms a link in the volcanic chain known as the Huzi Volcanic Zone[4] which basaltic vulcanism had built up on the *fossa magna* since the Pleistocene. Consequently there is here a profusion of phenomena portraying the intensive volcanic activities that characterized this region since the time of the Tertiary.

In the winter of 1925-6, the writer visited the southern part of the Idu peninsula with the object of examining the geological correlation between the peninsula itself and the outlying liparitic insular volcanoes (Kôdusima[5] and Niizima[6]) of the Idu Sititô[7]. After the earthquakes of the first half of 1930 that shook the northeastern coast-belt of the peninsula, the writer investigated the geologic structure of the meizoseismal area[8]. Again, after the destructive earthquake of Nov. 26, 1930 that convulsed the northern part of the peninsula, the writer renewed with increased interest the investigation of the Idu district, in which investigation he is still engaged. A preliminary account of the volcanic history of the district as generalized from fragmental results already

1) 伊豆. 2) 伊豆七島. 3) 大島. 4) 富士火山帶. 5) 神津島. 6) 新島.

7) H. TSUYA, "Volcanoes of Kôzu-shima", *Bull. Earthq. Res. Inst.*, 7 (1929), 269-334.

8) H. TSUYA, "On the Geologic Structure of Itô District, Idu", *Ibid.*, 8 (1930), 409-426.

communicated, together with some hitherto unpublished details, are presented in this report.

II. Tertiary Vulcanism.

Tertiary volcanics are distributed extensively over the Idu peninsula. They are altered andesites, liparites, dacites, and fresh andesites, all accompanying their own pyroclastics; besides solid lavas. As a consequence of their complicated modes of occurrence and dislocation, and partly because of the alterations to which some of them have been subjected, their sequence is interpreted in different ways by different authors. H. Ishiwara[9] tried to show that the Tertiary volcanics of the peninsula are accompanied by sedimentary rocks containing the uppermost Tertiary faunas, and that they must therefore belong to submarine eruptions of that time. He regarded these as eruptions from a Tertiary central volcano ("Nekko Volcano")[10] and also as from local fissure-eruptions. But, although he distinguished the eight kinds of propylite, dacite, pyroxene-andesite, tuffite, tuff-conglomerate, agglomerate, shale, and sandstone, and indicated their respective type-localities, he made no attempt to unravel the sequence of eruption of these volcanic materials. According to S. Kozu[11], the geological sequence of the southern part of the Idu peninsula is plagioliparite, potash-liparite, propylite, liparite, Tertiary sediments, dacite, and pyroxene-andesite. In his opinion, the vulcanism there began in the middle Tertiary with the eruption of the plagioliparite and ended in the later Tertiary with the eruption of pyroxene-andesite, on the sea-floor throughout the whole period, with repeated fluctuations in activity. The statements of the above two authors constituted until recently the main information regarding the general geology of the peninsula. Recently, R. Tayama[12] and H. Niino[13] attempted a systematic examination of the peninsula from the stratigraphical side, and discriminated numerous Tertiary volcanic rocks according to their stratigraphic succession.

9) H. ISHIWARA, "Geology of the Volcanoes of Idu Peninsula", *Report Earthq. Invest. Com.*, **17** (1898), 3-49, (in Japanese).

10) 猫越火山.

11) S. KŌZU, "Geology of the Southern Part of Idu Peninsula", *Report Geol. Survey*, **38** (1913), 1-19, (in Japanese).

12) R. TAYAMA, "Relation between the N. Idu Earthquake on Nov. 26, 1930 and the Geological Structure of N. Idu", *Report Sci. Res., Saitô Gratitude Foundation*, **11** (1931), 1-53, (in Japanese).

13) R. TAYAMA and H. NIINO, "An Introduction to the Geology of Idu Peninsula", *Ibid.*, **13** (1931), 1-81, (in Japanese).

