Geology in the Northern part of Yuzawa City Akita Prefecture Northeast Japan

by

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I. Foreword

This paper is results of field survey as form a part of geology survey, promotion-thesis of junior, Institute of Applied Earth Science, College of Mining Akita University. The author spent the total number of thirty days in his fieldwork in the area from August to November 1994, and engaged in the indoor work for a month. The survey area is in the Northern part of Yuzawa City, Akita Prefecture, belongs to so-called " green tuff region, Northeast Japan ". There are USUDA et al. (1981) and CHIDA (1989MS) as the other reports in this area.

The author is deeply indebted to Professor Takahiko MARUYAMA for many helpful suggestions during the course of this work. He would like to thank Associate Professor Toshio MIZUTA and Associate Professor Tokiyuki SATO for geological suggestions during the survey. The author wishes to thank Dr. Daizo ISHIYAMA for critical reading of manuscript and helpful advice on the translation into English.

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II. Geography

a. Location

The survey area is 60 kilometers southeast of Akita City, and is part of Akita Prefecture, Northeast Japan. The central and western parts of the area is part of Yuzawa City, the northeastern parts of the survey area is part of Masuda Town, and the southeastern parts of the survey area is part of the Inakawa Town.

The western boundary of the survey area is Route 13, the eastern area is Minase River, and the southern area is Route 397. These locations are shown in Fig.1.

The area locates to Asamai, Yokote, Yuzawa and Inaniwa of the map of the scale of 1:50000, and locates to Nishimonai, Zhumonzi, Yuzawa and Inaniwa of the map of the scale of 1:25000 of the publicated by Geographical Survey Institute. The survey area is covers about 20 square kilometers.

b. Traffic

There is a Yuzawa station of JR at southwest area. It arrive at about five hours from Tokyo by Yamagata Shinkansen. It is a fifteen minute walk from Yuzawa station of JR to the southern survey area, and five minute walk from Shimo-yuzawa station of JR to northern area.

In western area, Route 13 is situated from Yamaya to Yuzawa. It arrive at about two hours from Akita City by car. In addition, there is a Route 398 from Yamaya-toge to Yuzawa in the south area. There are bus service in these national highway (Fig. 1).

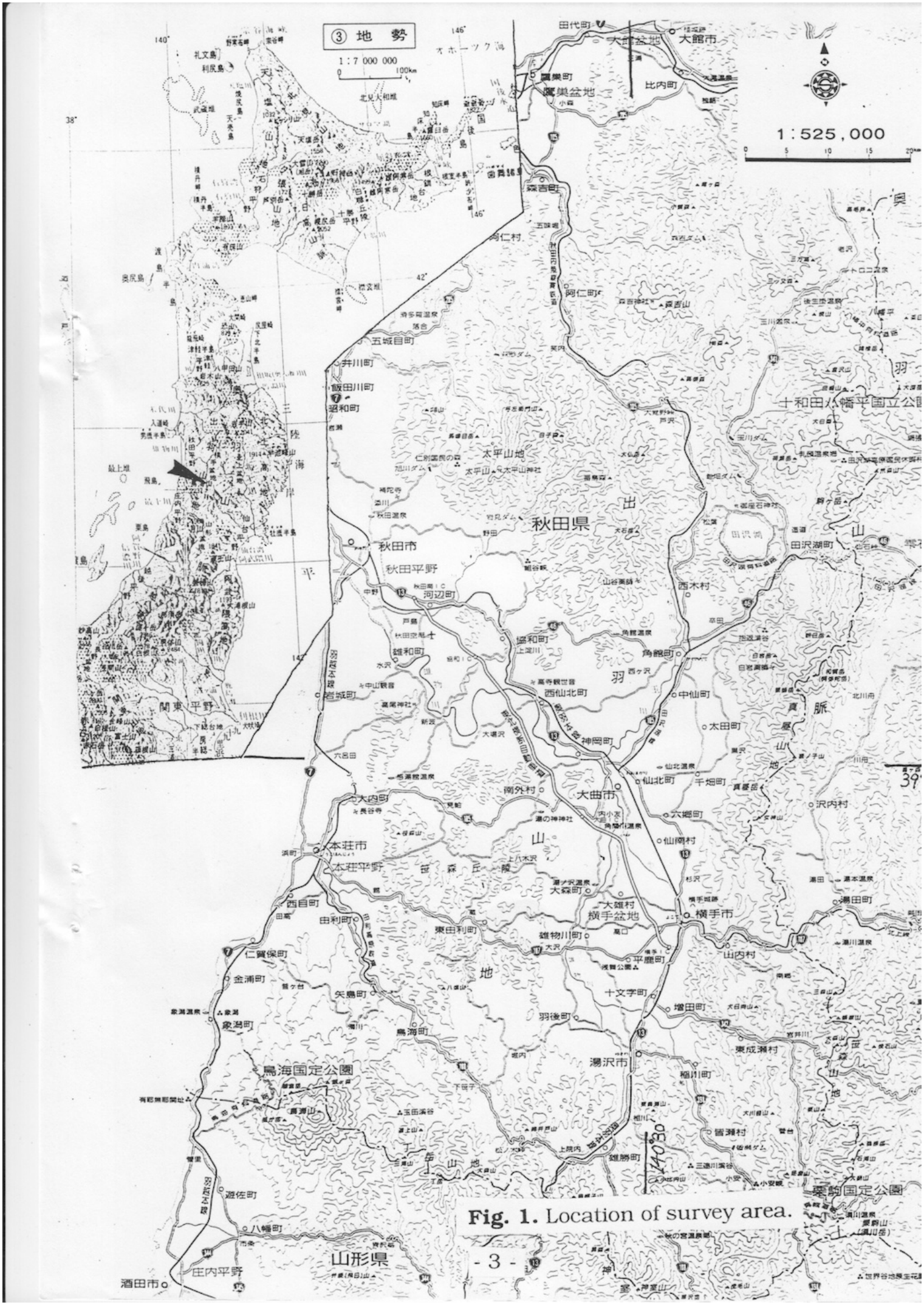


Fig. 1. Location of survey area.

III. a. Topography Outline

The area is located in southern part of Yokote basin, and is surrounded by the Minase River in eastern part, the Omono River in western parts and the Kaneuthisawa River in southern part. The highest points in the survey area are Mt.Amagadai(314.6 meters) in central north area and Mt.Mitakesan(317.9 meters) in the southwestern parts of the area.

There are two main ridges, the one is situated from Mt.Amagadai to north or south and the other is located from Mt.Mitakesan to Yamaya-toge. Topography of the ridge of Mt.Amagadai is characterized by that western parts of the ridge is sharp and eastern parts of the ridge is gentle slope (Fig.2)(Fig.3).

Mountain system

The mountain system of the survey area is characterized by the two ridges of which is located at the Amagadai and Mitakesan mountains. These mountains are nearly equal in height, however, the topography of Mt.Mitakesan is steeper than that of Mt.Amagadai. Fig.3 and 7 show the 3D view of summit level map and topographic view of Mt.Mitakesan. Map of the mountain system of the survey area is shown in Fig.4.

Drainage system

Main river of the area is the Minase River in northeast area, the Anekurasawa River of which flows through from east to west in central part of the area and the Kaneuchisawa River in southwest area. Those drainage system compose of dendritic structure as shown in Fig.5.

III. b. Relationship between the Topography and Geology

The steep topography around Mt.Mitakesan is occurring because of distribution of dacites. The Anekurasawa River which makes a curve toward the northwest in the midstream is reflecting occurrence of rocks composing folded structures. The contrast topography of the ridge containing Mt.Amagdai, such as mention above, suggests that the bed distributing around the area strikes about N-S and dips east.

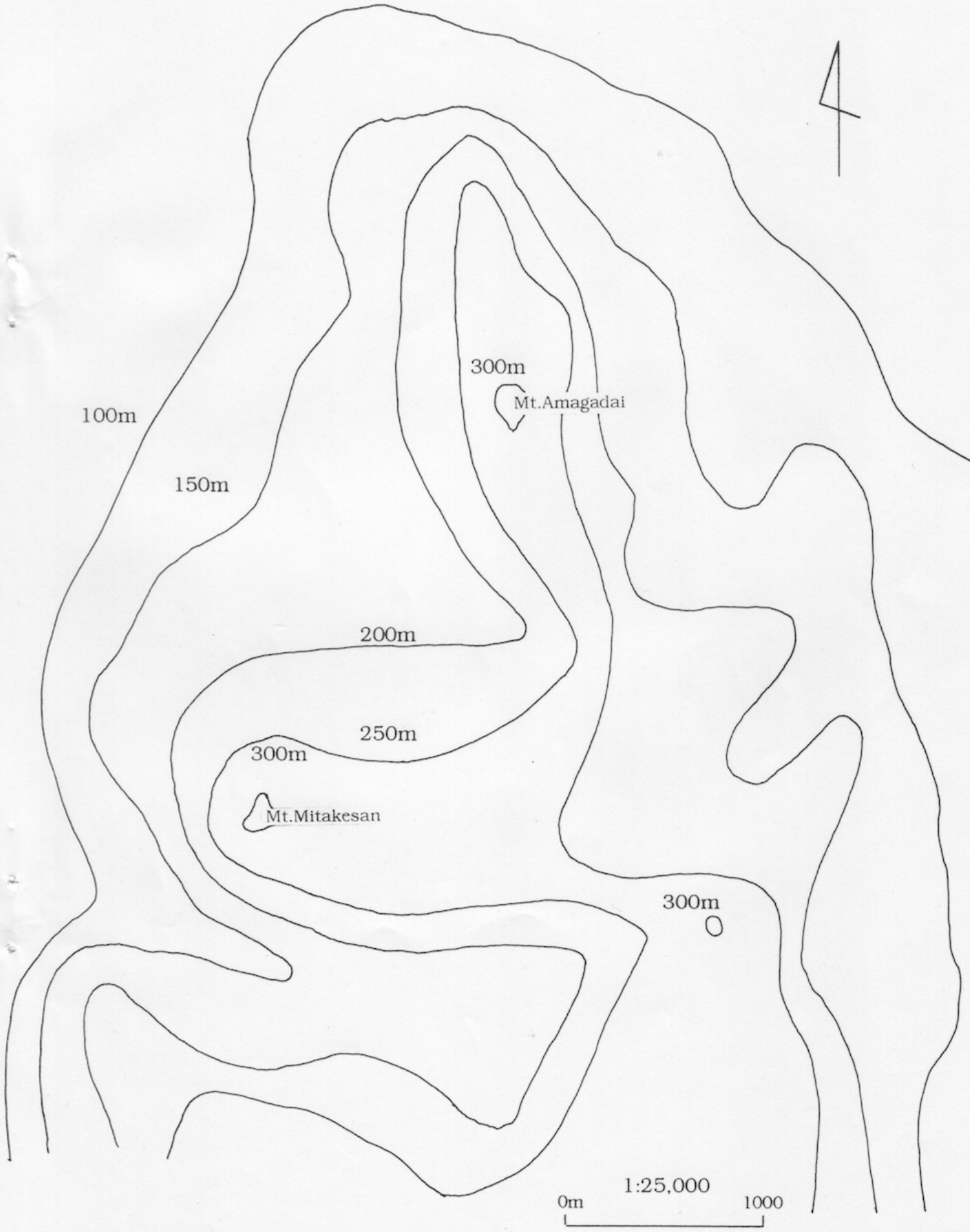
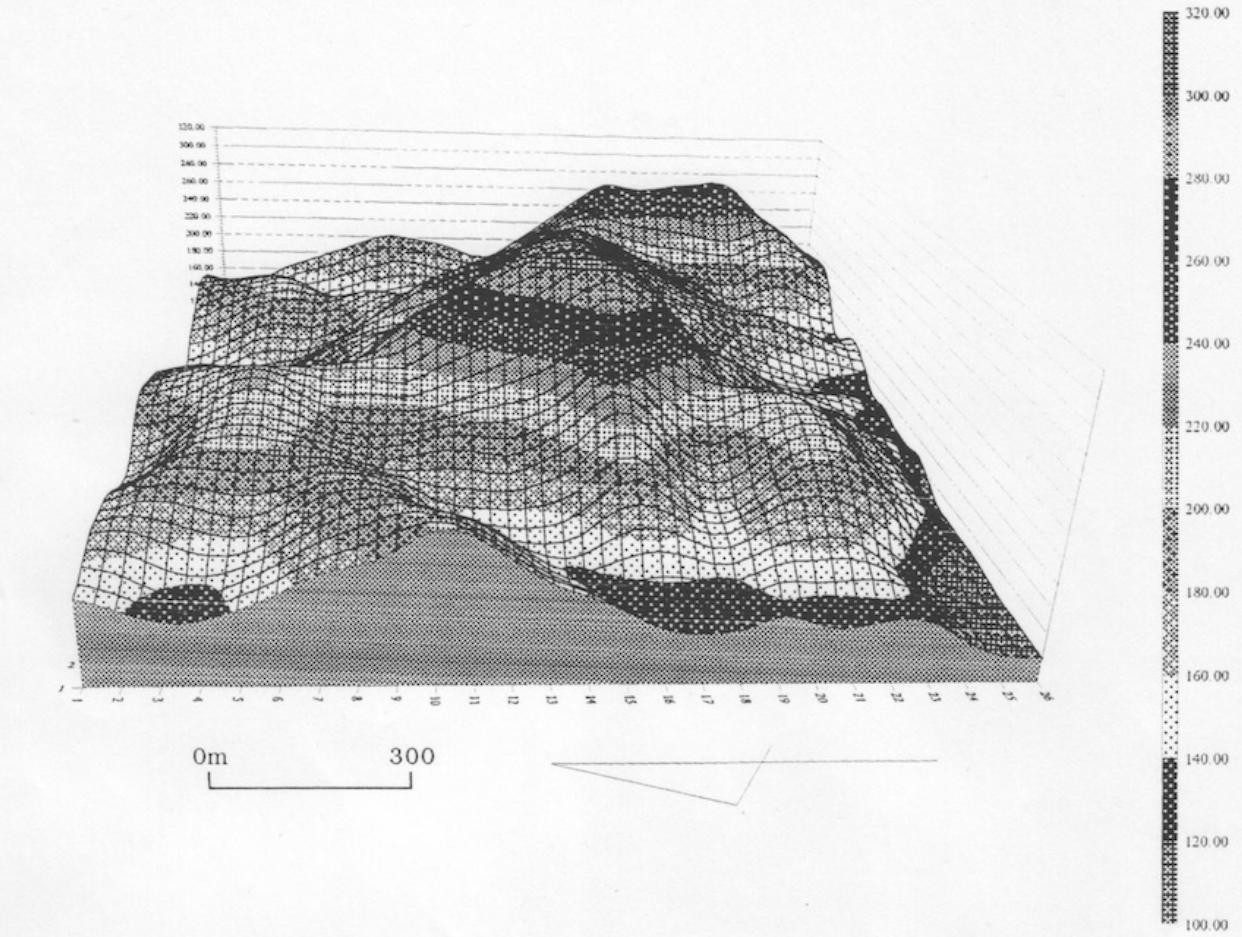


Fig. 2. Summit level map in the Northern part of Yuzawa City



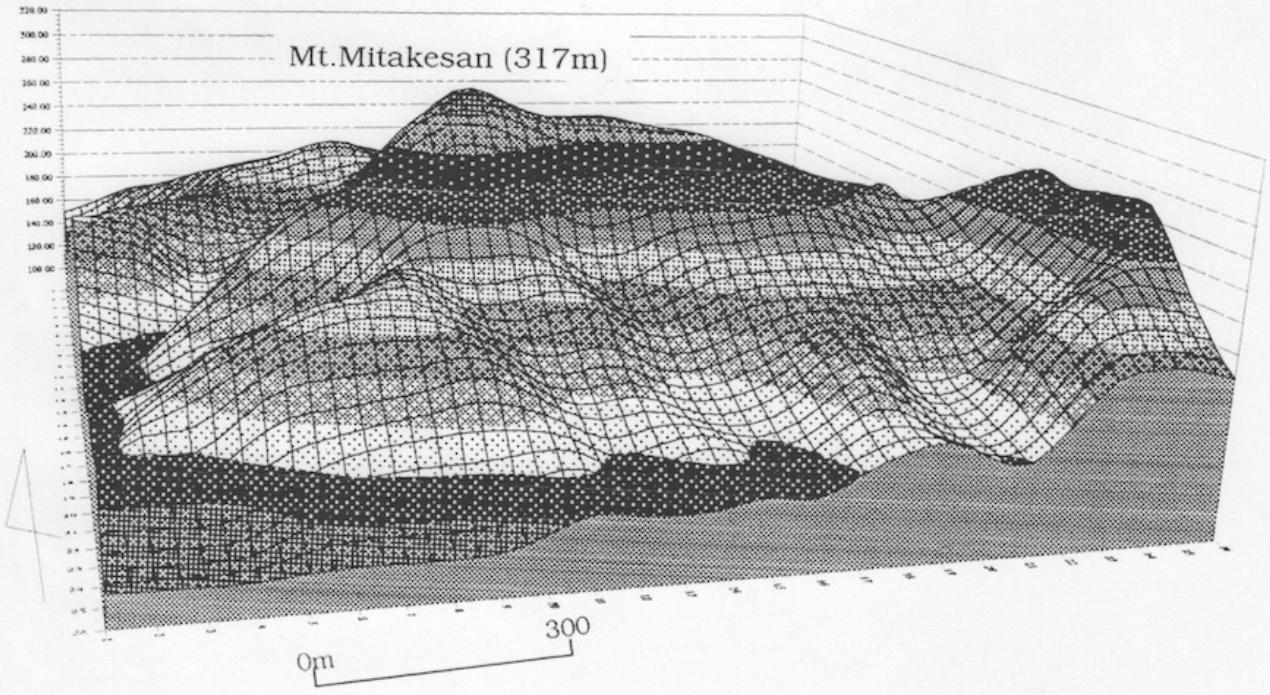


Fig. 3. 3D view of summit level map of the survey area.

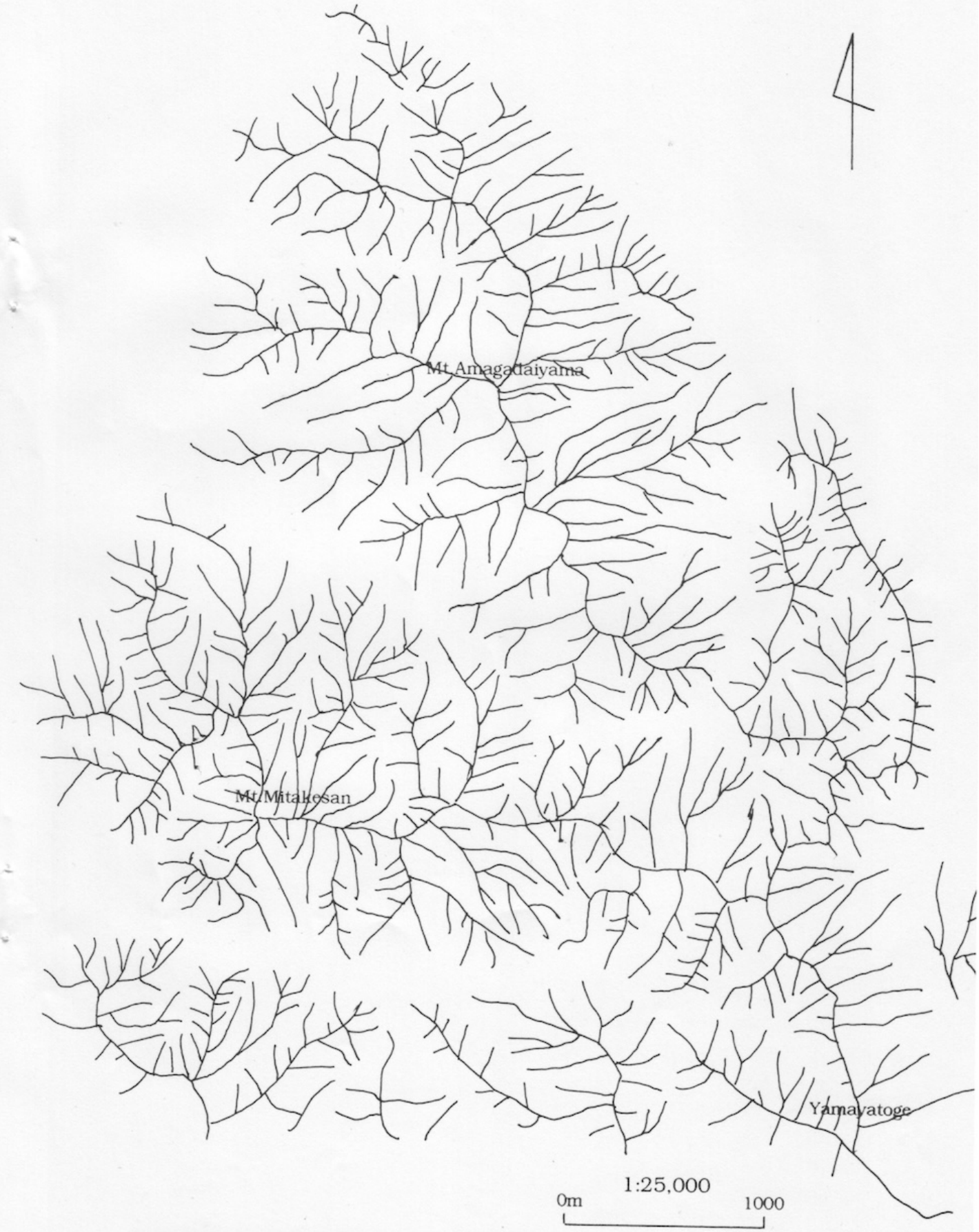


Fig. 4. Map of mountain system in the Northern part of Yuzawa City.