So far as the writer's observations go, the sequence of Tertiary vulcanism of the Idu peninsula is as follows:

1. Miocene vulcanism.

The first eruption phase in the Tertiary is represented by the altered andesites that are so widely distributed in the Idu peninsula, and which form the oldest formation now exposed there. Their age has not yet been definitely proved, but the upper limit to their possible range of age is fixed by the lower Miocene formations that overlie them unconformably.

The altered andesites, which occur as lava-flows interstratified with their pyroclastics, are associated with shale, sandstone, and conglomerate. As the last-named contains well-rounded pebbles of altered andesites, it is inferred that, although the altered andesites are largely from submarine eruptions, volcanic islands were built up on the Tertiary sea-floor and afterwards reduced by wave-action. From the thickness of the volcanics and the sizes of the pyroclastics, it is evident that the eruptions then were as wide-spread as they were energetic. These eruptions may have been alternately effusive and explosive, taking place from local vents which, however, have not yet been found.

The altered andesites vary considerably in megascopical as well as microscopical characters: they have not been uniformly effected by propylitization, although even in their freshest parts, their primary constituents are more or less replaced by secondary calcite, chlorite, silica, etc., while the base is devitrified. The freshest and most typical specimen of the altered andesites that could be obtained had phenocrysts of calcic plagioclase, augite, and hypersthene. The pyroclastic products had also been similarly altered.

The next series in the volcanic sequence suggests that subsequent to eruptions of the altered andesites, when possibly the oldest formation had been dislocated, a renewed outbreak of volcanic activity gave rise to eruptions of another and wholly different class of materials. This time the rocks were of a markedly acid type. They include varieties that range from potash-liparite, through plagioliparite, into dacite, and are distributed in the southern part and also in the western half of the northern part of the peninsula. The volcanic discharges consist largely of fragmentary materials (tuffs, tuff-breccias, and agglomerates), solid lavas being comparatively insignificant in amount and local in origin, though intrusive sheets, necks, and dikes frequently occur. None of

the erupted materials thicken sufficiently towards centres that might be taken to mark volcanoes of the central eruption type. The fragmentary materials form stratified beds containing marine fossils. As these materials become more calcareous, so do the fossils become more numerous. The few intercalated limestones have yielded fossils that indicate the age of the volcanics to be lower Miocene.

As to the succession of the volcanic events, no regular order in the eruptions of the various acidic rocks of this age has yet been established, although from certain available data the writer inferrs that these rocks, in the order of eruption, are: Potash-liparite, biotite-plagioliparite, hornblende-dacite, and hornblende-augite-dacite. These rocks, which have been subjected to more or less alteration, show their primary constituents to be silicified and sometimes sericitized, and the base devitrified, while its pore spaces are filled with recrystallized secondary quartz.

After the eruptions of the acidic rocks, there followed once more a period of volcanic activity, like that of the earliest andesites, but probably of less intensity. The andesites of this period occur as dikes, cutting through the lower Miocene beds. Like the earliest andesites, they also have been subjected to alteration. Whether or not they are the last manifestations of Miocene vulcanism in the district it is not possible yet to say, although another group of andesitic rocks that overlie them is quite fresh and seems much younger.

2. Pliocene vulcanism.

Vulcanism in later Miocene and earlier Pliocene cannot very well be ascertained as only a few rocks that probably belong to these periods have been found, and these few have yielded so far only fossils that are of small value as age-markers.

Vulcanism in the latest Pliocene is established by fossil evidence. Andesites and dacites are the rock-types represented. They occur in the central part of the Idu peninsula, accompanying their own tuffs, tuff-breccias, and agglomerates; besides solid lavas. They include various rocks which, in the order of eruption, are hornblende-pyroxene-dacite, pyroxene-dacite, pyroxene-andesite, and olivine-bearing pyroxene-andesite. The tuffs, both dacitic and andesitic, have yielded marine fossils by which we can assign them to submarine eruptions towards the close of the Pliocene. A number of andesitic bodies (dikes, lava-flows, and agglomerates) that intrude into and extend over the Miocene series in other parts of the peninsula are probably of this period.