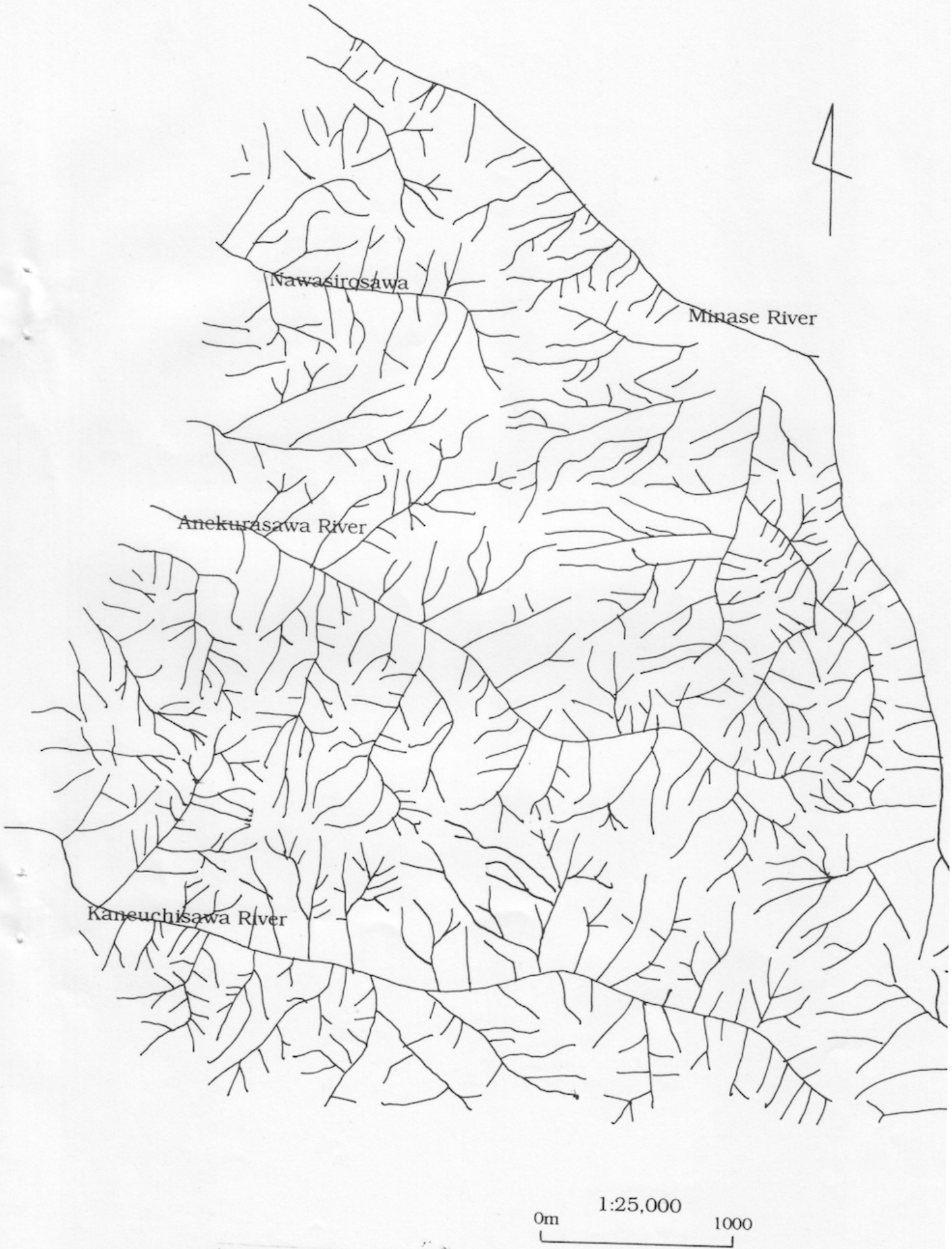


Fig. 5. Drainage system map in the Northern part of Yuzawa City

Fig. 6. Topographic view of the survey area.

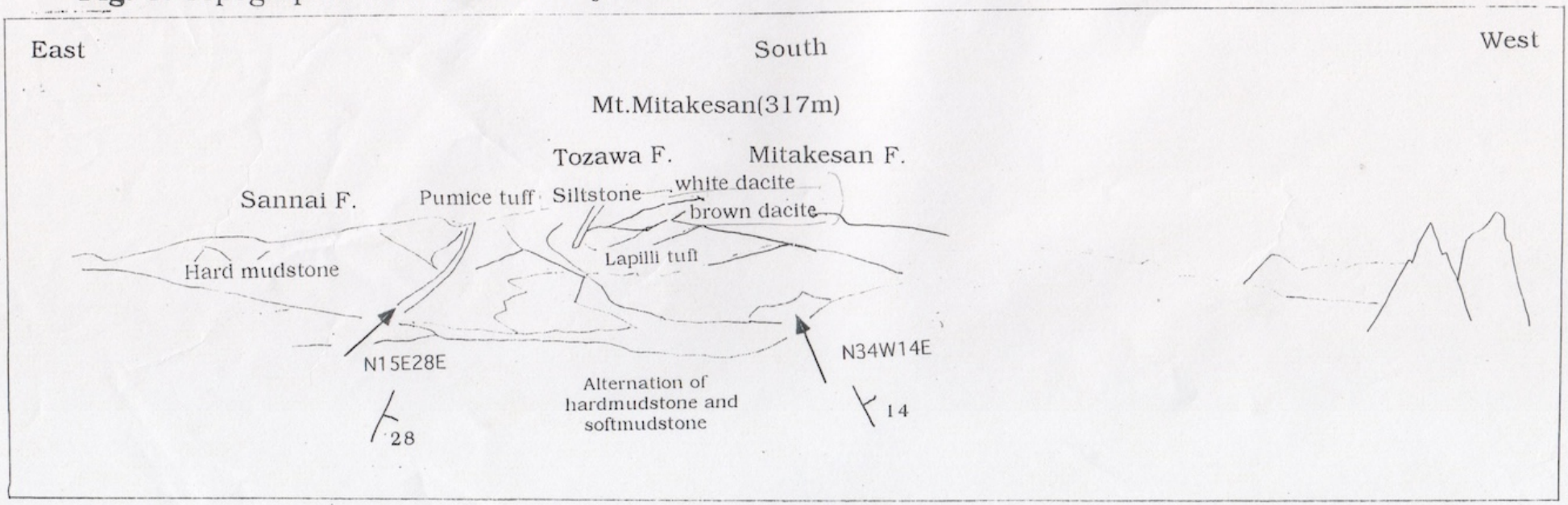
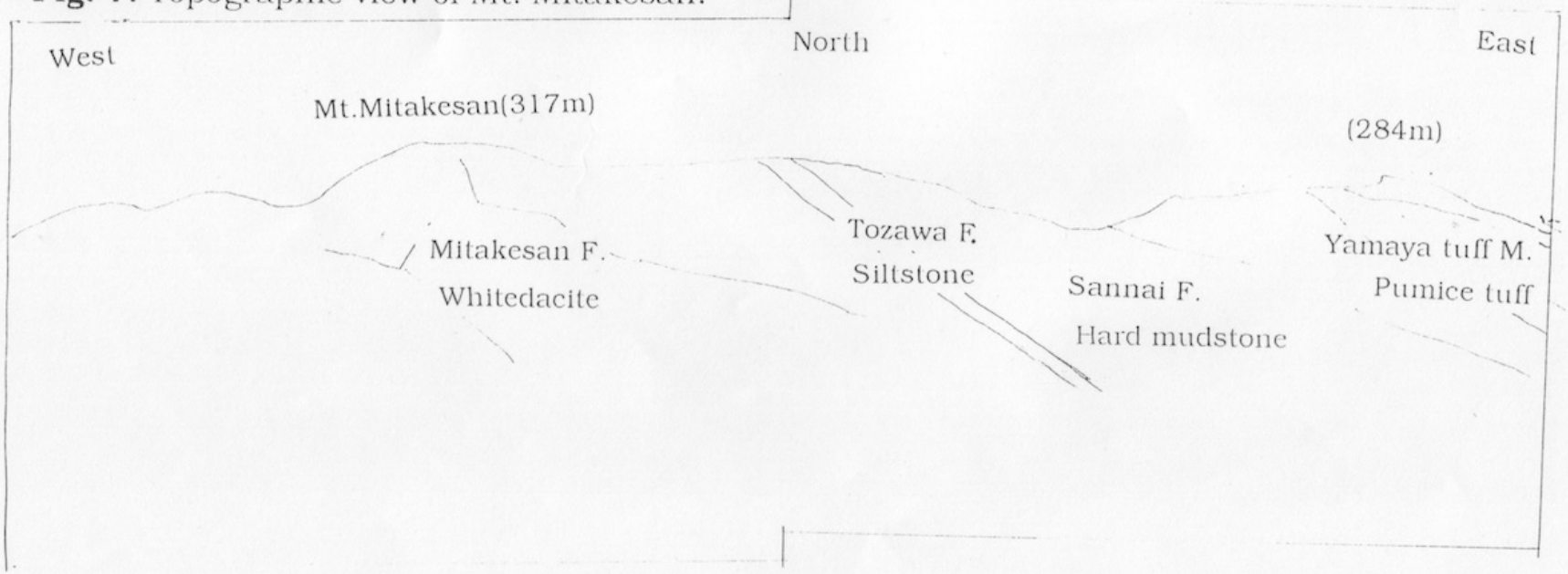


Fig. 7. Topographic view of Mt. Mitakesan.



IV. Geology Outline

The northern part of Yuzawa City is underlain by the Hosogoezawa Formation, Mitakesan Formation, Tozawa Formation, Sannai Formation, Yamaya Tuff Member, Ainono Formation, Ochoshinaidake Pyroclastics Member, Pleistocene deposits and Alluvial deposits in ascending order.

The Hosogoezawa Formation consists of pyroxene andesite of the upper parts and volcanic conglomerate of the lower parts, and is distributed in the southwestern part of the survey area. Almost pyroxenes in the pyroxene andesite are chloritidization.

The Mitakesan Formation unconformably overlies the Hosogoezawa Formation. The Mitakesan Formation is composed mainly of glassy brown dacite and a lava dome of white dacite intruding the brown dacite, and is accompanied by autobrecciated lava of the white dacite, fine tuff and lapilli tuff. The brown dacite locates in the northern and western part of Mt.Mitakesan, the white dacite occurs in Mt.Mitakesan. These dacites and the lapilli tuff are characterized by containing abundant xenoliths of pebble of altered andesite.

The Tozawa Formation consisting the siltstone which is well layered unconformably overlies the Mitakesan Formation. The Tozawa Formation is distributed in the region from south to north of eastern Mt.Mitakesan, has a tendency to become thinner toward the north. The Tozawa Formation disappear in the northeastern part of Mt.Mitakesan. The siltstone of the Tozawa Formation yields the calcareous nanno fossiles which correspond to NN6.

The Sannai Formation conformably overlies the Tozawa Formation, and is widely distributed in the region from south to north of the northern Yuzawa. The Sannai Formation is composed mainly of the hard mudstone which is well layered, and is accompanied by fine tuff. Alternating beds of hard mudstone and soft mudstone composing some folded structures predominate around downstream of the Anekurasawa River.

The Yamaya Tuff Member occurs as a well key bed in the Sannai Formation, and is distributed in the area from Yamaya to the Anekurasawa River. The Sannai Formation situating in the southeastern part of the area is intruded by dacite of the Ochoshinaidake Pyroclastics Member at Iwanosawa.

The Ainono Formation conformably overlies the Sannai Formation. The Ainono Formation is distributed in the eastern part of the area, and consists of massive soft mudstone with fine tuff.

The Pleistocene deposits locates in Iwasaki of the northern part of the area, and is composed of sand, mud and well rounded pebbles and cobbles with lapilli tuff.

The Alluvial deposits occurs along the region from upstream to downstream of the Nawashiro Stream, Anekurasawa River and Kaneuchisawa River. The Alluvial deposits consists mainly of well rounded to angular pebbles of the hard mudstone. (Fig. 8.)(Fig. 9.)(Fig. 10.)

Fig. 8. Route map of the survey area.

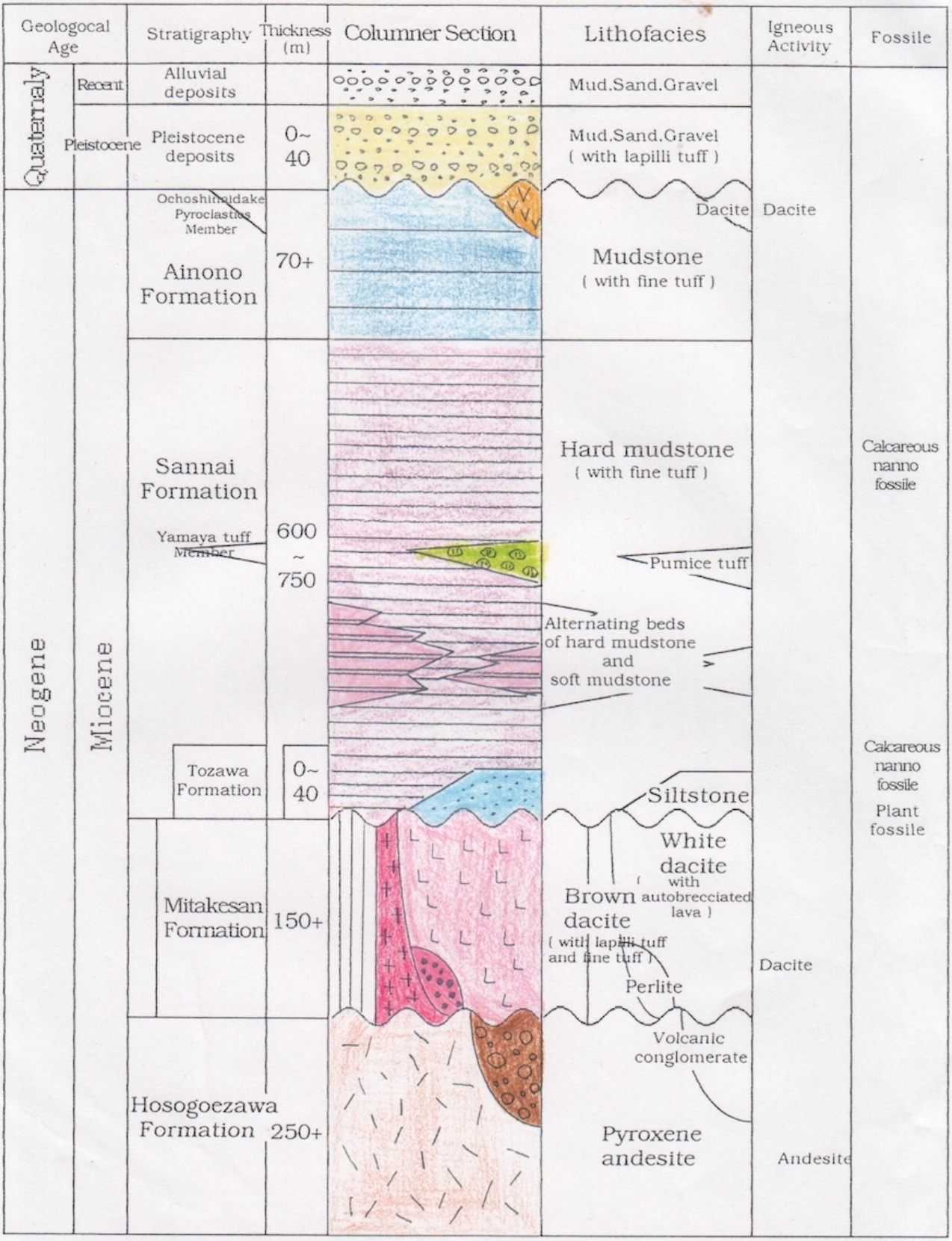


Fig. 9. Compiled column in the Northern part of Yuzawa City.

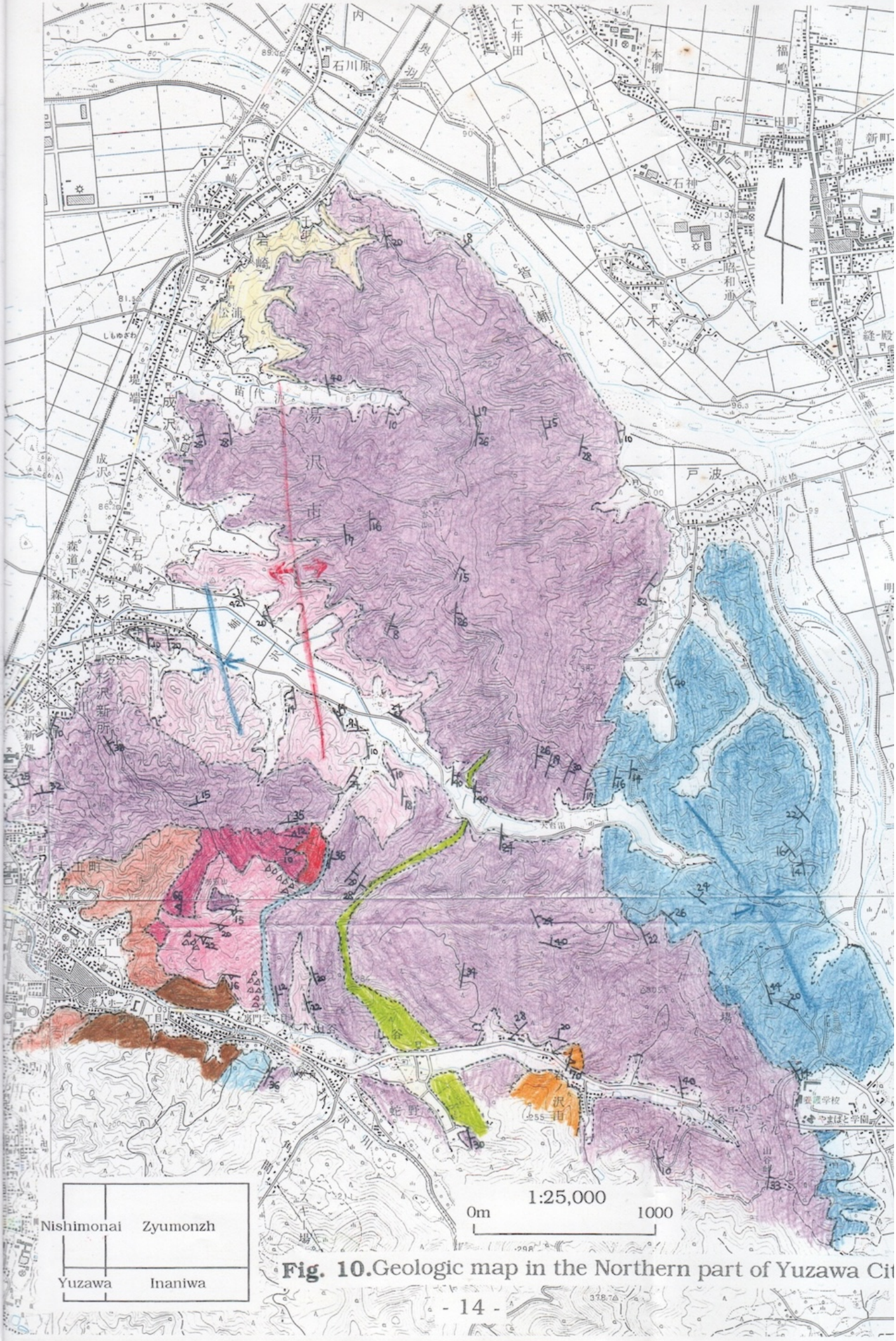
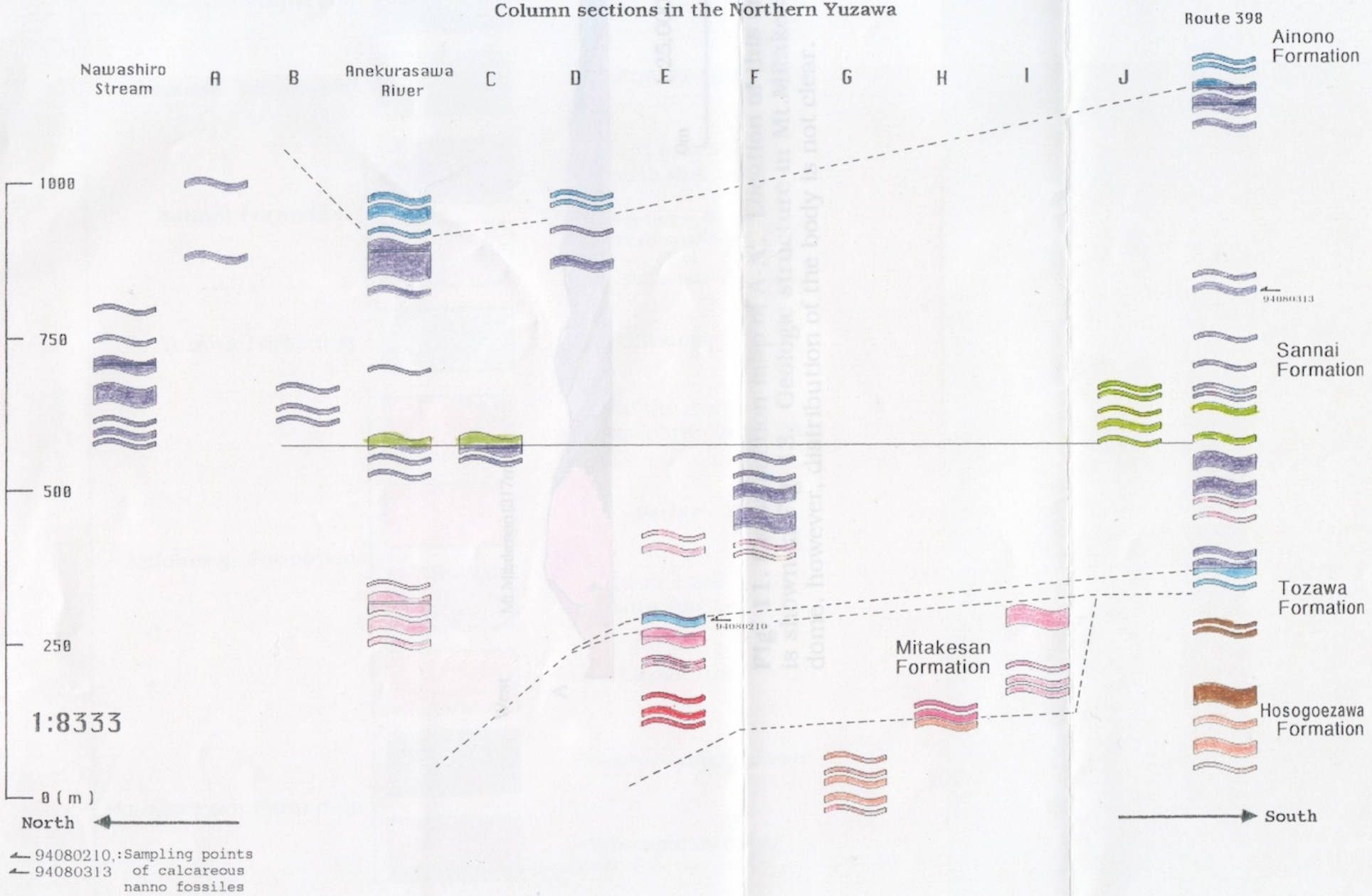


Fig. 10. Geologic map in the Northern part of Yuzawa Cit


Column sections in the Northern Yuzawa
Nawashiro Stream
A
B
Anekurasawa River
C
D
E
F
G
H
I
J
Route 398
Ainono Formation
1000
750
500
250
0 (m)
1:8333
94080313
Sannai Formation
Tozawa Formation
94080210
Mitakesan Formation
Hosogoezawa Formation
North
South
94080210, 94080313 : Sampling points of calcareous nanno fossiles

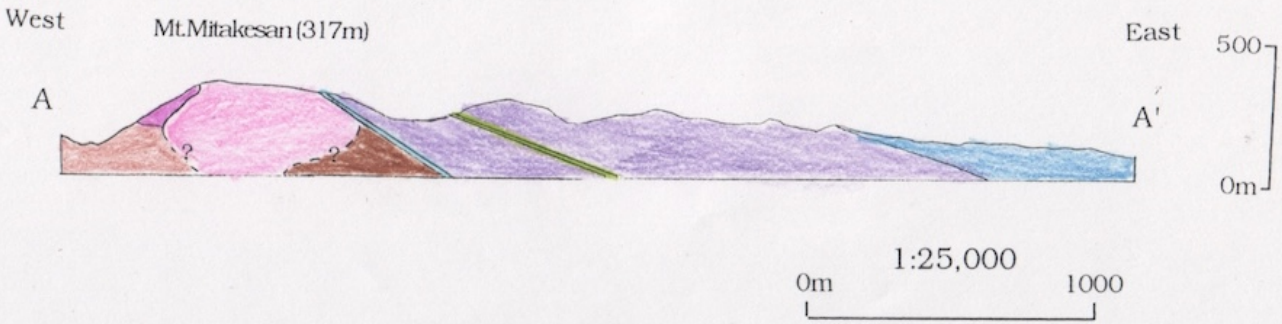


Fig. 11. Cross section map of A-A'. Location of this cross section is shown in Fig. 13. Geologic structure in Mt.Mitakesan is a lava dome, however, distribution of the body is not clear.

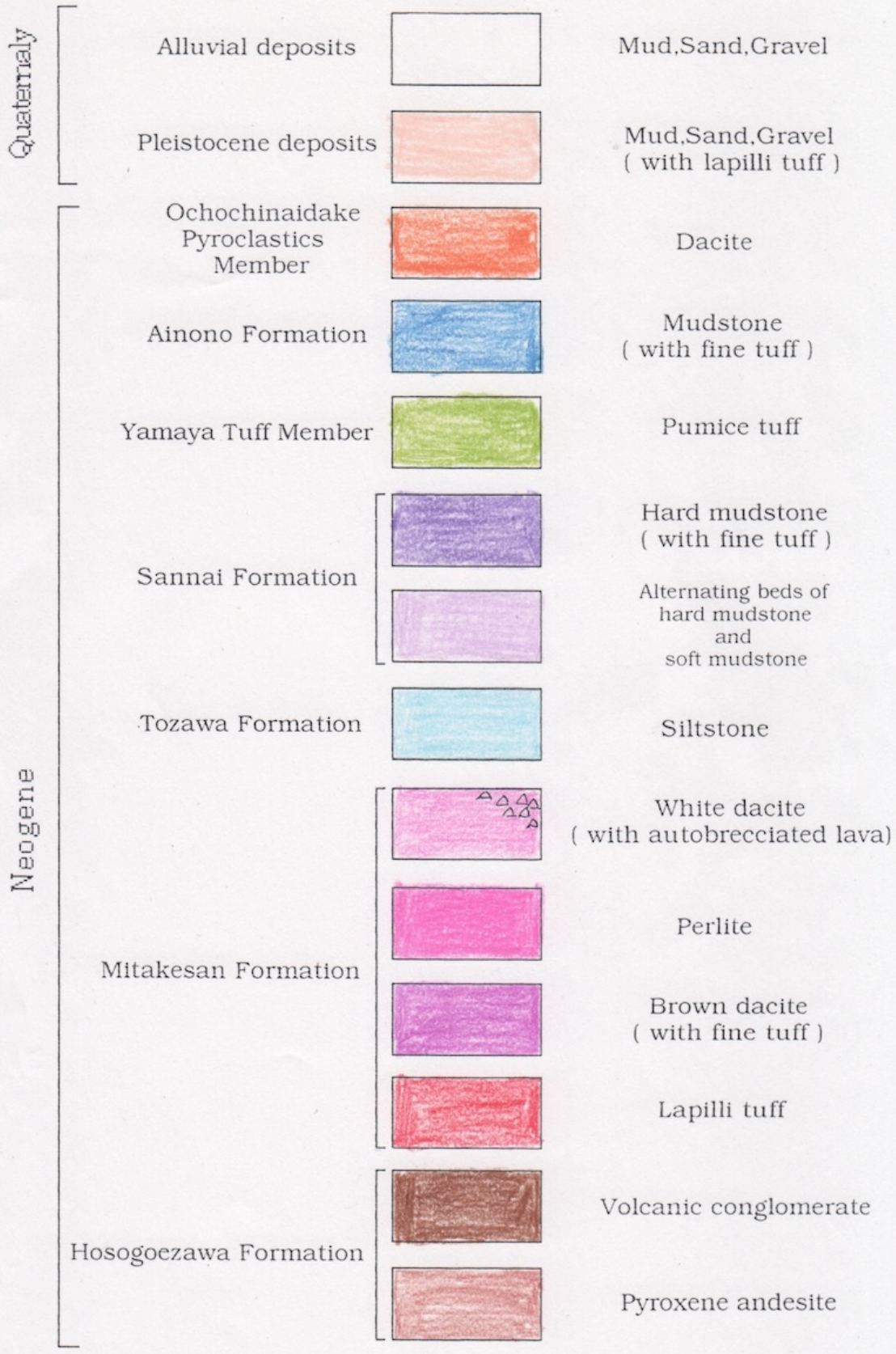


Table 1. Legend of the geologic map and cross section

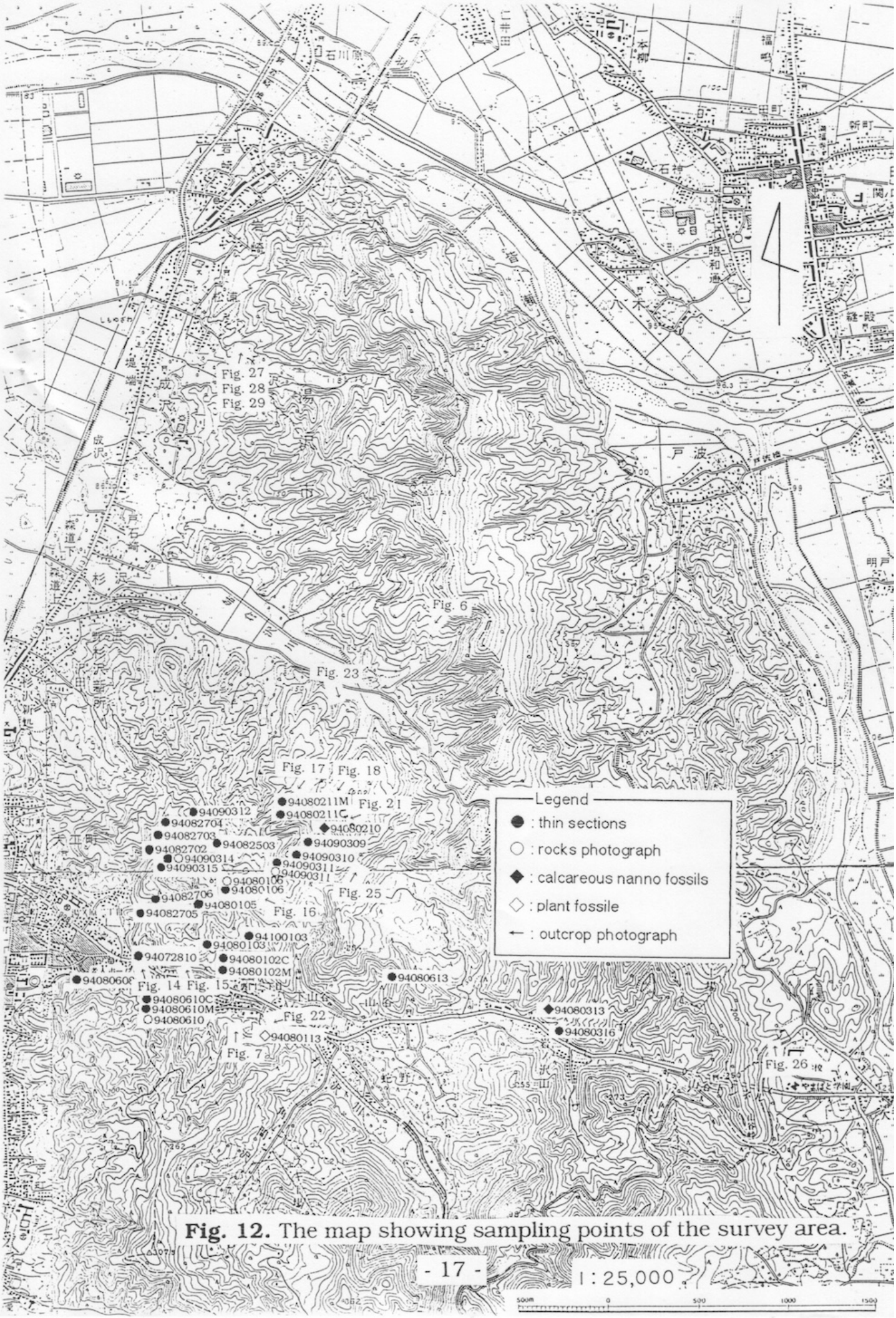


Fig. 12. The map showing sampling points of the survey area.

Fig. 13. Locations for route maps and column sections.

1 : 25,000

V. a. Geology

The strata in the area are the Hosogoezawa Formation, Mitakesan Formation, Tozawa Formation, Sannai Formation, Yamaya Tuff Member, Ainono Formation, Ochoshinaidake Pyroclastics Member, Pleistocene deposits and Alluvial deposits in ascending order. The details of these strata are discrimination as follows:

Hosogoezawa Formation

The Hosogoezawa Formation correspond to the Sekiguchi Formation by TAKEUCHI et al.(1972), the Asazhukiyama and Kamikubo Formations by KIMURA et al.(1981). The Hosogoezawa Formation was defined by USUDA et al.(1981).

[*Type locality*] Yunohara, Yuzawa City.
[*Definition*] Pyroxene andesite and volcanic conglomerate.
[*Distribution*] The pyroxene andesite occurs from near Yuzawa municipal to the northern part of Yunohara. The volcanic conglomerate occurs around Uramon, Yuzawa.
[*Thickness*] 250 meters (+).

The Hosogoezawa Formation is underlain by the pyroxene andesite and the volcanic conglomerate.

The pyroxene andesite is massive and very hard, and is dark reddish brown with dark green spots, so-called "green tuff alteration" is striking. The pyroxene andesite of which is shown in Fig.14 shows columnar joints trending N70° E,64° W at the bridge of Uramon Ichome. The outcrop of the Pyroxene andesite is adjacent to that of the perlite of the Mitakesan Formation with a distance about 10 meters at sabo dum of the H stream showing Fig.13. These formations are covered by talus deposits and is not observed. The pyroxene andesite occurs at downstream to upstream of the G stream showing Fig.13. Gravel in the stream are also the pyroxene andesite, however, a pebble of hard mudstone was found at the ridge of the stream.

The pyroxene andesite changes from strongly altered andesite with obscure phenocrysts of plagioclase at the downstream to weakly altered andesite at the upstream in the naked eye. Under a microscope, mafic minerals of the andesite in the northern part of the area are more strongly altered than those of the andesite in the southern part of the area, and amounts of the hematite and magnetite increase from the

southern part to the northern part in the area. Chlorite and saponite are major alteration minerals. is replaces pyroxene and amphibole of the andesite. Most of the saponite occurs at the core of plagioclase in the andesite. It is not clear the mechanism that the Fe-Mg-bearing minerals as the saponite ($(Mg,Al,Fe)_3(OH)_2(Si,Al)_4O_{10}$) replaces the plagioclase.

The volcanic conglomerate occurs at the Kaneuchisawa River, Uramon. The rock consists of a large amount of pebble to cobble of the pyroxene andesite with a small amount of pebble of mudstone.

The matrix of the volcanic conglomerate is also composed of granule to pebble of the andesite. The consolidation between the gravels and the matrix is hard. The gravel of the volcanic conglomerate is poor sorting, well rounded, and is deposited a clastsupport (Fig.15). The rock is characterized by containing fresh euhedral augite under a microscope.

[*Stratigraphic relationship*]

It presume that the lower part of the Hosogoezawa Formation is the pyroxene andesite, and the upper part of the Hosogoezawa Formation is the volcanic conglomerate. The reason is as follows:

1) The geologic structure in the area is monoclinic structure dipping into east. The volcanic conglomerate situates eastern part of the pyroxene andesite.

2) The pyroxene andesite was altered strongly, however the volcanic conglomerate was altered weakly, and the augite in the conglomerate is fresh.

Fig. 14. The pyroxene andesite with columnar joints at the type locality of the Hosogoezawa Formation. Photomicrograph of the thin section from this outcrop is shown in Plate 2 (Uramon, Yuzawa City).

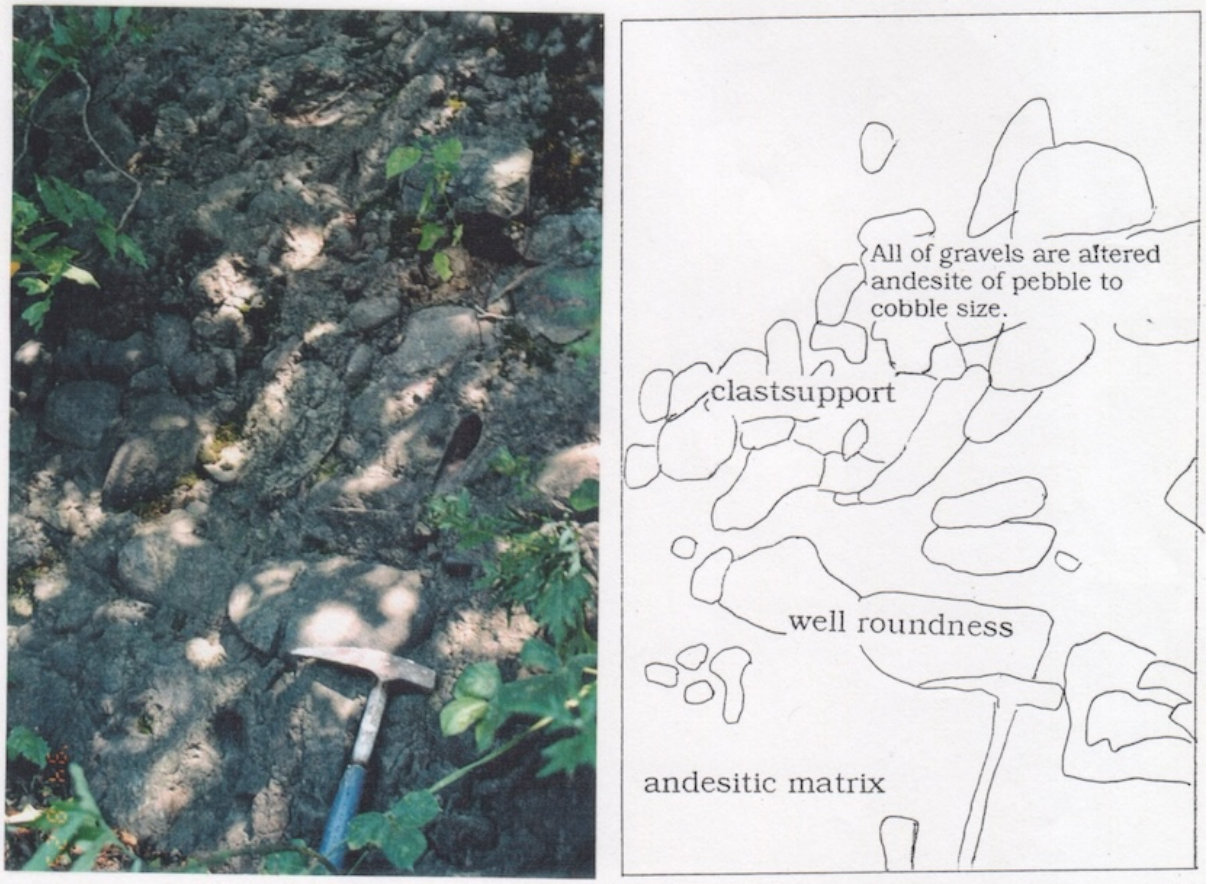


Fig. 15. The volcanic conglomerate of the Hosogoezawa Formation (Uramon, Yuzawa City).

Mitakesan Formation

The Mitakesan Formation is newly named.

[*Type locality*] Mt.Mitakesan,Yuzawa City.
[*Definition*] Brown dacite,lapilli tuff, perlite, and the white dacite of which compose lava dome with autobrecciated lava.
[*Distribution*] The Mitakesan Formation is distributed at Mt.Mitakesan with elliptic shape trending NE-SW.
[*Thickness*] 150 meters (+).

The formation is composed of the lapilli tuff, brown dacite, perlite, and the white dacite of which compose the lava dome in ascending order. The lapilli tuff, brown dacite and white dacite are characterized by abundantly containing altered andesite gravel.

The lapilli tuff predominate in the northwestern Mt.Mitakesan, frequently contains the flatted white pumice of which size is maximum 15 centimeters length. The planes composed of the direction of elongation of the pumices are almost horizontal planes. The lapilli tuff is accompanied by the abundant altered andesite of which size are about 2×3 centimeters. It is imagine that these pebbles derives from the pyroxene andesite of the Hosogoezawa Formation of the lower part. A few fragments of chert were included in the lapilli tuff under a microscope. Some fragments also occurs in other fragments, however, the origin of those fragments of chert is not clear.

The brown dacite is distributed in the western to the eastern Mt.Mitakesan. The color of the rock is brown to reddish brown, is containing abundant pebble of altered andesite, however, it is found in only fresh outcrops, the weathering outcrops shows such as hollow inside owing to previous weathering of the andesite pebble. The flow structure of the brown dacite is distinct, very fine grained quartz crystals occurs along the flow structure. Most of the phenocrysts of the brown dacite are plagioclase showing albite twin under a microscope. The majority of the rock is glass as a groundmass. The planes of the flow structure at the outcrops are almost horizontal. It is plains at the western part of Mt.Mitakesan dips 60 to 70° west. The inclination of the plane was formed during the intrusion of the lava dome of the white dacite.

The perlite is black and glassy, occurs at small area of the eastern Mt.Mitakesan. There are outcrops of the pyroxene andesite of the Hosogoezawa Formation and the perlite of the Mitakesan Formation at the sabo dam in the H stream of Fig. 13. Both outcrops occur very

close each other. Some gravels of the andesite and perlite were found at the branch, trending south, of the H stream. Based on the distribution of the outcrops of the andesite, the perlite of the Mitakesan Formation occurs beneath the Hosogoezawa Formation. The relationship accords with the fact that the prelite consists of the marginal part of the lava dome. The perlitic structure is distinct in the perlite, and include the phenocrysts of plagioclase showing albite twin and zonal texture with euhedral shape, and augite showing euhedral shape.