III. Quaternary Vulcanism.

Either at the end of the Pliocene age or in the beginning of the Pleistocene, the Idu peninsula underwent elevation, and the submarine formations rose in one part, at least, above the sea-level of that time. In the southern part of the peninsula, wide-spread Tertiary vulcanism was succeeded by Quaternary relative quiescence; while probably some time later, in the northern part, subaerial vulcanism became active, when a sedimentary series[14] of the earliest Pleistocene had been more or less deformed, and continued its activity the whole of the Pleistocene. At the present day vulcanism is confined to activities of insular volcanoes in the Idu Sitito group.

Not a few investigators have studied this Quaternary vulcanism, and in the following review of the subject the writer has combined the results of their studies with data of his own.

3. Pleistocene vulcanism.

Pleistocene vulcanism built up numerous andesitic and basaltic volcanoes of central type. Of these volcanoes, Amagi[15], Usami[16], Taga[17], and Yugawara[18] are aligned from south to north in the northeastern part of the peninsula. Usami, which is the oldest of these four volcanoes, is built up of lava-flows of pyroxene-andesite and olivine-pyroxene-andesite, with intercalations of pyroclastic products. The next in age is Taga and then Yugawara. Their products are olivine-pyroxene-andesite accompanying pyroclastic material; besides solid lavas.

In the vicinity of the Atami hot-spring resort[19] we find pyroxene-dacite masses, which, according to H. Kuno, extruded later than the products of volcano Taga, but earlier than the products of volcano

14) This series consists of gravels, tufaceous sandstone, and shale. It has yielded abundant plant fossils.

15) 天城火山.

16) 宇佐美火山. This name is proposed here for the first time to designate the volcanic body that extends to the west of Usami, a village about 4 km. north of the Itô hot-spring resort (伊東温泉).

17) 多賀火山. This was proposed to represent a volcanic body adjacent to the north of the volcano Usami, by H. Kuno who is studying that body. The term "Atami Volcano" in the writer's previous paper (*Bull. Earthq. Res. Inst.*, 8 (1930), 409-426) comprises these two volcanoes—Usami and Taga.

18) 湯ヶ原火山. The existence of this volcano was first suggested by T. Hirabayashi (*Report Earthq. Invest. Com.*, 16 (1898), 58-73), and was affirmed lately by H. Kuno.

19) 熱海温泉.

Yugawara. It is therefore clear that dacitic and andesitic vulcanism acted alternately in the Pleistocene age.

Amagi, which is the largest volcano in the peninsula, and occupies the eastern half of the central part of the latter, consists, besides the main volcano, of numerous parasitic cones. It appears to be younger than the three above-mentioned—Usami, Taga, and Yugawara. According to J. Suzuki[20], who studied the volcano in detail, the main body is built up of fragmental ejecta and repeated lava-flows of pyroxene-andesite; while the parasitic cones, which are younger than the main body, may be divided into three groups, in the order of eruption and also according to the nature of the products: the parasitic cones of the first stage (pyroxene-andesite, hornblende-bearing pyroxene-andesite, and olivine-bearing pyroxene-andesite), the parasitic cones of the second stage (products similar to those of the first), and the parasitic cones of the third stage (olivine-bearing pyroxene-andesite and olivine-basalt). The writer observed at the northern foot of the volcano that a lava-flow of pyroxene-andesite (a product of one of the parasitic cones of the second stage?) covers an olivine-pyroxene-andesite from volcano Usami.