The white dacite is distributed at the area from Mt.Mitakesan to the southern Mt.Mitakesan, however, the hard mudstone of the Sannai Formation occurs at the top of Mt.Mitakesan as an island. The fresh white dacite shows white to light gray. The altered white dacite shows pail purple in color because of iron-bearing minerals. The rock show clear flow structure in the naked eye. The gravels of altered andesite in the white dacite are 30×20 centimeters in maximum size and 3×2 centimeters in average size. The amount of the gravels in the white dacite is lesser than that of the gravels of the brown dacite. In addition, the white dacite is accompanied by vesicular parts of the pumiceous glass of which size is maximum 3 centimeters. The flow structure in the white dacite is distinct. The fine particles of volcanic glass and quartz are distributed along the flow structure.

The white dacite composes of a lava dome. There are autobrecciated dacite and vesicular dacite at the area of the southeastern Mt.Mitakesan and at the contact between the white and brown dacites in the area from northern to northeastern Mt.Mitakesan. The planes of flow structure of the white dacite strikes E-W and dips 15 to 20° south (Fig.19).

[*Differences between the white dacite and the brown dacite*]

1) The amounts of glass and plagioclase phenocryst in the white dacite are lesser than those of glass and plagioclase phenocryst in the brown dacite.

2) The color of matrix of the white dacite is white, on the other hand, the color of matrix of the brown dacite is brown.

3) A large amount of pumiceous glass are included in the white dacite, however, no pumiceous glass occur in the brown dacite.

[*The different feature of the white dacite from the dacite of the Mahirugawa Formation and the dacite of the Ochoshinaidake Pyroclastics Member*]

1) The white dacite includes large amounts of the glass and the gravels of the altered andesite as xenoliths, on the other hand, other dacites do not include glass and xenolith derived from lower formations.

2) The white dacite of this formation is glassy and the flow structure

is very distinct in the naked eye, the other dacites are not glassy, and the flow structure is not so developed.

[*Age of emplacement*]

The emplacement of the white dacite was carried out prior to the transgression in the Nishikurosawa stage, under terrestrial environment. The brecciated part of the lava dome of the white dacite at the mountaintop of Mt.Mitakesan and the brown dacite in the western Mt.Mitakesan were eroded, and the lava dome was overlay by sediments after transgression. The reasons are as follows:

1) In the continuity outcrop of the white dacite of Fig.13 in the southern Mt.Mitakesan, the white dacite is glassy and clearly flow structure. The planes of the flow structure strikes E-W and dips 15 to 20° south. It imagine that this is related to the flow trend of magma in the lava dome.

The autobrecciated lava of the white dacite, showing brecciated flow structure, and perlite occur at the margin of the intrusive rock. The white dacite does not occurs in the southern part from Route 398. Therefor, the emplacement was carried out at Mt.Mitakesan. However, the white dacite showing flow structure with glassy feature is overlain by the hard mudstone of the Sannai Formation at the top of Mt.Mitakesan, where does not occur the siltstone of the Tozawa Formation.

If the white dacite had intruded prior to the deposition of the sediments, at the contact part between the hard mudstone and the white dacite is brecciated striking, and become to the autobrecciated lava, and the hard mudstone is altered. However, the white dacite at here shows glassy and clearly flow structure, and the hard mudstone had not altered.

It suggest that the brecciated parts of the white dacite had been removed owing to erosion prior to the deposition of the mud and the silt.

2) The flow structures are also distinct in each fragment of the autobrecciated white dacite. This fact suggests the autobrecciated lavas were formed under relatively high temperature condition. Therefor, it presume that these were not composed underwater effusion.

3) The white dacite consisting of lava dome contacts the siltstone of the Tozawa Formation without the brown dacite at the eastern Mt.Mitakesan.

[*Stratigraphic relationship*]

The dacites of the Mitakesan Formation intruded into the volcanic

conglomerate of the Hosogoezawa Formation in the southern part of Mt.Mitakesan. The Mitakesan Formation also were deposited on the pyroxene andesite and intruded into the pyroxene andesite.

The direct relation between the Mitakesan Formation and the Hosogoezawa Formation is unknown because the boundary has not been found. However, the composition of the volcanic conglomerate participate in action of water, and the dacites were formed under terrestrial environment. Therefor, the stratigraphic relationship between the Hosogoezawa and Mitakesan Formations would be unconformity.

The brown dacite abutted on the pyroxene andesite and the volcanic conglomerate of the Hosogoezawa Formation prior to the formation of the lava dome as show in Fig. 31a-2.

Fig. 16. The white dacite of the Mitakesan Formation. Photomicrograph of the thin section from this outcrop is shown in Plate 10 (Mitakesan,Yuzawa City).

Fig. 17. The fresh outcrop of the brown dacite of the Mitakesan Formation. Photomicrographs of the thin sections from this outcrop are shown in Plate 16 and 17, (Mitakesan,Yuzawa City).

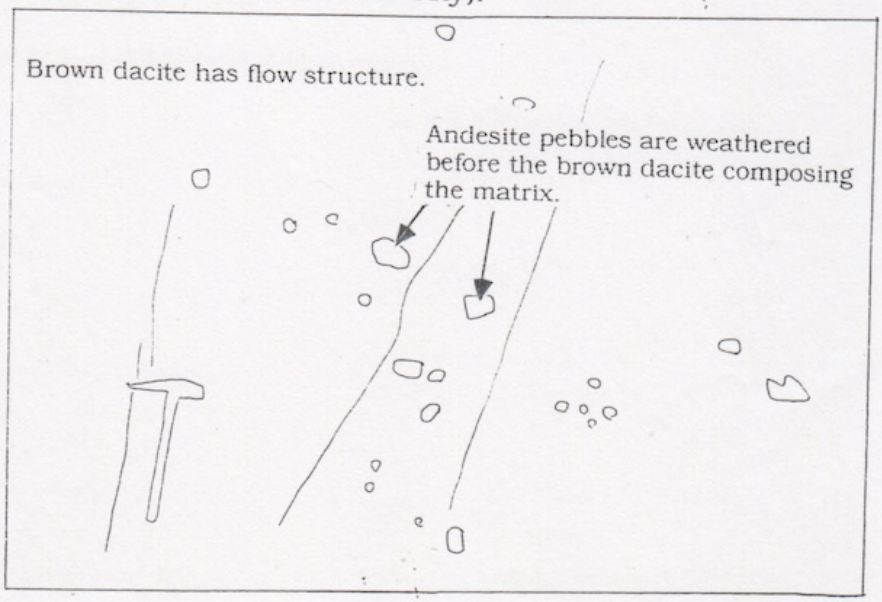
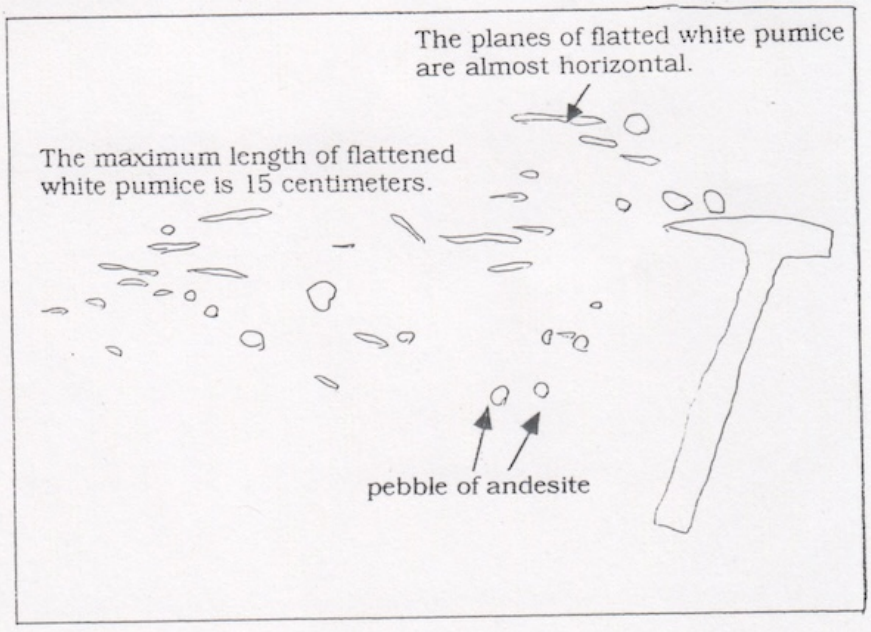


Fig. 18. The lapilli tuff of the Mitakesan Formation (Mitakesan,Yuzawa City).



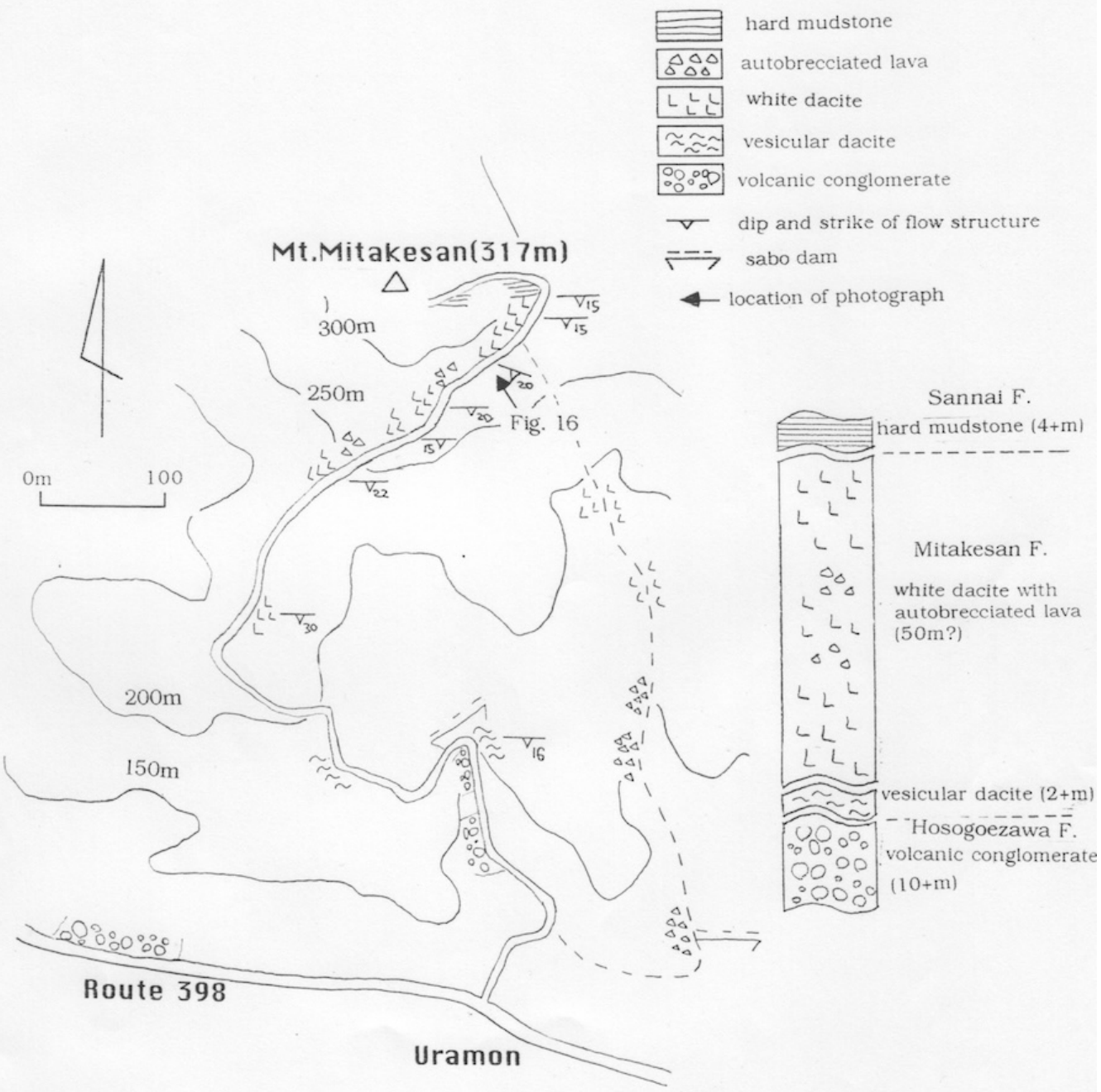


Fig. 19. Route map showing lithologic distribution of the Hosogoezawa, Mitakesan and Sannai Formations in southern Mt.Mitakesan. The flow structure of the white dacite strikes N-S and dips 15 to 30° south. In the stream showing dotted line, the gravels are also the white dacite, however, a pebble of hard mudstone presumed the Sannai Formation was found at the midstream. There are no outcrop of the Tozawa Formation in mapped area. Mapped area is shown in Fig. 13.

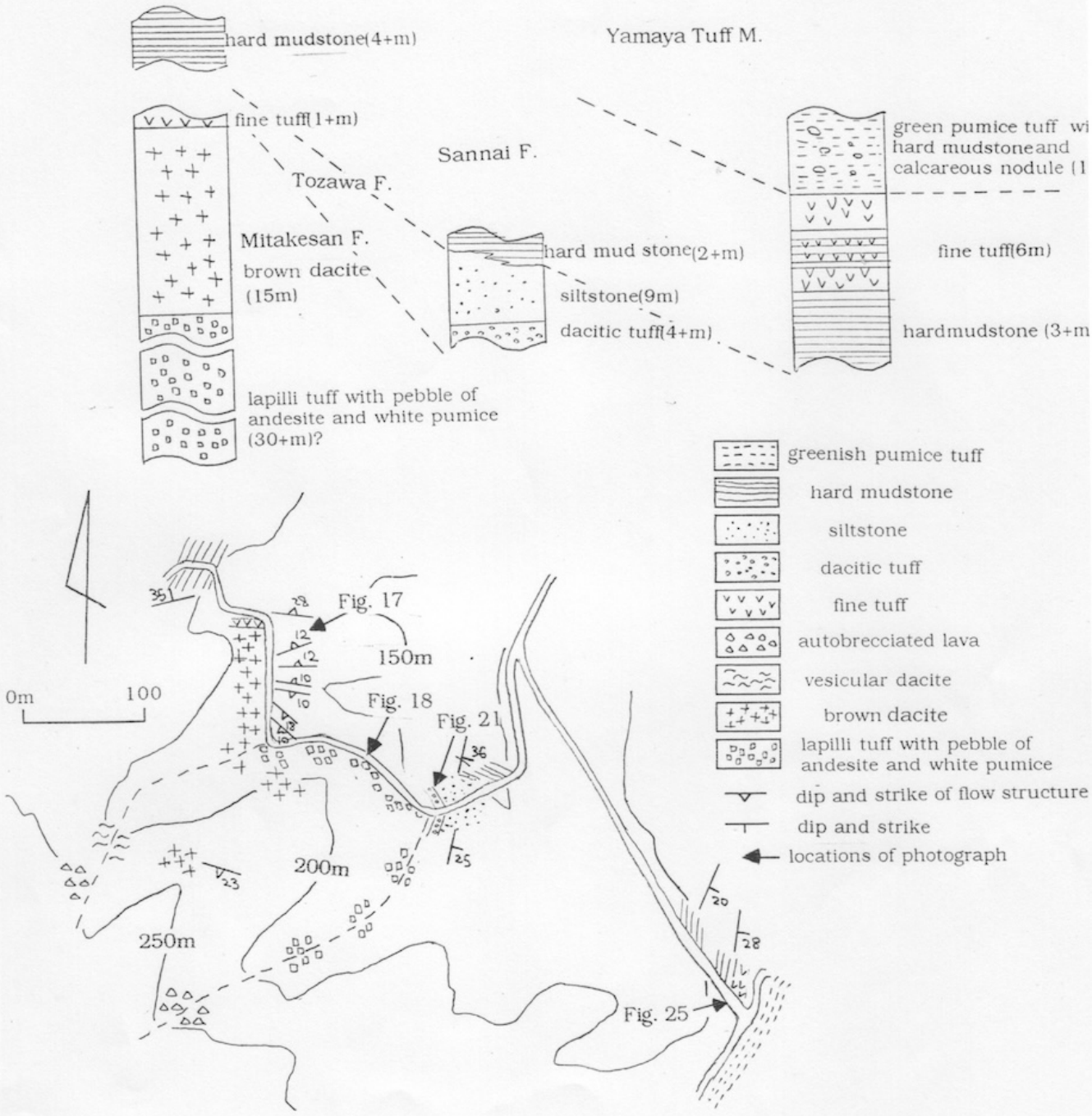


Fig. 20. Route map showing lithologic distribution of the Mitakesan, Tozawa and Sannai Formations and Yamaya Tuff Member in northern Mt.Mitakesan. At entrance of the stream of north, showing dotted line, gravels of hard mudstone are abundantly occurring, however, those were not found in midstream of the stream. The flow structure of the brown dacite in mapped area are folded. Mapped area is shown in Fig. 13.

Tozawa Formation

The Tozawa Formation was defined by TAKEUCHI et al.(1970).

[*Type locality*] Eastern Mt.Mitakesan,Yuzawa City.
[*Definition*] Siltstone showing bluish gray in color. The siltstone intercalates dacitic tuff.
[*Distribution*] The Tozawa Formation occurs trending N-S in the western Mt.Mitakesan, and become thinly extinction in the northeastern Mt.Mitakesan.
[*Thickness*] 0 ~ 40 meters.

The formation is composed mainly of the siltstone. The siltstone is bluish gray, fine to medium grain. The rock is well layered with bedding planes 2 to 5 centimeters apart. The dacitic tuff with granule is deposited in the basal part of the formation.

The siltstone of the formation is thinly distributed toward the north beginning with the 500 meters point of the northeastern Mt.Mitakesan. In the area of Fig.20, the siltstone of this formation is adjacent to the lapilli tuff of the Mitakesan Formation of the lower part. However, its boundary has not been found. Fig.21 shows around the point. The siltstone become thinly extinction at the outcrop of Fig.21, where the siltstone gradual changes into overlie the hard mudstone of the Sannai Formation, the upper part of this formation, with transition ranges in thickness about 1 meters. The exposed thickness of the formation in this outcrop is 9 meters.

The Tozawa formation yields carbonizated plant fossile and the calcareous nanno fossils of which is as *Reticulofenestra pseudoumbilica* and so forth. Judgment of calcareous nanno fossils are listed in Table 2. It suggests that the deposition of the formation occurs at the latter Nishikurosawa age which environment was deep sea.

[*Stratigraphic relationship*]

The siltstone does not predominate in the northern Mt.Mitakesan where the Sannai Formation of the upper formation of the Tozawa formation abut on the brown dacite of the Mitakesan Formation and the pyroxene andesite of the Hosogoezawa formation, as shown in Fig.12. The Sannai Formation conformably overlies the Tozawa formation as will be seen later. Therefor it suggests that the Tozawa formation unconformably overlies the Mitakesan Formation.

It presume that steep slopes of the lava dome of the Mitakesan Formation has disturbed to the deposit of the silt of this formation,

therefor the siltstone has little for deposition, and afterward the thick deposition of the mud of the Sannai Formation occurred. Therefor, it imagine that the siltstone is thinly distributed under the hard mudstone in the northern Mt.Mitakesan as shown in Fig.31b-7.

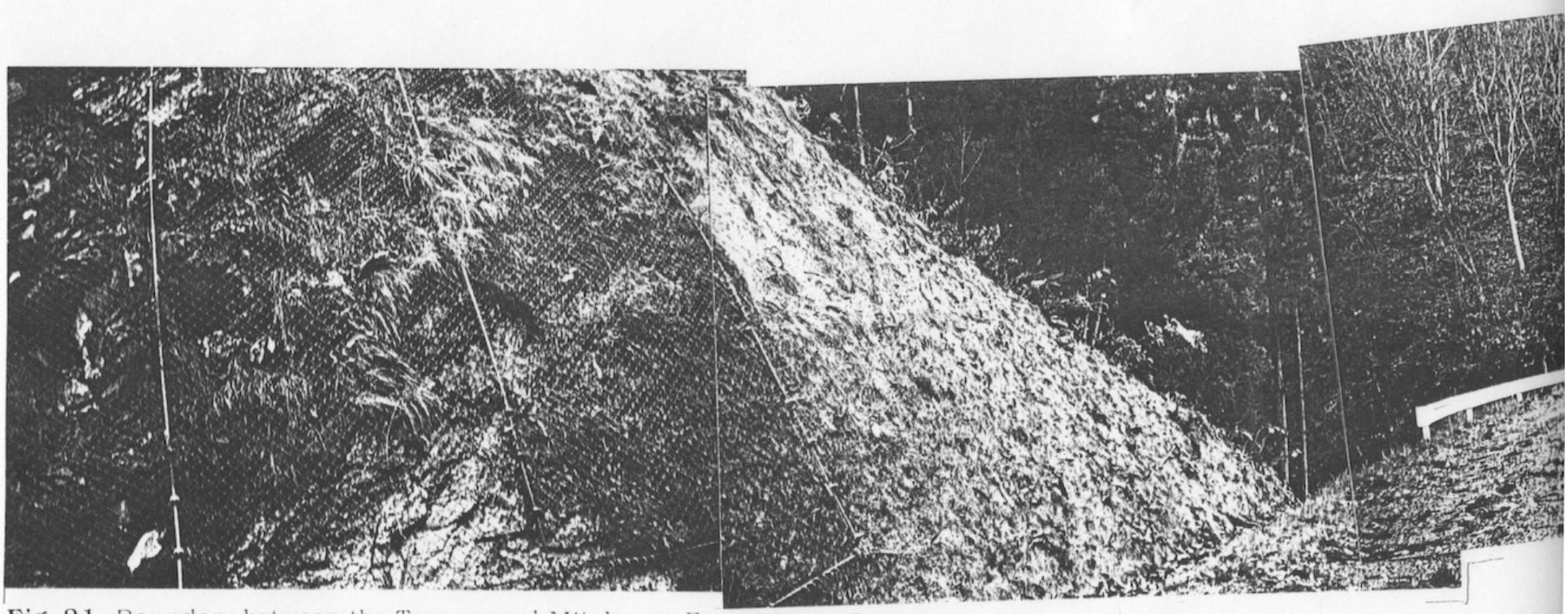
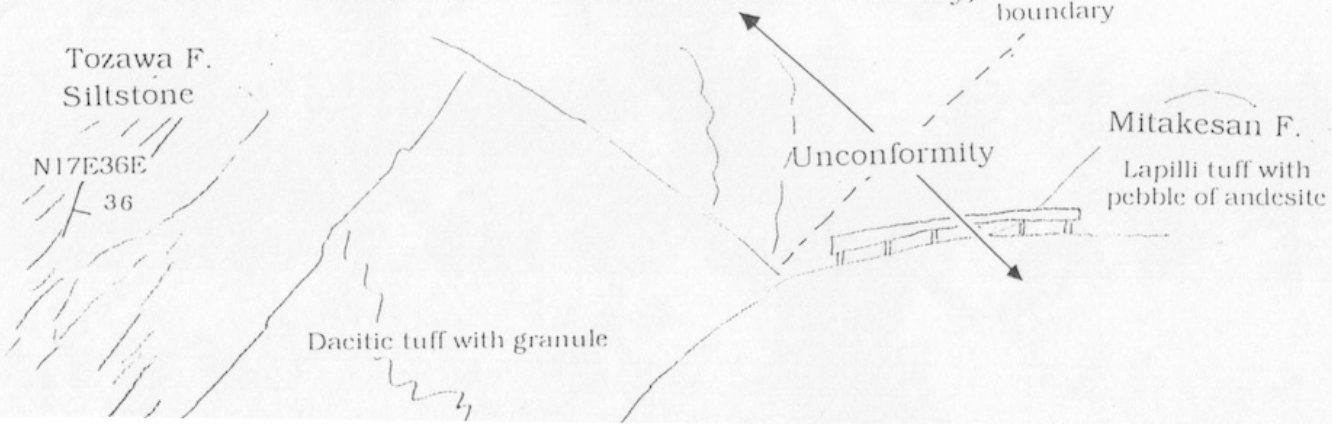


Fig. 21. Boundary between the Tozawa and Mitakesan Formations. Dacitic tuff under the siltstone is different from the dacites of the Mitakesan Formation because of this dacitic tuff does not have the pebble of andesite which characterizes Mitakesan Formation (Mitakesan,Yuzawa City).



Sannai Formation

The Sannai Formation was named Sannai shale by MURYAMA(1937), and was defined the Sannai Formation by HAYAKAWA et al.(1954).

[*Type locality*] The midstream of the Anekurasawa River, Yuzawa City.
[*Definition*] Hard mudstone and alternating beds of hard mudstone and soft mudstone.
[*Distribution*] The Sannai Formation is extensively distributed in the northern part of Yuzawa City, and is distributed isolated at the mountaintop in Mt.Mitakesan.
[*Thickness*] 600 ~ 750 meters.

The formation is composed of the hard mudstone and the alternating beds of hard mudstone and soft mudstone with the yellowish white fine tuff of which ranges in thickness from 5 to 40 centimeters.

The hard mudstone is grayish brown in fresh part, and is well layered with bedding planes 5 to 15 centimeters apart. Weathering parts of the rock is grayish white, and is break to block less than 4 × 5 centimeters size. The hard mudstone is extensively distributed in the north and south of the central part of the survey area. The rock mainly strikes NS and dips 10 to 20° east, in the western part of the area, the rock strikes EW and dips 10 to 30° north.

The hard mudstone of the Sannai Formation adjoins the andesite of the Hosogoezawa Formation in the northwestern part of Mt.Mitakesan, where lacks the Tozawa and Mitakesan Formations. There were no outcrops in the northwestern part of Mt.Mitakesan, where the boundary between the Sannai and Hosogoezawa Formations showing Fig.10 is decided by the location of gravels showing as shown in Fig.24.

The alternating beds consists of the grayish brown colored hard mudstone with bedding planes 10 to 20 centimeters apart and the grayish black colored soft mudstone with bedding planes 2 to 5 centimeters apart, and are well layered (Fig.23). The alternating beds of the hard mudstone and the soft mudstone is extensively distributed around region from midstream to downstream of the Anekurasawa River, and occurs in the small area of Shimo-yamaya. The beds at the downstream of the Anekurasawa River strikes mainly NW to SE, dips 10 to 20 north or south, and is showing folded structures.

The hard mudstone of the Sannai Formation at Iwanosawa in the southern part of the area yields calcareous nanno fossiles such as *Reticulofenestra spp*. as listed in Table 2. However, the paleoenvironment could not suppose from these fossiles.

Pumice tuff of Yamaya Tuff Member as mention later is distributed in the southern part of the Sannai Formation. It is a well key bed in the hard mudstone of the Sannai Formation.

[*Stratigraphic relationship*]

The boundary between the siltstone of the Tozawa Formation and the hard mudstone of the Sannai Formation situates at the Shimo-yamaya as shown in Fig.22. Moreover, the hard mudstone of the Sannai Formation exhibits a gradational contact with the underlying siltstone of the Tozawa Formation at the northeastern part of Mt.Mitakesan as show in Fig.20. Therefor the stratigraphic relationship between the Tozawa and Sannai Formations is conformity.

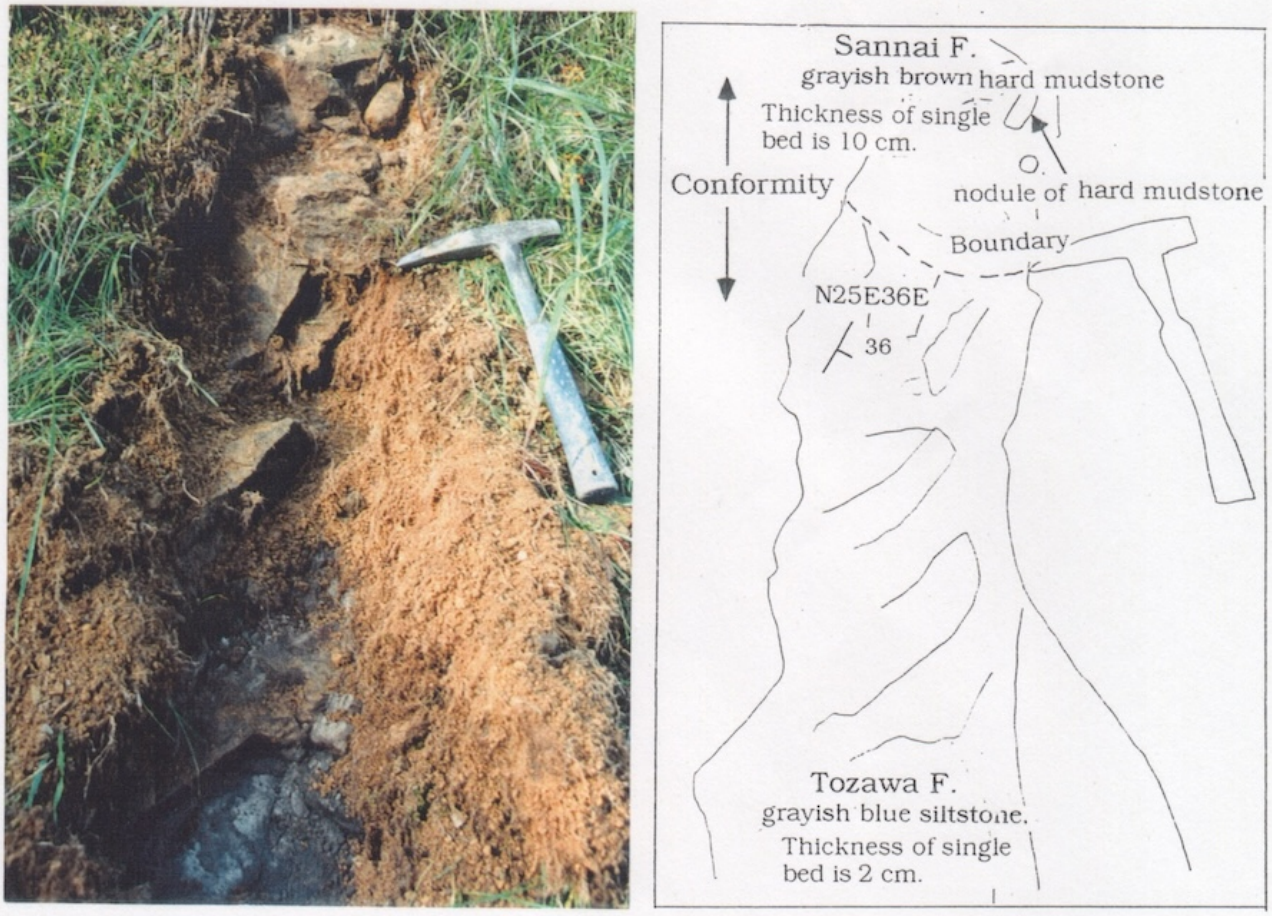


Fig. 22. Boundary between the Tozawa Formation and the Sannai Formation. The siltstone of this outcrop yields calcareous nanno fossiles and carbonizationed plant fossil. The calcareous nanno fossiles are listed in Table 2. (Uramon,Yuzawa City).

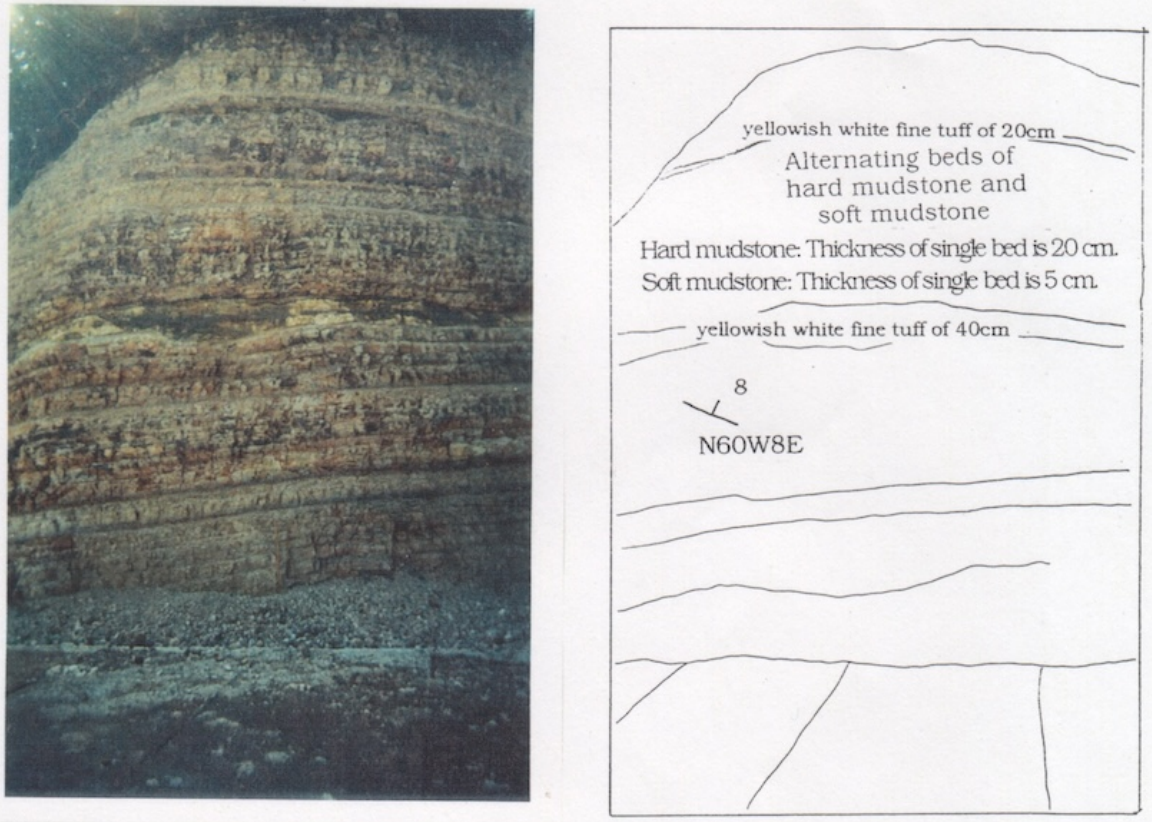


Fig. 23. Alternating beds of hard mudstone and soft mudstone of the Sannai Formation. (Midstream of Anekurasawa River, Yuzawa City)

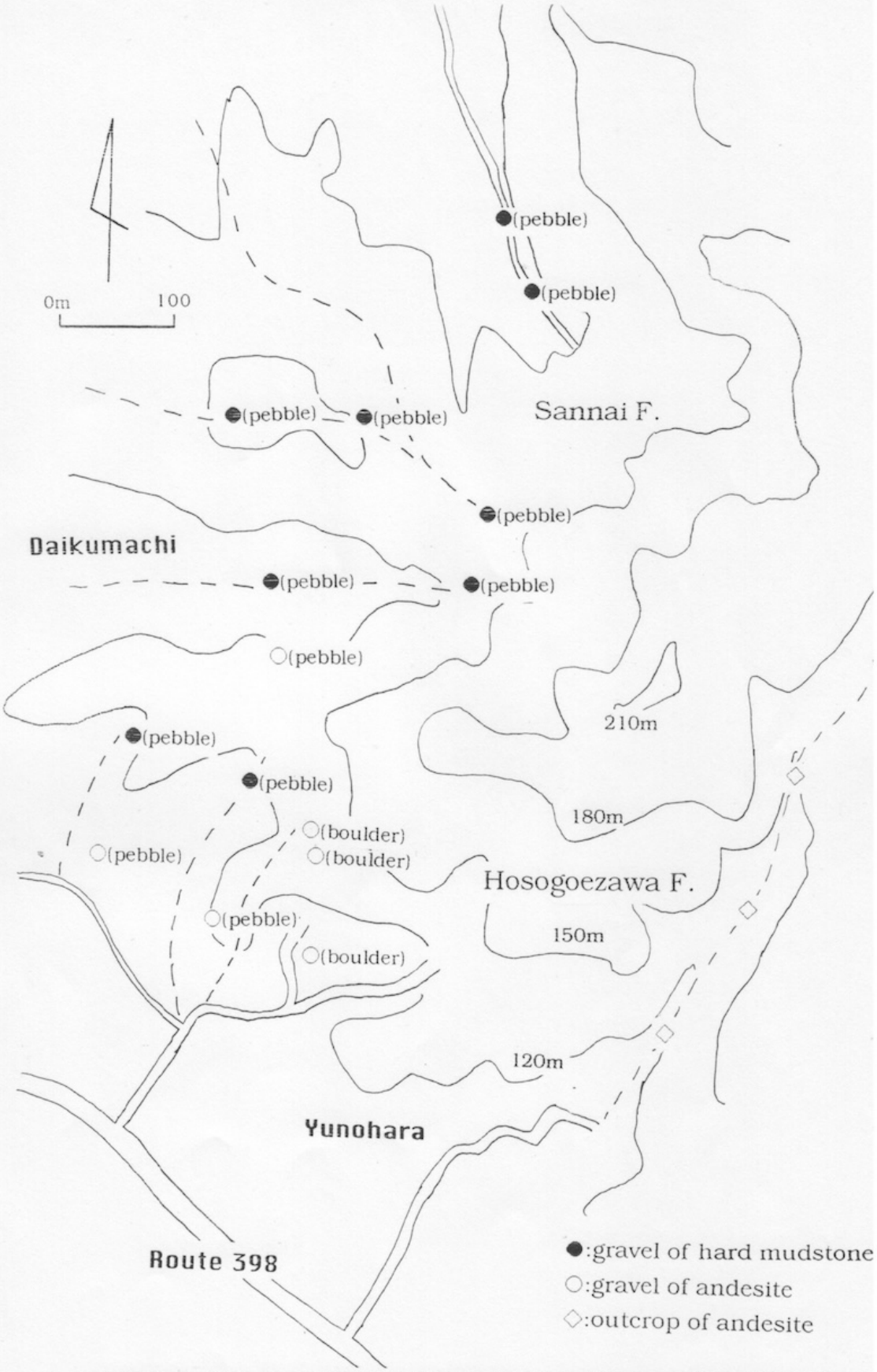


Fig. 24. Route map showing lithologic distribution of the Hosogoezawa and Sannai Formations in western Mt. Mitakesan. The ridge topography showing contours of 210 and 180 meters is presumably indicating a boundary line between the Hosogoezawa and Sannai Formations. Mapped area is shown in Fig. 13.

Yamaya Tuff Member

The Yamaya Tuff Member was defined by KIMURA et al.(1981).

[*Type locality*] Yamaya, Yuzawa City.
[*Definition*] Green pumice tuff.
[*Distribution*] The green pumice tuff is distributed in the region from Yamaya to the Anekurasawa River, which become to thinner toward the north.
[*Thickness*] 0 ~ 120 meters.

The Yamaya Tuff Member consists mainly of the pumice tuff. It is characterized by abundant flattened green pumices ranging up to 1 × 2 centimeters in size, and widely occurs around Yamaya. The pumice tuff of this member is well key bed in the Sannai Formation.

The pumice tuff strikes NW - SE from Yamaya to the eastern Mt.Mitakesan, and strikes NE - SW from the eastern Mt.Mitakesan to the midstream of the Anekurasawa River. The tuff has a general tendency to become thinner toward the north, and disappear around area over the Anekurasawa River.

The basal part of the pumice tuff is containing abundant pebbles of mudstone and hard mudstone and calcareous nodules.
The size of these pebbles are about 3 × 4 centimeters. The outcrop at area, about 500 meters south by the midstream of the Anekurasawa River, is boundary between the Sannai Formation and the Yamaya tuff Member. At the outcrop, alternating beds of the hard mudstone and white fine tuff of the Sannai Formation is overlain by the green pumice tuff of this member as shown in Fig.25.

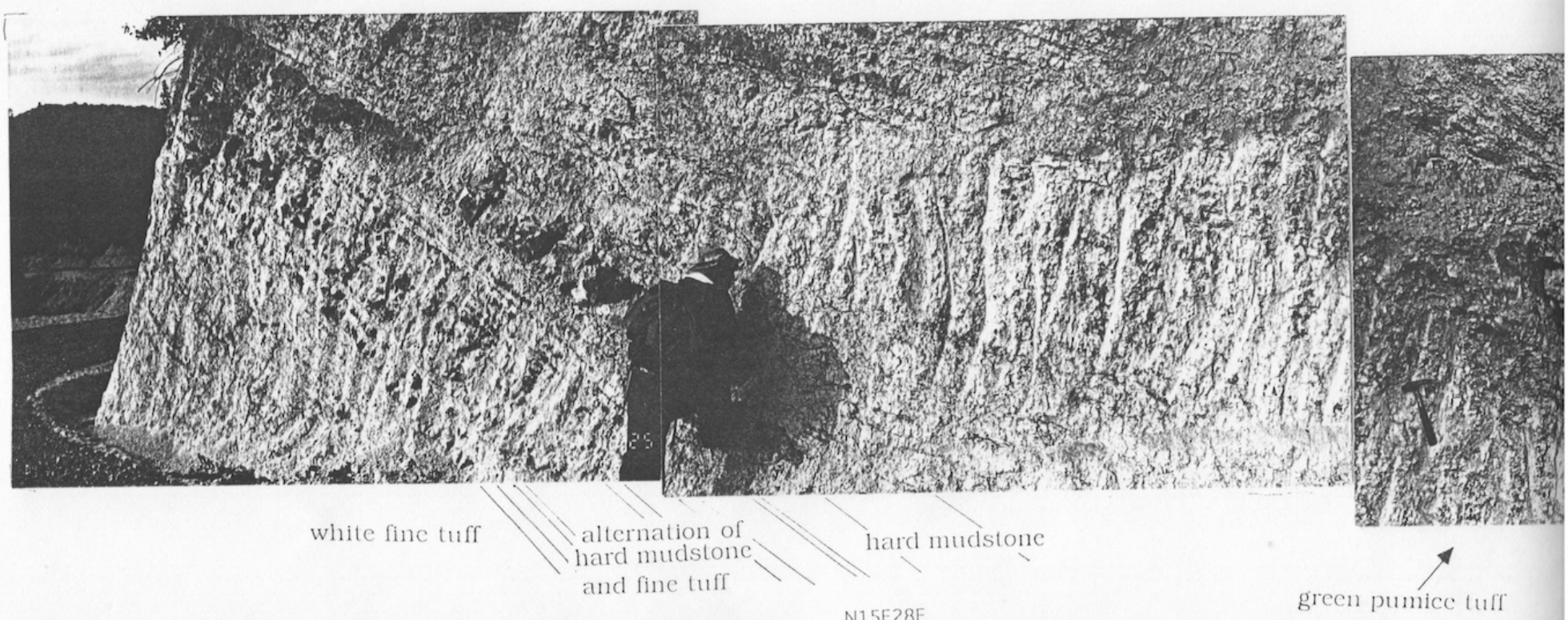


Fig. 25. The pumice tuff of the Yamaya Tuff Member. The basal part of the Yamaya Tuff Member includes pebbles and cobbles of hard mudstone and calcareous nodules, and the basal part changes to alternating beds of white fine tuff and hard mudstone as shown in this figure (Midstream of the Anekurasawa River, Yuzawa City).