Outside the boundary of the northeastern foot of volcano Amagi, there is a group of basaltic volcanoes—the Oomuroyama group—which J. Suzuki regarded as third stage parasitic cones of the former. The youngest volcano in this group is Oomuroyama[21], which consists of a cinder-cone (Oomuroyama proper) and extensive lava-flows, morphologically representing a typical aspi-conide. Besides this, the group comprises the volcanoes Komuroyama[22], Jôbosi[23], and Umenokidaira[24], and the Itô scoria-bed. These volcanic bodies might have been built up by vulcanism of a later date, when the volcanoes Amagi, Usami, and Taga had been more or less dislocated and dissected[25]. Considering the youngest volcano, the vulcanism in this group seems to be the last to have occurred in the Idu peninsula, the time being the late Pleistocene. The morphological features of Oomuroyama indicate youth: so youthful in fact that it may well date from a much later age.

In addition to the foregoing, there are a number of Pleistocene volcanoes in the northwestern part of the peninsula. Their structural details and their products, however, have not yet been investigated.

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20) J. SUZUKI, "Geology of the Amagi Volcanic Group, Prov. Idu", *Jour. Geol. Soc.*, Tôkyô, **28** (1921), 431-448, (in Japanese).

21) 大室山. 22) 小室山. 23) 城星火山. 24) 梅ノ木平火山.

25) H. TSUYA, *Bull. Earthq. Res. Inst.*, **8** (1930), 409-426.

4. Recent vulcanism.

In the Idu peninsula, Pleistocene vulcanism was succeeded by a period (Recent) of relative quiescence, while the present numerous hot-springs there represent a stage of post-volcanic thermal activity. In the Idu Sititô territory, on the contrary, vulcanism, both basaltic and liparitic, has been active in recent times. This recent vulcanism has already been discussed in a previous paper[23], in which the writer endorsed the views that were put forward independently by T. Tsujimura[27] and S. Tsuboi[28].

IV. Correlation of the Vulcanism in the Idu District with that in Adjoining Districts.

In the preceding pages the writer gave the sequence of the vulcanism in the Idu district since the Neogene time. To present as one

	Basic Effusives	Volcanic Bodies	Acidic Effusives	Volcanic Bodies
Recent	Basalts and basaltic andesites	Ôsima group in Idu Sititô	Plagioliparites	Niizima group in Idu Sititô
Pleistocene	Basalts Olivine-pyroxene-andesites Pyroxene-andesites	Oomuroyama group Volcanoes: Amagi Yugawara Taga Usami	Dacites	Lava-flows in the vicinity of Atami
Pliocene	Olivine-bearing pyroxene-andesite Pyroxene-andesite	Lavas and pyroclastics intercalated with sediments (Hiyekawa[29] beds)	Dacites	Lavas and pyroclastics intercalated with sediments (Hiyekawa beds)
Miocene	Altered andesites	Lava-flows? and dikes	Dacites Plagioliparites Potash-liparites	Lava-flows, necks, and dikes; besides pyroclastics
	Altered andesites (propylite)	Lava-flows and pyroclastics intercalated with sediments		

26) H. Tsuya, *Bull. Earthq. Res. Inst.*, **7** (1929), 269–334.

27) T. Tsujimura, "On the Topography of Kôzu-shima and Nii-jima Islands (Izu)", *Report Earthq. Invest. Com.*, **89** (1918), 57–96, (in Japanese).

23) S. Tsuboi, "Volcano Ôshima, Idzu", *Jour. Col. Sci., Tokyo Imp. Univ.*, Art. 6, **43** (1920), 1–146.

29) 冷川.

whole view the leading rock-types that erupted during the vulcanism, the general rock-sequence as they erupted is tabulated in page 7.

As will be seen from the table, Neogene vulcanism began with eruptions of andesite which was afterward subjected to alteration, so that succeeding vulcanism was alternately liparitic (or dacitic) and andesitic. This seems to be the case not only with the Idu district, but also with of the much larger region of the *fossa magna*, of which Idu district forms but a very small fraction. In view of this it is possible to correlate the Idu peninsula with several adjoining districts:

1. In the central part of Sinano province[30], according to F. Homma[31], vulcanism dates from the Miocene as shown in the following rock-sequence:

1) Two-pyroxene-andesite, olivine-andesite, and hornblende-andesite ..... Lower Miocene.
2) Biotite-liparite and augite-hornblende-biotite-dacite (with quartz-diorite and diorite) ... Upper Miocene.
3) Two-pyroxene-andesite (with diorite-porphyrite) ..... Lower Pliocene.
4) Biotite-andesite, hornblende-andesite, and two-pyroxene-andesite ..... Pleistocene.
5) Olivine-bearing two-pyroxene-andesite ..... Recent.

Of these, the oldest andesites are particularly worthy of notice in that they are from submarine eruption, and have been subjected to alteration (silicification and chloritization) as recognized in the oldest andesites in the Idu district.

2. In the Asigara district[32] adjoining the north part of the Idu peninsula is developed the so-called Misaka series, which practically consists of andesitic-basaltic lavas and basic pyroclastic rocks with local intercalations of limestone and clastic rocks[33]. This series is of Miocene age, and the volcanics in it seem to be products of submarine eruptions of that time. This volcanic phase was succeeded by the intrusion of a large mass of quartz-diorite which may be correlated with a similar one of later Miocene age in Sinano province. The intrusion of the quartz-

30) 信濃國.

31) F. HOMMA, *Geology of the Central Part of Sinano Province*, (Tokyo, 1931), 79–84, (in Japanese).

32) 足柄地方.

33) K. SUGI, "On the Metamorphic Facies of the Misaka Series in the Vicinity of Nakagawa, Prov. Sagami", *Jap. Jour. Geol. Geogr.*, 9 (1931), 88–142.

diorite was followed by renewed eruptions of pyroxene-andesite, both solid and fragmental, which, with intercalations of clastic rocks, constitute the Pliocene formation (Asigara bed) of the district.

3. In the Ôiso district[34], adjoining the northeast part of the Idu peninsula, the oldest volcanic material is the pyroxene-andesite fragments contained in a siliceous sandstone of Miocene or older age; while at least, four stages of vulcanism in the succeeding ages may be recognized in the succession of the volcanics there developed, the first being represented by hypersthene-hornblende-dacite (lower Miocene), the second by pyroxene-andesite (Miocene-Pliocene), the third by hornblende-pyroxene-dacite (lower Pleistocene), and the fourth by olivine-pyroxene-andesite (upper Pleistocene)[35].

The districts above cited are a few examples of regions that are within the *fossa magna*, in which Tertiary vulcanism is generally characterized by the earliest eruptions of andesites during early Miocene or earlier. It is probable that these early eruptions took place in the *fossa magna*, which diastrophism had caused to be formed during early Tertiary at the boundary between southwestern and northeastern Japan. It is particularly noteworthy that in these districts, as in the Idu district, andesitic rocks and liparitic or dacitic rocks erupted alternately.

V. On the Distributions of the Andesitic and the Liparitic or Dacitic Rocks in the Idu District.

The relation of vulcanism to crustal disturbances in the Idu district is a subject that calls for further investigation. At the same time several important facts regarding the locations of volcanic vents are clearly known to the writer. Leaving aside for a while the Tertiary andesitic rocks, the location of the original vents of which have not yet been found, the Quaternary andesitic and basaltic rocks mostly erupted from volcanoes in the northern part of the Idu peninsula and in the Idu Sititô territory. These volcanoes lie in the so-called Huzi Volcanic Zone, which Quaternary vulcanism built up in the *fossa magna* that traverses central Japan in N. N. W.-S. S. E. direction.

Liparitic and dacitic rocks erupted from vents as shown by their dikes, necks, and dome-shaped lava-masses that are distributed in the Idu peninsula. These vents may be grouped in a system of parallel

34) 大磯地方.

35) H. Tsuya, "Petrographic Notes on the Sedimentary Rocks of Southwest Sagami Province", *Bull. Earthq. Res. Inst.*, 9 (1931), 354-373.