Ainono Formation

The Ainono Formation was defined by TAKEUCHI et al.(1970), and correspond to Tonami Formation by KIMURA (1972).

[*Type locality*] Upstream of the Anekurasawa River, Masuda Town.
[*Definition*] Soft mudstone.
[*Distribution*] The Ainono Formation is distributed from southern Tonami of Masuda Town to Inakawa skiing ground of Inakawa Town.
[*Thickness*] 70 meters (+).

The Ainono Formation is composed mainly of massive soft mudstone, and contains partly intercalated the fine tuff of which is 5 to 30 centimeters thick, it is layered, however, the soft mudstone of the Ainono Formation does not layer as well as the hard mudstone of the Sannai Formation. The soft mudstone of the Tozawa formation is dark brown in fresh parts, and is dark white in weathering parts. The weathered soft mudstone is broken into the pieces of which size are about 0.5 × 3 centimeters.

Pumice tuff with pale green pumice occurs at Inakawa skiing ground, and is 50 centimeters thick. In addition, pumice tuff locates at area in 500 meters northeast by Yamaya-toge, and is 6 meters thick. However, these pumice tuffs are not continual beds and does not become to key beds. Dips and strikes of the soft mudstone around the latter pumice tuff are not fixed. It is possible that the latter pumice tuff suffered landslide on the basis of there geographical features.

The tuff of the Ainono Formation resembles the Ochoshinaidake Pyroclastics Member by USUDA (1981) mentioned later.

[*Stratigraphic relationship*]

At outcrop in the northeastern part of Yamaya-toge, shown in Fig. 26, the well layered hard mudstone of the Sannai Formation is overlain by the soft mudstone of which are broken into pieces of the Ainono Formation with the yellowish white fine tuff of which is 30 centimeters thick. Therefor the stratigraphic relationship between the Sannai and Ainono Formations is conformity.

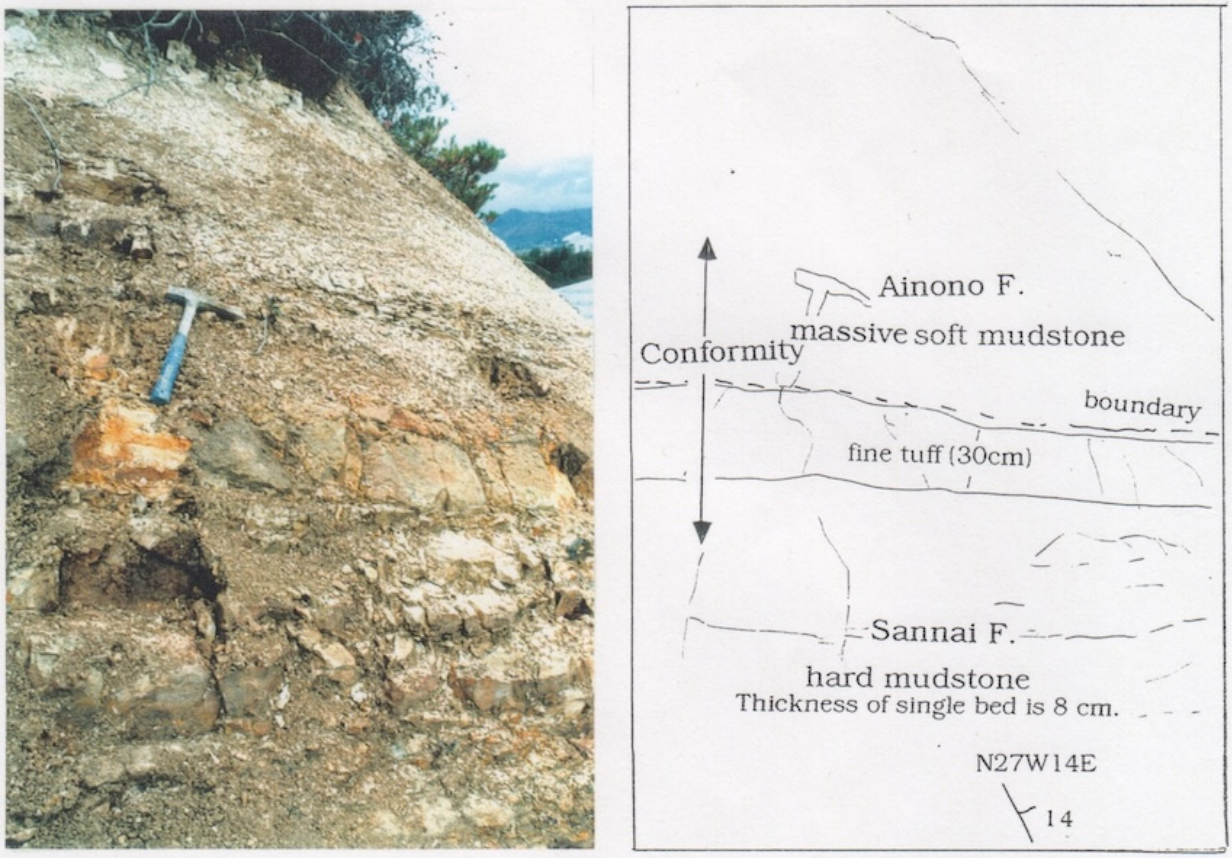


Fig. 26. Boundary between the Ainono Formation and the Sannai Formation. The weathering part of the Ainono Formation is characterized by mudstone becoming to the pieces which size are about 0.5 × 3 centimeters as shown in this figure (Yamaya-toge, Inakawa Town).

Ochoshinaidake Pyroclastics Member

The Ochoshinaidake Pyroclastics Member was defined by KIMURA (1972), was redefined as a member of the Ainono Formation by MURAYAMA et al.(1981).

[*Type locality*] Iwanosawa,Yuzawa City.
[*Definition*] Dacite.
[*Distribution*] The Ochoshinaidake Pyroclastics Member occurs at small area in Iwanosawa.
[*Thickness*] The thickness of the member is unknown.

The member in the survey area is the grayish white colored dacite. The rock has weak flow structure, abundant small hole and a little phenocrysts of plagioclase in the naked eye. At Iwanosawa, the planes of the flow structure of the dacite strikes N20° E and dips 70° east. The rock comprises almost quartz, and the flow structure is not clearly under a microscope. The dacite of the member does not contain the glass and the xenoliths of the andesite such as the dacites of the Mitakesan Formation.

In the northern part of Yuzawa City, the member locates small area at the type locality. According to the MURAYAMA et al.(1981), the member intrude the Tozawa and Sannai Formations in the southern part of Yuzawa. The MURAYAMA et al.(1981) pointed out that the Ochoshinaidake Pyroclastics Member consists of a lava dome and lava flow of the dacite and rhyolite after the deposition of the Ainono Formation.

The strikes of the Sannai Formation around Iwanosawa are disturbed surrounding the dacite of this member. It presume that the dacite at Iwanosawa is marginal parts of the lava dome.

Pleistocene deposits

[*Type locality*] Iwasaki,Yuzawa City.
[*Definition*] Pebbles to cobbles with lapilli tuff.
[*Distribution*] The Pleistocene deposits is distributed in Iwasaki.
[*Thickness*] 0 ~ 40 meters.

The Pleistocene deposits consists of sand, mud and pebbles to cobbles of andesite, granite, basalt, mudstone and hard mudstone, and is accompanied by the lapilli tuff. These deposits are distributed in the area from downstream of Nawashiro Stream to Iwasaki, and is deposited in the area in which is lower than 140 meters above sea level. A part of the Pleistocene deposits occurs as a mountainous district owing to erosion. The pebbles and cobbles of the Pleistocene deposits are well rounded and poor sorting. Some gravels with elliptic shape has weak imbricate structure. Trend of arrangement of the gravels strikes about NW-SE and dips 10 to 20 ° north. Matrix of the Pleistocene deposits comprises reddish brown colored mud and sand.

The sand of the matrix has sedimentary structures at outcrop in the downstream of the Nawashiro Stream as shown in the Fig.29, which is showing that deposition of the sand occurs from east to west. The lapilli tuff at the most upper parts of the outcrop unconformably overlies the gravels and matrix as shown in Fig.28. The lapilli tuff is characterized by abundant containing the pebbles to granules of andesite which is 1 × 2 centimeters at the average. The consolidation between the pebbles of the andesite and the matrix is hard.

There is normal fault with 10 centimeters gap in the lapilli tuff. Trend of the fault strikes about N 70 ° E and dips 88° west. There is also fault at the gravel parts of the outcrop showing Fig.27. The fault is accompanied by fault clay, and the west parts of the outcrop is composed of only white colored sand. The fault strikes N 80° E and dips 82° east. The gap of the fault is unknown. Cause of formation of the faults moved during the Pleistocene and relationship between these faults at Iwasaki and Higashi-tyoukaisan fault (The Reseach Group for Active Faults of Japan,1991) distributing in the southwestern part of the Yuzawa City are not clearly.

[*Stratigraphic relationship*]

The Pleistocene deposits vertically locates to the strike of the hard mudstone of the Sannai Formation as shown in Fig. 30. In addition, the matrix of the deposits is soft. Therefor the stratigraphic relationship between the deposits and the Sannai Formations is unconformity.

Fig. 27. Pleistocene deposits in Iwasaki. In the northern part of this area, the lapilli tuff shown in figure 28 are found the only this outcrop. (Iwasaki, Yuzawa City)

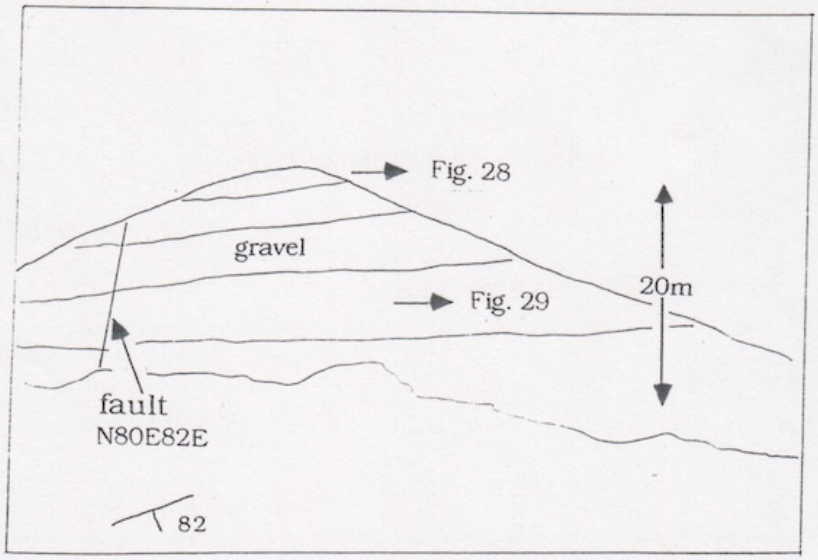


Fig. 28. The upper most parts of the outcrop shown in figure 27. A part is lapilli tuff. The lapilli tuff is characterized by comprising granules and pebbles of andesite. B part is gravels of igneous rocks and mudstone. The gravels, well rounded pebbles to cobbles, are depositing matrix support. The matrix is the tuffceous mud and tuffceous sand which color is redish brown.

Fig. 29. Sedimentary structure in the Pleistocene deposits.

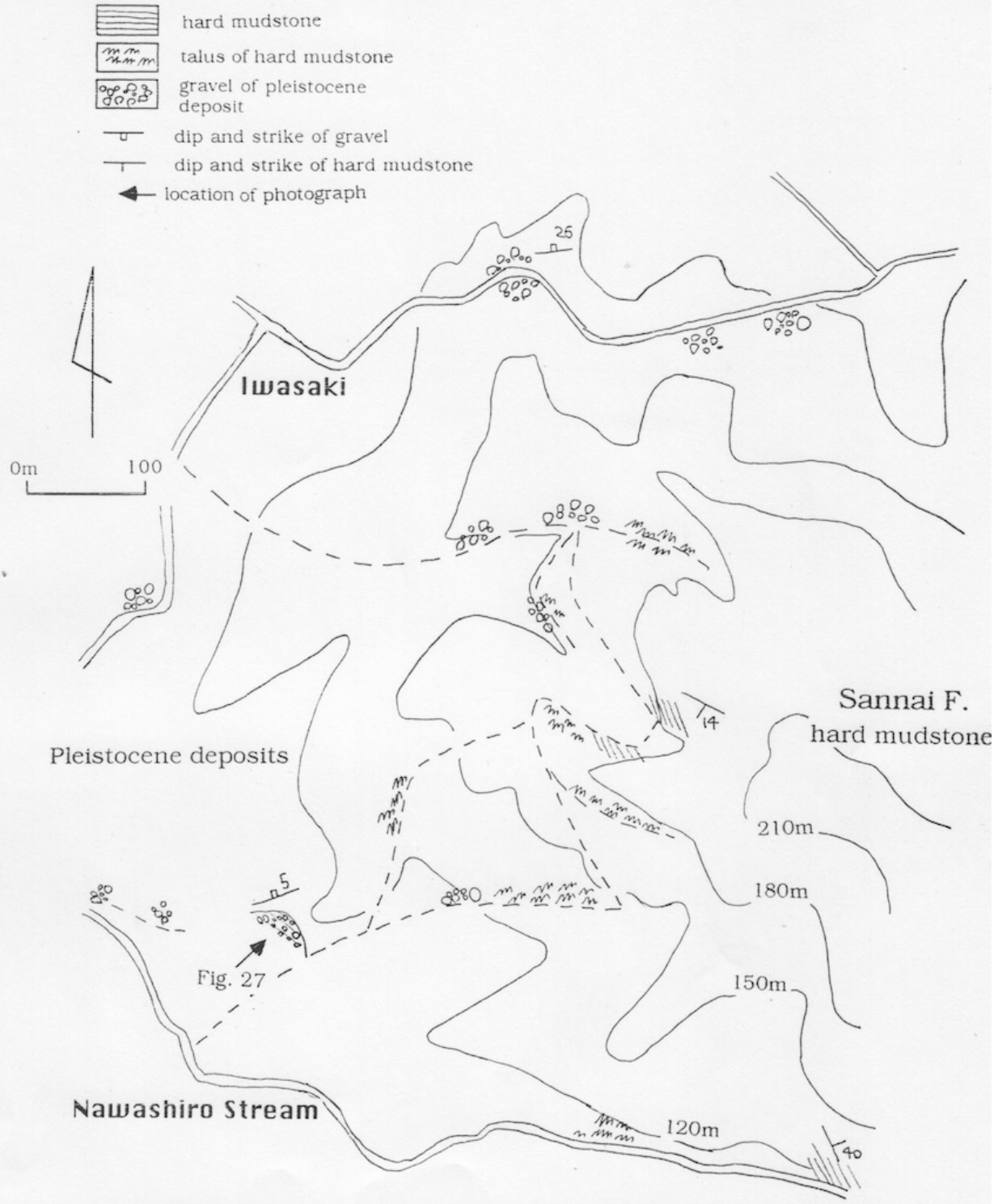


Fig. 30. Route map showing lithologic distribution of the Pleistocene deposits and Sannai Formation in Iwasaki. Mapped area is shown in Fig. 13. It presume that the lapilli tuff of the outcrop of figure 27, unconformably overlies the gravels, is overlain by the gravels again on the basis of distribution of the gravels and dip and strike of the gravels.

Alluvial deposits

[*Type locality*] Downstream of the Anekurasawa River, Yuzawa City.
[*Definition*] Pebbles of hard mudstone, mud and sand.
[*Distribution*] The Alluvial deposits is distributed along the Nawashiro Stream, Anekurasawa River and Kaneuchisawa River.
[*Thickness*] The thickness of the Alluvial deposits are unknown.

The Alluvial deposits occurs along the region from the midstream to downstream of the Nawashiro Stream and Anekurasawa River which compose an alluvial plain and the downstream of the Kaneuchisawa River where occurs as alluvial fan. The alluvial plain are usually well occurred in the western parts of the main ridge containing Mt.Amagadai, and is not distributed in the eastern parts of that. The Alluvial deposits consists mainly of well rounded to angular pebbles of hard mudstone and matrix composing of mud and sand. It presume that the pebbles of the hard mudstone derives from that of the Sannai Formation. The consolidation between the pebbles of the hard mudstone and the matrix is soft.

The differences between the Alluvial deposits and the Pleistocene deposits are that the Pleistocene deposits comprises a large quantity of pebbles of igneous rocks and the Alluvial deposits are composed of the pebbles of the only hard mudstone.

	94080210 (Tozawa F.)	94080313 (Sannai F.)
Coccolithus pelagicus	few	few
Dictyococcites spp. (>5)	few	
Dictyococcites spp. (>3)	common	common
Reticulofenestra pseudoumbilica	abundant	
Reticulofenestra spp. (>7)		common
Reticulofenestra spp. (5>3)	common	abundant
Sphenolithus moriformis		rare

Table 2. List of calcareous nanno fossils. Sampling points are shown in Fig. 12.
(Judgment : Associate Professor Tokiyuki S ATO)

V. b. Rocks

Igneous rocks in the northern Yuzawa are the pyroxene andesite, volcanic conglomerate, lapilli tuff, brown dacite, perlite, white dacite and dacite. The details are as follows:

Pyroxene andesite

Condition : The pyroxene andesite occurs as lava flow, gravel of the volcanic conglomerate and pebble in the lapilli tuff, brown dacite and white dacite. The pyroxene andesite occurs as columnar joints at times.

Horizon : Hosogoezawa Formation.

Observation in the naked eye : The pyroxene andesite is massive and very hard, and is dark reddish brown with dark green spots owing to such as chlorite and epidote. The alteration of the pyroxene andesite in the area has a general tendency to become weaker toward the north and plagioclase in the pyroxene andesite become fresher toward the north.

Observation under a microscope : The pyroxene andesite shows porphyritic texture, and the principal minerals are mainly the plagioclase of which anorthite contents are 26 to 37 %. Almost all of pyroxenes in the pyroxene are replaced chlorite and epidote replaces. Most of the saponite occurs at the core of plagioclase in the andesite. Mafic minerals of the pyroxene andesite in the northern part of the area are more strongly altered than those of the andesite in the southern part of the area. In the southern part, the andesite lacks even those alteration minerals and some holes often occurs in the thin-section of the pyroxene andesite. Amounts of the hematite and magnetite in the pyroxene andesite increase from the southern part to the northern part in the area.

Volcanic conglomerate

Horizon : Hosogoezawa Formation.

Observation in the naked eye : The gravel of the volcanic conglomerate

is poor sorting, well rounded, and is deposited a clastsuport. It has not imbricate structure. The volcanic conglomerate consists of a large quantity of pebble to cobble of the pyroxene andesite with a small amount of pebble of mudstone. The matrix of the volcanic conglomerate is also composed of granules to pebbles of the andesite. The consolidation between the gravels and the matrix is hard.

Observation under a microscope : The volcanic conglomerate is characterized by that phenocrysts of euhedral augite and plagioclase in the rock are fresher than that in the pyroxene andesite. The phenocrysts of augite in matrix of the volcanic conglomerate are also fresh, however, saponites replaces the plagioclase in matrix of the volcanic conglomerate. Anorthite contents of the phenocrysts of plagioclase are about 26 %.

Lapilli tuff

Horizon : Mitakesan Formation.

Observation in the naked eye : The lapilli tuff frequently contains the flatted white pumice of which size is maximum 15 centimeters length, and is accompanied by the abundant pebbles of altered andesite of which size are about 2×3 centimeters. The altered andesite pebbles are very soft, therefor those are broken up with bare hands. The lapilli tuff is rarely containing the brown colored chert which size is about 1×1 centimeters.

Observation under a microscope : The lapilli tuff consists mainly of the altered andesite fragments and the chert fragments. A few fragments of chert were included in the lapilli tuff under a microscope. Some fragments also occurs in other fragments.

Brown dacite

Condition : Occurrence condition of the brown dacite in the area is not clear whether the rock is lava flow or a part of lava dome.

Horizon : Mitakesan Formation.

Observation in the naked eye : The brown dacite has the flow structure, which is distinct. The color of the rock is brown to reddish brown, is

characterized by containing abundant pebble of the altered andesite, however, it is found in only fresh outcrops, the weathering outcrops shows such as hollow inside owing to previous weathering of the andesite pebbles.

Observation under a microscope : The brown dacite has a large amount of glass and a small amount of quartz and plagioclase with albite twin. The quartzs and plagioclases is principal minerals in the brown dacite, and are arranged along the flow structure. The groundmass of the brown dacite consists of the glass. The anorthite contents of the phenocrysts of the plagioclase in the brown dacite are 25 %. Amount of the glass and the plagioclase phenocryst in the brown dacite are more than that in the white dacite, and the quartz in the brown dacite is fewer than that in the white dacite.

Perlite

Condition : The perlite occurs as a part of a lava dome.

Horizon : Mitakesan Formation.

Observation in the naked eye : The perlite is black, glassy, and is rather soft, therefor it is broken up with bare hands with strength. All of the perlite cropping out in this area is fresh.

Observation under a microscope : The perlite contains euhedral augite phenocryst and the euhedral plagioclase phenocryst which anorthite contents are about 25 %. The plagioclase phenocryst shows albite twin and zonal structure. The augite phenocryst is fresh. The perlite is distinct perlitic structure.

White dacite

Condition : The white dacite occurs as intrusive rock composing a lava dome with autobrecciated lava.

Horizon : Mitakesan Formation.

Observation in the naked eye : The fresh white dacite shows white to light gray. The altered white dacite shows pail purple in color. The white dacite show clear flow structure and is accompanied by vesicular

parts of the pumiceous glass of which size is maximum 3 centimeters and average 5 millimeters, however, those pumiceous glass are not welded such as welded tuff. The white dacite is containing the altered andesite gravel of which size is maximum 30×20 and average 3×2 centimeters. It presume that those pebbles of the altered andesite are the pyroxene andesite of the Hosogoezawa Formation; the white dacite took in that as xenolith. The autobrecciated lava occurs in marginal part of the lava dome, which is characterized by that flow structures are also distinct in each fragments of the lava.

Observation under a microscope : Almost all of the minerals in the white dacite is the quartz, which gaps are occupied glass composing flow structure. The white dacite includes a small quantity of phenocrysts of plagioclase showing albite twin and zonal structure. The anorthite contents of the phenocrysts of the plagioclase in the white dacite are about 25 %.

Dacite

Condition : The dacite occurs as intrusive rock and is composing a part of the lava dome which differs that of the white dacite as mention above.

Horizon : Ochoshinaidake Pyroclastics Member.

Observation in the naked eye : The dacite is the grayish white, has weak flow structure, abundant small hole and a little phenocrysts of plagioclase. The flow structure in the rock is weaker than that of the brown dacite and the white dacite.

Observation under a microscope : The dacite comprises almost quartz and plagioclase, is showing aphyric texture, and the flow structure is not clearly. A large quantity parts of the quartz in the dacite are arranged as bold lines, because of this, the dacite is showing the flow structure in the naked eye.

VI. Geological Structure

The geological structure of the area has a general tendency to strike N-S and dip 10 to 30° east, therefor the strata of the area become older toward the west. The strikes of the hard mudstone of the Sannai Formation around Mt.Mitakesan surround the dacites of the Mitakesan Formation. The pumice tuff of the Yamaya Tuff Member strikes NW-SE up to the eastern Mt.Mitakesan and strikes NE-SW from eastern Mt.Mitakesan to the north. These facts support the idea that deposition of mud prior to become the hard mudstone is controlled by lava dome structure of the Mitakesan Formation.

Around the downstream of the Anekurasawa River distributing the alternating beds of the hard mudstone and the soft mudstone of the Sannai Formation is characterized by the prevalence of the folded structures which strikes N-S and dips 20° or fewer. There is syncline axis striking N-S in the soft mudstone of the Ainono Formation of the eastern area.

The Sannai Formation of the southern part of the area strikes about E-W. It suggests that the dacite of the Ochoshinaidake Pyroclastics Member widely distributing in the southern Yuzawa (USUDA et al., 1981) are intruding the Sannai Formation at Iwanosawa.

VII. Geotectonic History

Field survey in the northern Yuzawa leads to the following interpretation on the geotectonic history :

1. Effusion and sedimentation of the Hosogoezawa Formation, (Monzen Age).

So-called " green tuff volcano activity " carried out effusion of the pyroxene andesite. According to USUDA et al.(1981), the pyroxene andesite of the Hosogoezawa Formation in the southern Yuzawa unconformably overlies Kamuroyama Granites as basement rocks, therefor the Hosogoezawa Formation correlates to Monzen Group in the Oga Peninsula. The gravels of the andesite are formed by erosion under terrestrial environment, and deposited in the hollow spot such as lake and changes the volcanic conglomerate (Fig.31a-1).

2. Effusion and sedimentation of the Mitakesan Formation, (Daizhima Age).

Felsic igneous activity carry out, and the lapilli tuff and brown dacite including abundant xenoliths of the andesite which are presumed the Hosogoezawa Formation effused. The lava dome of the white dacite intrude the brown dacite, and are eroded under terrestrial environment. However, the time gap between the intrusion of the white dacite and the effusion of the brown dacite is not clear. It presume that this age is Daizhima age on the basis of the effusion and intrusion carried out just before Nishikurosawa transgression (Fig.31a-2,3,4).

3. Sedimentation of the Tozawa Formation, (Nishikurosawa Age).

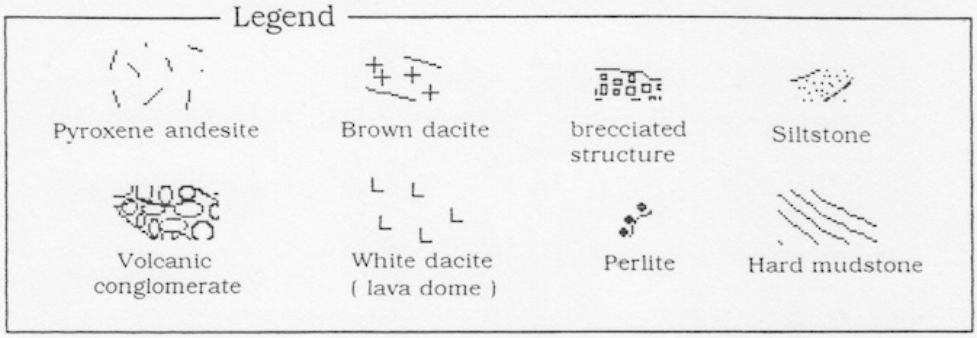
Rapid submergence occurs after the erosion of the lava dome of the white dacite, and the northern Yuzawa were transgressed. Marine erosion may have formed such as so-called " basal conglomerate ", however, it assume that the gravels of the basal conglomerate were moved rapidly, because of the gravel were little for rapid submergence and marginal parts of the lava dome were steep cliff. Afterward, the deposition of silt of the Tozawa Formation occurred when the lava dome and around the area remaining the unstable environment which is difficult to deposition of sediments were submerged to deep sea. It imagine that the plant fossil in the siltstone of the Tozawa Formation slid on the steep cliff of the marginal parts of the lava dome (Fig. 31b-5).

4. Sedimentation of the Sannai Formation, (Onnagawa Age).

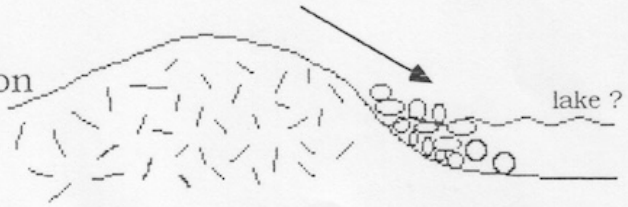
The deposition of the silt end at once. The silt underlay the mud containing large quantity of diatom under environment remaining deep sea. The sea of this age become unstable environment in the middle of the age, formation of alternating beds with soft mud and felsic igneous activity with pumice tuff occurred. The mud of the Sannai Formation was deposited to a thickness of 700 meters. These depositions were controlled by the lava dome structure of the Mitakesan Formation (therefore the strikes of the Sannai Formation are surrounding the Mitakesan Formation as mention above) (Fig. 16b-6).

5. Sedimentation of the Ainono Formation, (Funakawa Age).

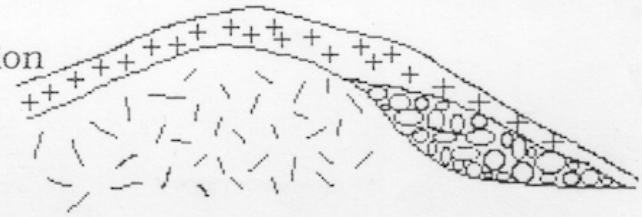
The sea environment changes, and the deposition of the mud including abundant the diatom changed to sedimentation of the mud of which little contains the diatom of the Ainono Formation.



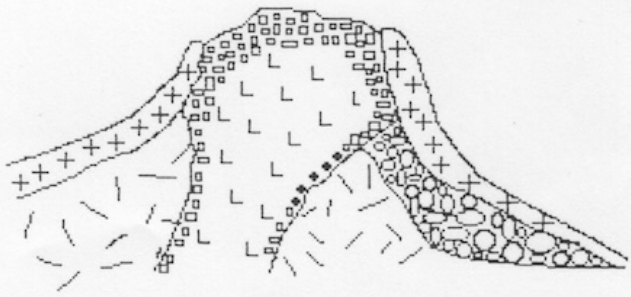
1) The effusion and sedimentation of Hosogoesawa Formation . (Monzen Age)



2) The effusion and sedimentation of brown dacite of Mitakesan Formation . (Daizhima Age)



3) The formation of lava dome by white dacite .



4) Erosion

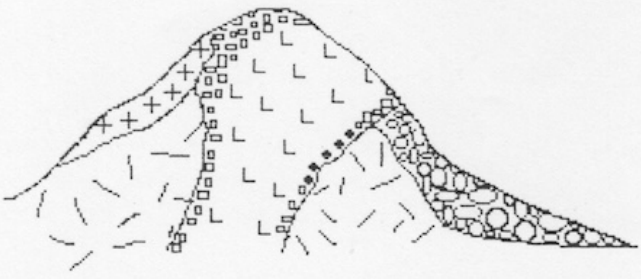
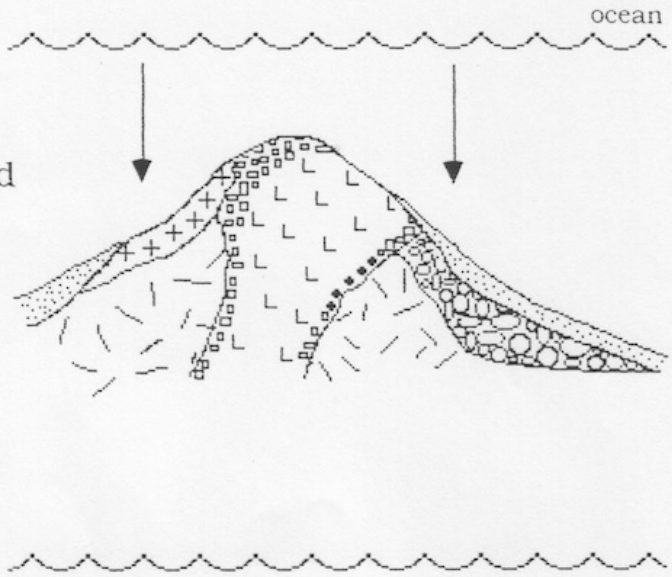
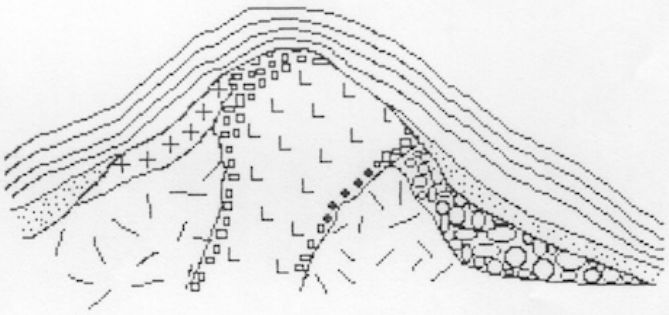


Fig. 31a. Geotectonic history in the Northern part of Yuzawa City.

5) The sedimentation of siltstone of Tozawa Formation after rapid submergence . (Nishikurosawa Age)



6) The sedimentation of hard mudstone of Sannai Formation . (Onnagawa Age)



7) Recent

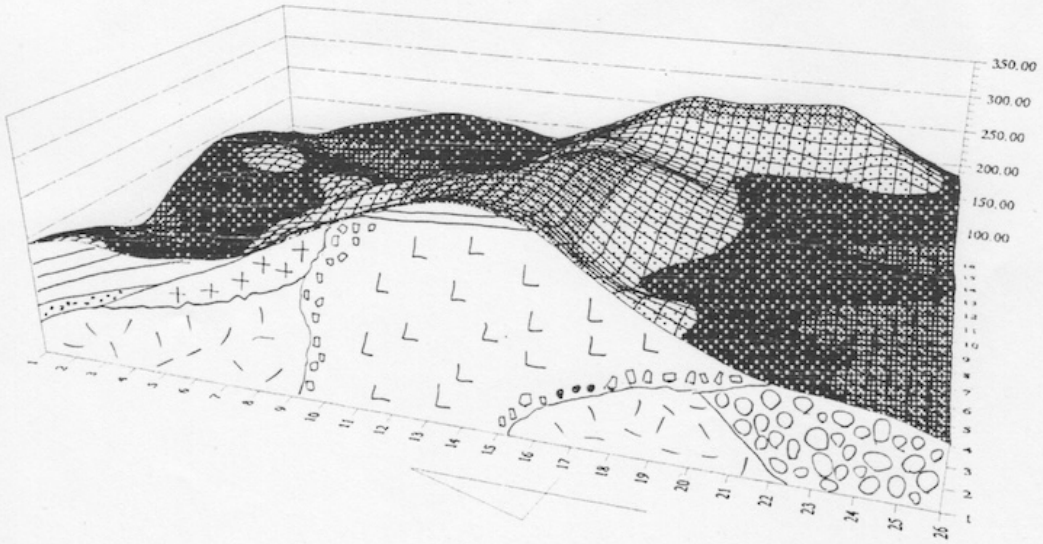


Fig. 31b. Geotectonic history in the Northern part of Yuzawa City.

VIII. Applied Geology

There are Tonami mineral spring in east area and Yunohara hot spring at Yunohara, southwestern Mt.Mitakesan. Tonami mineral spring is the artesian flowing well which quantity is 5 liters per minute and the temperature is 13.5 ℃.

Around Yamaya in the southern area and the northern part of Yamaya-toge in the eastern area are showing landslide topography. The region in the northern Yamaya-toge is used for skiing ground of Inakawa.

The region in the southern and western part of Mt.Mitakesan are sabo designation area designated by Akita Prefecture. At entrance of streams around the region are established sabo dams.

IX. Conclusion

First discoveries by this field survey and unsolved problems are as follows :

1) Mt.Mitakesan has been considered to consist of andesite widely occurring in western parts of Mt.Mitakesan and mudstone in eastern parts of Mt.Mitakesan and the dacite which is similar to dacite of Mahirugawa Formation in Kinpho and Mato Mountains, distributing at small area in mountaintop of Mt.Mitakesan (USUDA et al., 1981). However, Most of Mt.Mitakesan consists of the white dacite which is different in both age and feature from the dacite of the Mahirugawa Formation. The white dacite is a lava dome formed prior to Nishikurosawa transgression, and newly named as Mitakesan Formation.

2) The brown dacite predominate in the northwestern Mt.Mitakesan. The brown dacite are intruded by the white dacite. The Mitakesan Formation consisting of these dacites unconformably overlies the Hosogoezawa Formation. However, it is not clear whether the brown dacite is lava flow or a part of lava dome.

3) The Mitakesan Formation effused under terrestrial environment in the Daizhima Age, and the Tozawa Formation is including the calcareous nanno fossils which paleoenvironment was presumably deep sea of the Nishikurosawa Age. Therefor, the stratigraphic relation between the Mitakesan Formation and the Tozawa Formation is unconformity with long time gap and rapid submergence.

4) Around downstream of the Anekurasawa River, eastern part of the area, is dominated by the folded structure dipping gently.

5) The Pleistocene deposits predominate in Iwasaki, northern area. A part of the Pleistocene deposits occurs as a mountainous district, however, the process of formation of the Pleistocene deposits is not clear.

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（要旨）

Sugawara, T., 1995, Geology in the Northern part of Yuzawa City, Akita Prefecture, Northeast Japan.（菅原 透，東北日本、秋田県湯沢市北部地域における地質.）

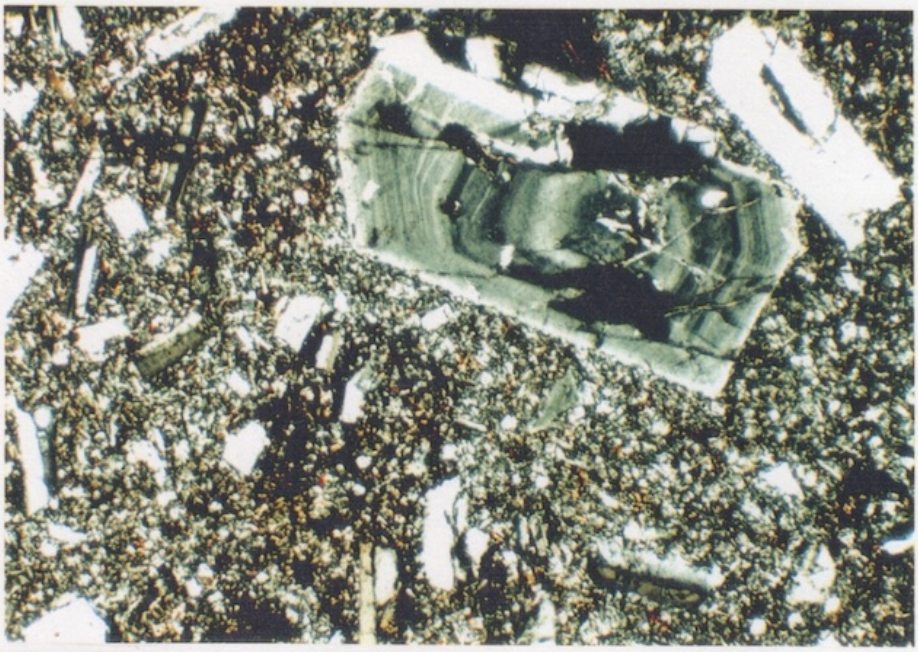
湯沢市北部地域の地質は下位より順に、細越沢層の輝石安山岩および火山円礫岩、御嶽山層の火山礫凝灰岩、褐色石英安山岩、白色石英安山岩および流紋岩、戸沢層のシルト岩、山内層の硬質泥岩、山谷凝灰岩部層の浮石凝灰岩、相野々層の軟質泥岩、雄長子内岳火砕岩部層の石英安山岩、更新世の円礫層および沖積層から成る。本調査は、御嶽山が、西黒沢海進以前の陸成の褐色石英安山岩、およびそれを貫き溶岩円頂丘をなす白色石英安山岩により構成されることを明らかにし、これを御嶽山層と新命名した。御嶽山層の噴出が陸域であるのに対して、その上位の戸沢層の堆積環境は深海である。御嶽山層と戸沢層の層位関係は時間間隙の大きな不整合であり、急速な地層の沈降があった。

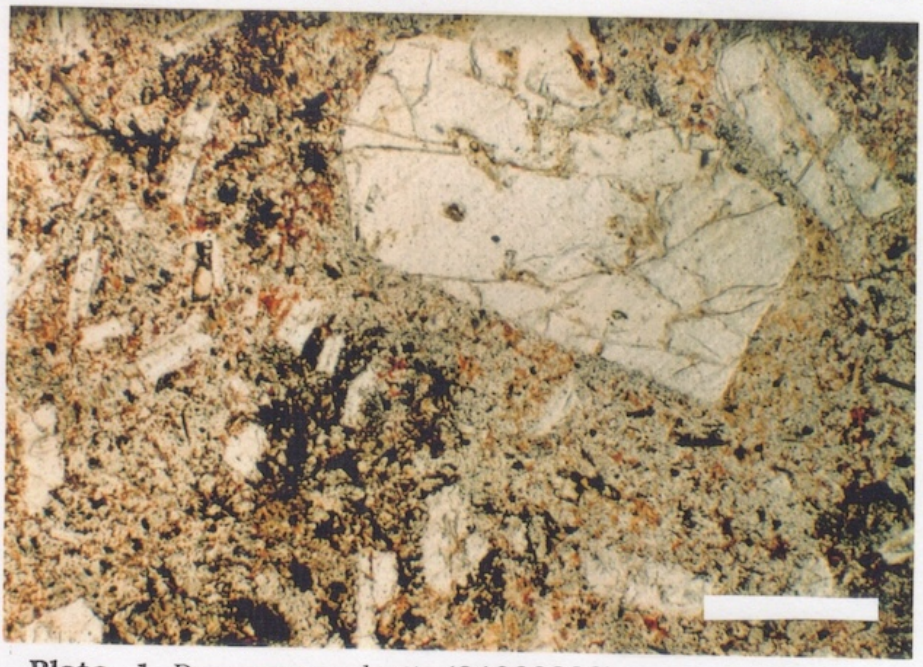
（地名・地層名）

Yuzawa	湯沢
Yunohara	湯ノ原
Daikumachi	大工町
Kaneuchisawa River	鉦打沢川
Hosogoezawa Formation	細越沢層
Mt.Mitakesan	御嶽山
Mitakesan Formation	御嶽山層
Yamaya	山谷
Shimo-yamaya	下山谷
Yamaya-toge	山谷峠
Tozawa Formation	戸沢層
Sannai Formation	山内層
Anekurasawa River	姉倉沢川
Mt.Amagadai	天ヶ台山
Yamaya Tuff Member	山谷凝灰岩部層
Iwanosawa	岩の沢
Tonami	戸波
Masuda	増田
Inakawa	稲川
Nawashirosawa	苗代沢
Iwasaki	岩崎
Ainono Formation	相野々層
Ochoshinaidake Pyroclastics Member	雄長子内岳火砕岩部層

Plates

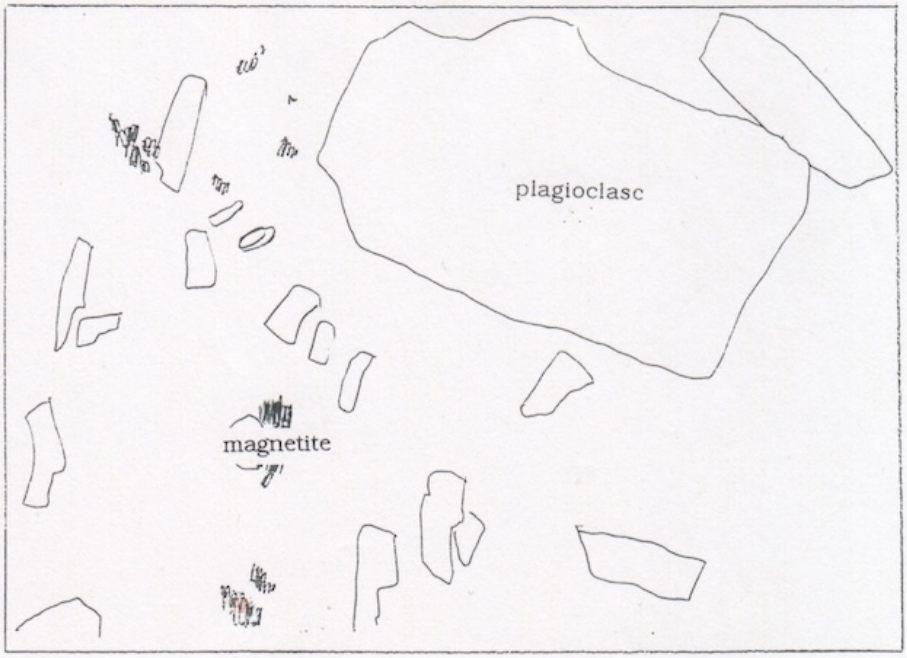
Photomicrographs and photographs of rocks of this survey area. Sampling points are shown in Figure 12.