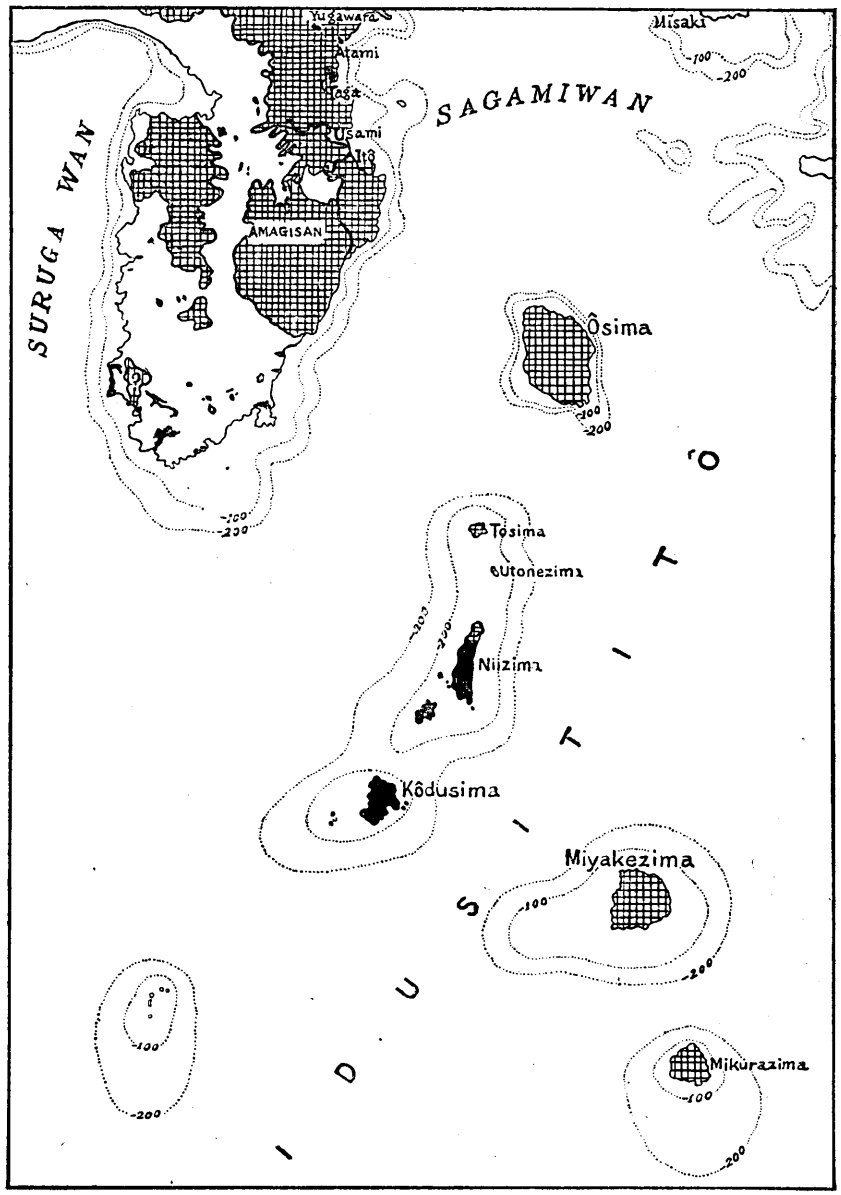

Fig. 1. Sketch map showing distribution of some volcanic rocks in the Idu district.
Cross-hatched areas: Quaternary andesitic and basaltic masses.
Black areas: Liparitic and dacitic masses, except their pyroclastics. (Tertiary and Quaternary.)
All Tertiary rocks, except liparites and dacites, and Quaternary sediments are left blank.

zones having a general direction, N. E.-S. W. Parallel to these zones is the line connecting the liparitic insular volcanoes of Idu Sititô. (See Fig. 1.)

These two trends—the N. N. W.-S. S. E. trend of andesitic volcanoes and the N. E.-S. W. trend of liparitic volcanoes or vents—seem to be surface manifestations of the ground structure of the district; the former representing a principal fracture and the latter a subsidiary one. But, these trends were not determined by any visible structural lines in the rocks, but by the presence of volcanic vents. If the sites of the volcanic vents had been fixed by dislocation or lines of weakness in the earth's crust, they should lie below the formations that are now visible at the surface.

VI. Summary and Conclusions.

Owing to a tectonic disturbance that occurred during the Eogene, central Japan was subjected to dislocation, resulting in a great fracture —Naumann's *fossa magna* or Yabe's *Itoigawa-Sunto Line*—that severed the geological continuation of Japan between southwestern and northeastern Japan. It is highly probable that this disturbance was responsible for the vulcanism that operated at the boundary of these two large geologic units of Japan in the early Neogene. So great was the vulcanism that in many districts at the boundary, volcanic rocks and pyroclastic sediments are the chief representatives of the lower Neogene formations. Since that time vulcanism has operated in these districts repeatedly with alternate renewal and decay of activity. The Idu district occupies the Pacific side of the boundary between southwestern and northeastern Japan. The volcanic history, as inferred from the sequence of volcanic rocks of this district, is briefly summarized as follows:

1. Miocene vulcanism. The oldest vulcanism occurred during early Miocene or a little before it, with submarine eruptions of andesites. This oldest vulcanism was followed, probably some time later when the formations practically composed of the oldest andesites had more or less deformed, by submarine eruptions of liparites and dacites. This phase of vulcanism, was succeeded by a subordinate phase of activity, characterized by minor extrusions of andesites. All these Miocene volcanic rocks were subjected more or less to alterations—chloritization, silicification, sericitization, etc. The succession of these rocks implies considerable time, although its actual duration is a question we have no means of answering at present. The only precise datum is that

afforded by faunal evidence, which assigns the dacitic volcanics lying some distance above the base of the complex to lower Miocene.

2. Pliocene vulcanism. Regarding vulcanism during late Miocene and early Pliocene, we are largely in the dark as only a few rocks have been identified with these ages. In the latest Pliocene age, eruptions of dacites and andesites took place. They were again largely submarine eruptions.

3. Pleistocene vulcanism. At the close of the Tertiary, or in the beginning of the Pleistocene, Idu peninsula was subjected to crustal movement, generally in the sense of uplift. It was not until some time after the movement that raised so much of the Tertiary sea-floor into land had taken place, that Pleistocene vulcanism became vigorous. It was chiefly concentrated in the northern part of the peninsula; while in the southern part, Tertiary vulcanism was succeeded by Pleistocene and Recent relative quiescence. The andesitic volcanoes Amagi, Usami, Taga and Yugawara, together with other yet uninvestigated volcanoes in the northwestern part of the peninsula, are, as also the dacitic masses in the vicinity of Atami, products of Pleistocene vulcanism. The basaltic Oomuroyama group represents the last vulcanism, which probably occurred some time later, at the time when the early Pleistocene volcanoes Usami, Taga, etc., were subjected to more or less dislocation and dissection.

4. Recent vulcanism. In the Idu peninsula, none of the latest volcanoes is known to have erupted in historic times; while the numerous hot-springs there are displaying post-volcanic thermal activity. In the Idu Sitito, on the contrary, liparitic and basaltic vulcanism was active during historic times.

An examination of the materials that were erupted during the whole course of the vulcanism and so fully recorded in the geology of the Idu district, reveals the fact that andesitic and liparitic or dacitic rocks have played their rôle in every age from lower Miocene up to Recent. Thus, a discrimination of the two lineages—andesitic and liparitic or dacitic—is essential to a proper understanding of the vulcanism of the district. As to the genetical relationship between the two lineages, very little can be said now. If we assume in the meantime that the rocks of these two lineages were derived from a common stock-magma, then their differentiation from this magma must be explained by one or other of two alternatives: (1) Either the partial magmas that separated out during early Tertiary had remained throughout suc-

ceeding ages as available sources of the andesitic rocks on the one hand and of the liparitic or dacitic rocks on the other, and that further differentiation had gone on within them; or (2) that differentiation to an advanced stage had proceeded repeatedly along definite lines at wide intervals of time. Of these two alternatives, the writer is inclined to accept the former, agreeing with S. Tsuboi in the opinion that the basaltic and liparitic rocks which erupted during Recent time in the Idu Sititô territory are descendants respectively of the andesitic and liparitic or dacitic rocks that erupted during the Tertiary and early Pleistocene in the Idu peninsula.

Examples presenting close analogies with the volcanic sequence of the Idu district could be cited from adjoining districts: Sinano, Asigara, and Ôiso.

The distribution of the sites of vents of liparitic and dacitic rocks shows distinct zones parallel with each other in the direction from N. E. to S. W. The directions of these zones are very remarkable in contrast with the Huzi Volcanic Zone, which runs in the N. N. W.-S. S. E. direction, and in which direction the Quaternary andesitic and basaltic volcanoes of the district are aligned. The zones of these two directions—N. E.-S. W. and N. N. W.-S. S. E.—seem to represent the underground fracture lines connected with available sources, respectively, of the acidic volcanic rocks and the basic volcanic rocks.

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18. 第三紀以後に於ける伊豆地方の火山活動に就いて（豫報）

地震研究所　津　屋　弘　達

昭和五年十一月二十六日の北伊豆地震以後北伊豆地方の地質を研究してゐる間に同地方に於ける火山岩の噴出順序を或程度まで確めることが出來た。本論文はその結果に既に以前公けにしたものを加へて伊豆地方全般の火山活動を總括したものである。

伊豆地方に於ては安山岩類と流紋岩類（或は石英安山岩類）とが第三紀及び以後の火山活動によつて同時或は交互に噴出してゐる。既に坪井誠太郎博士はこの事實を認められ、筆者も斷片的に認めてゐたのであるが、最近の研究によつて一層詳かにすることが出來た。即、伊豆地方に於て知ることが出來る最初の火山活動は中新世初期或はそれより稍古期の安山岩の噴出に初まり、其後同地方の火山活動は鮮新世、更新世を經て現世に至るまで各時代毎に安山岩類及び流紋岩類（或は石英安山岩類）の噴出によつて繰返されてゐる。所謂フオツサマグナの中に在る他の地方（例へば信濃地方、足柄地方等）と伊豆地方とを火山岩の噴出順序の上から對比すると何處でも大體同樣であることが認められる。

伊豆地方に於ける火山岩の分布を見るに、第三紀の安山岩は伊豆半島一帶に分布してゐて今の所

その噴出の中心が明かでないが、第四紀の安山岩類は主として北伊豆と伊豆七島中の大島、三宅島、八丈島等との所謂富士火山帶に相當する部分に限られてゐる。これに反して流紋岩類の分布をその岩脈、岩頸、火山體等の分布によつて見ると北東一南西に走る數帶に分たれてゐる様に見える。その最も著しいものは伊豆七島に於ける流紋岩火山島の配列に見られるが、伊豆半島に於ても、殊にその南部に於て、認められる。この北東一南西の酸性火山岩帶ともいふべきものはこの火山岩に貫かれてゐる地層の構造線とは一致してゐない様である。從つて、一般に火山岩噴出地點が地殻の弱線に支配されるものとすれば火山帶を決定する地殻の弱線は地表に近い部分の地層に見られる構造線では示されない場合がある様に考へられる。富士火山帶とこれに斜交する酸性火山岩帶は伊豆地方を通過する二方向の地殻の弱線を示し、これらが夫々基性火山岩類及び酸性火山岩類の本源と連絡あるものと考へることが出來る。

尙、本論文は伊豆地方の火山活動に關する總括的研究の豫報で、詳しいことは更に研究の結果報告したいと思つてゐる。