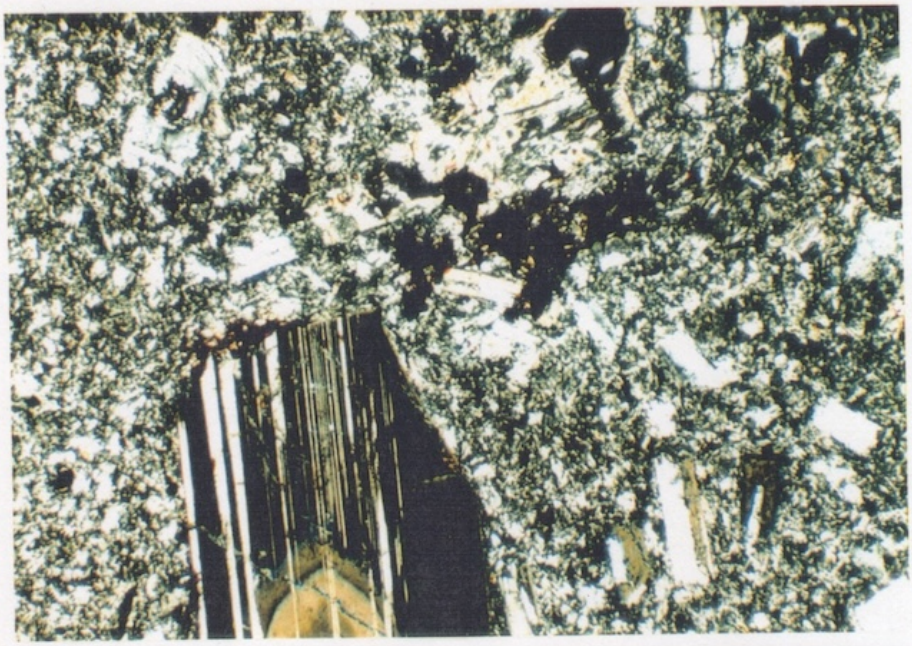


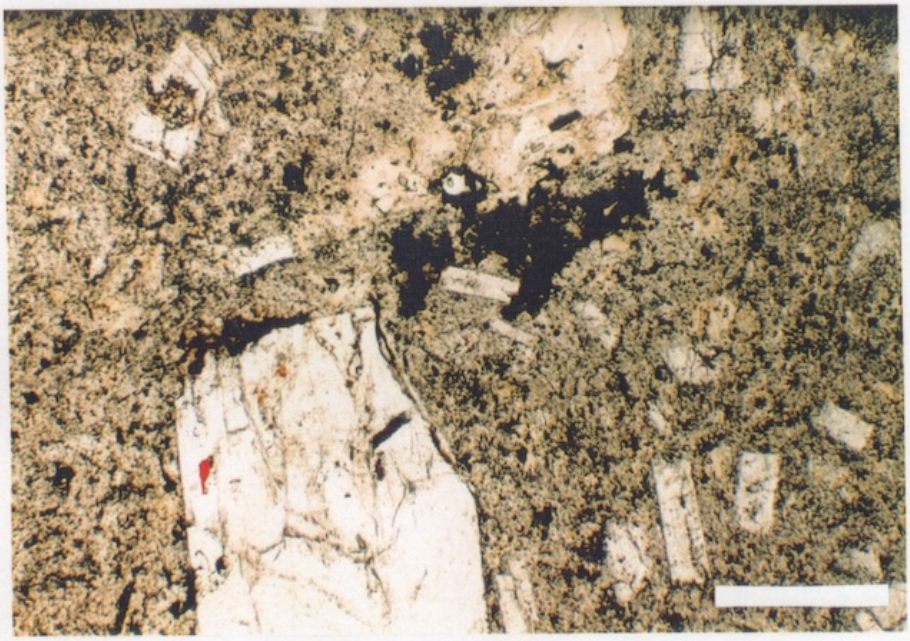


No. :94080608
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : porphyritic
principle minerals : plagioclase(An37%)
Accessory minerals : magnetite, biotite
Altered minerals : zeolite

Plate 1. Pyroxene andesite (94080608).

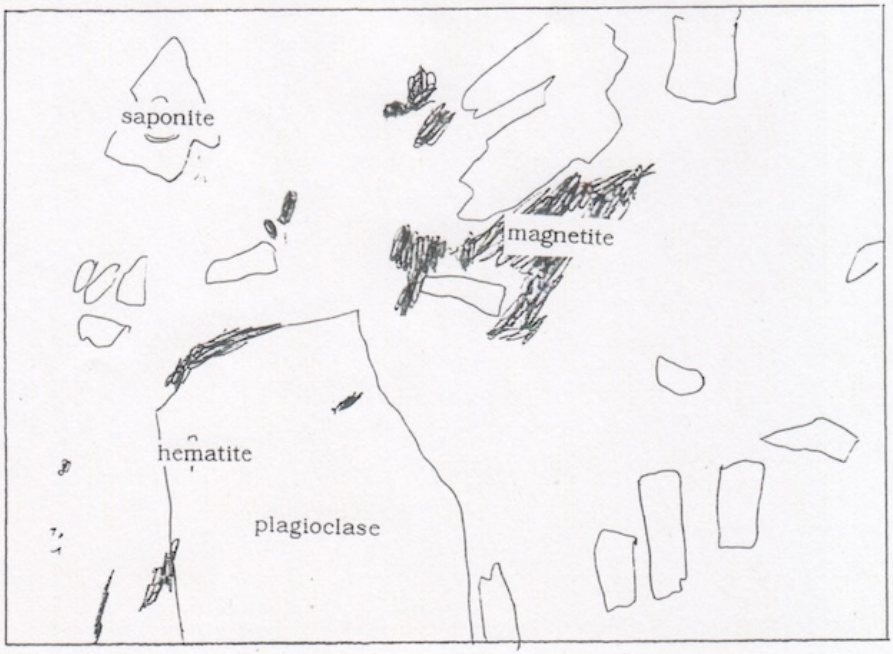


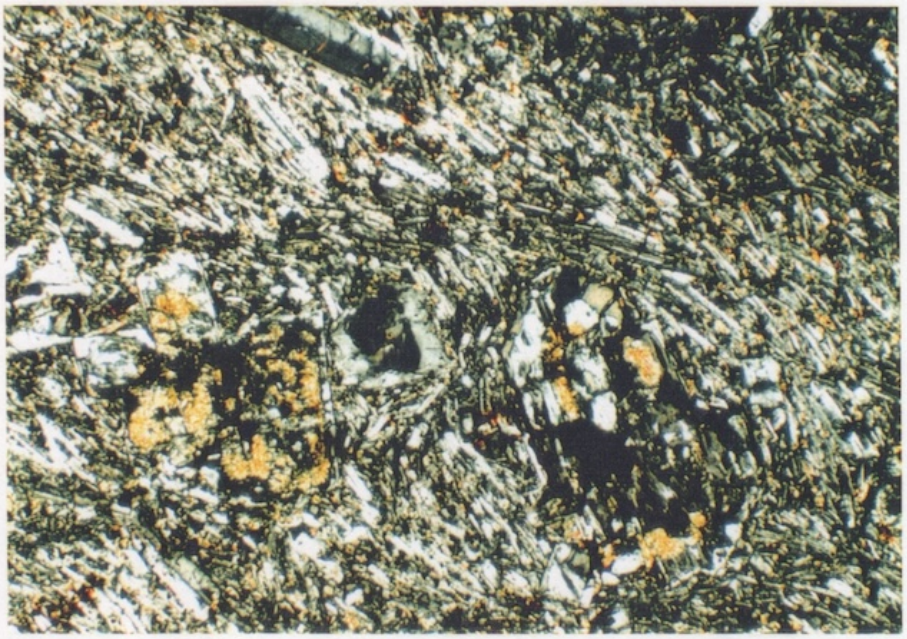


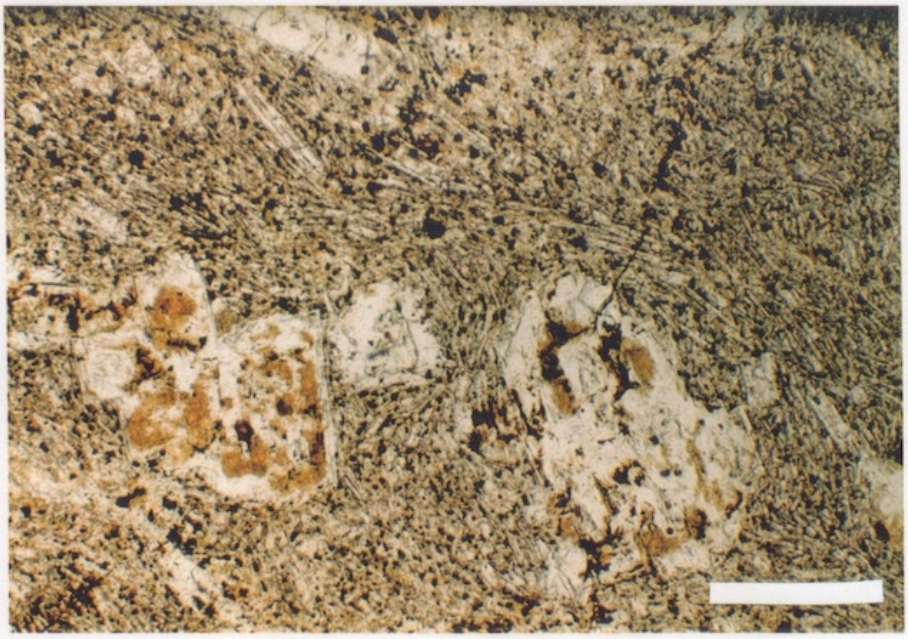


No. :94072810
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : porphyritic
principle minerals : plagioclase(An27%)
Accessory minerals : magnetite
Altered minerals : saponite. hematite

Plate 2. Pyroxene andesite (94072810).







No. :94082705
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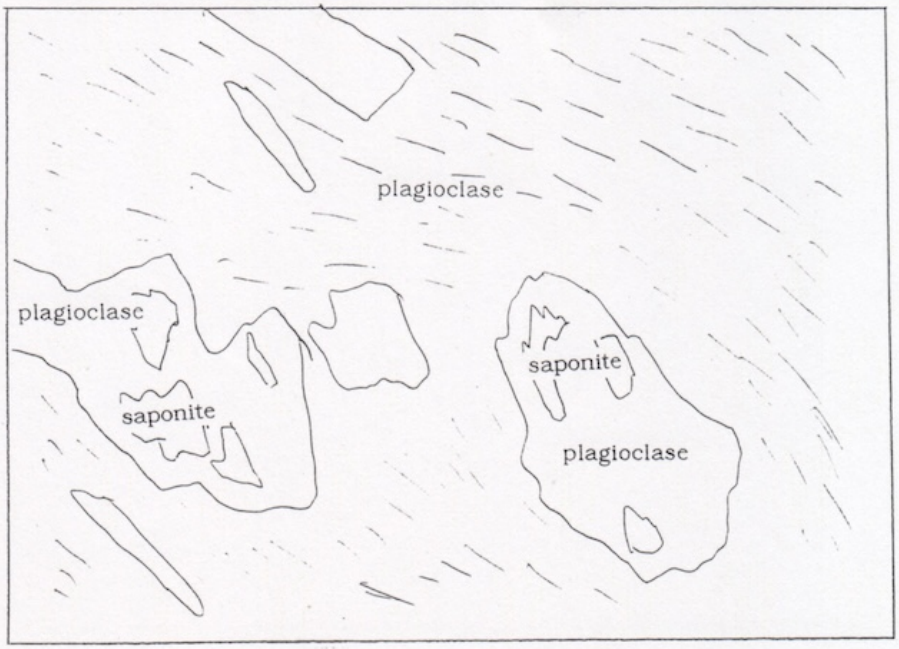
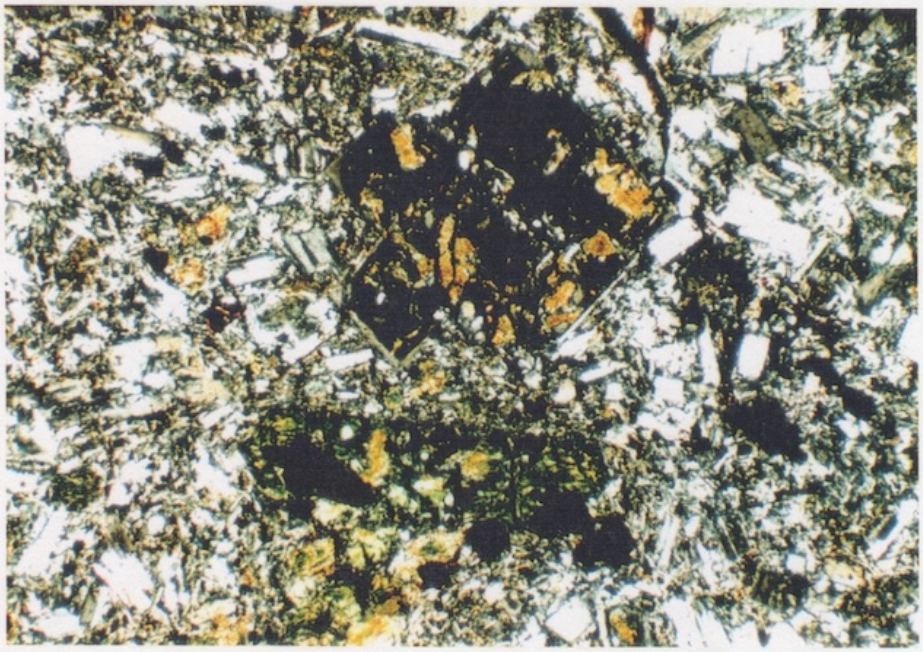
Lower : opened polars
Scale bar 0.5mm.
Texture : porphyritic, pilotaxitic
principle minerals : plagioclase(An30%)
Accessory minerals : magnetite
Altered minerals : saponite

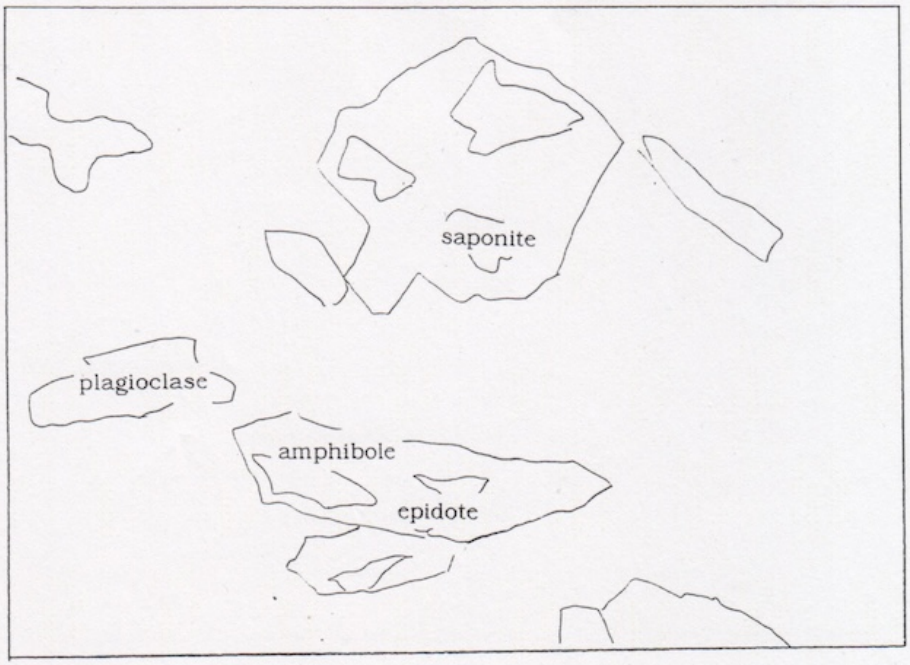
Plate . 3. Pyroxene andesite (94082705).

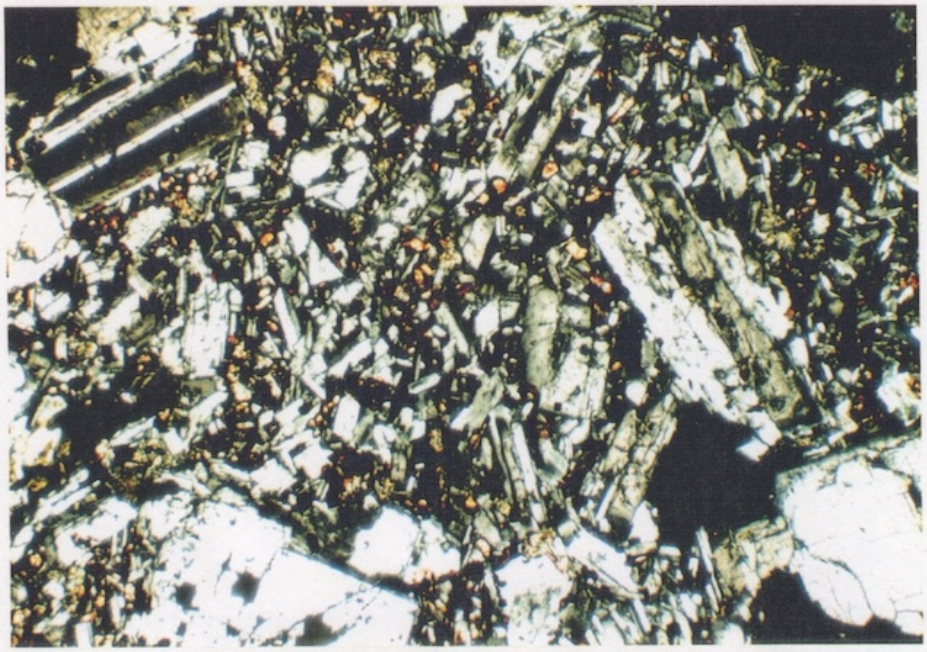


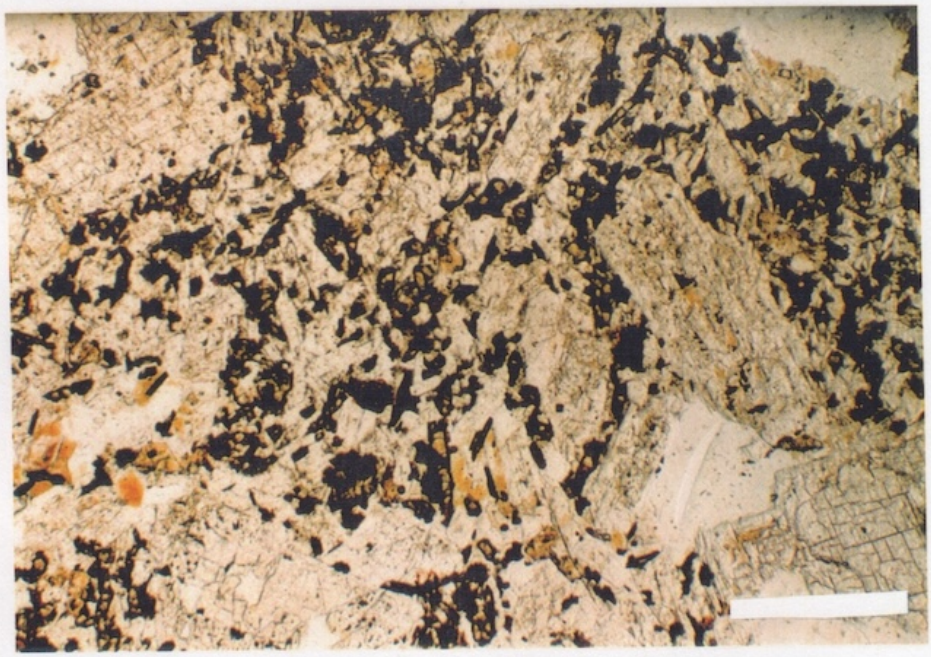


No. :94082702
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : porphyritic
principle minerals : plagioclase(An27%), amphibole
Accessory minerals : magnetite
Altered minerals : epidote, saponite, hematite

Plate 4. Pyroxene andesite (94082702).







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Lower : opened polars
Scale bar 0.5mm.
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principle minerals : plagioclase(An26%).
Accessory minerals : magnetite
Altered minerals : saponite, hematite

Plate 5. Pyroxene andesite (94082704).

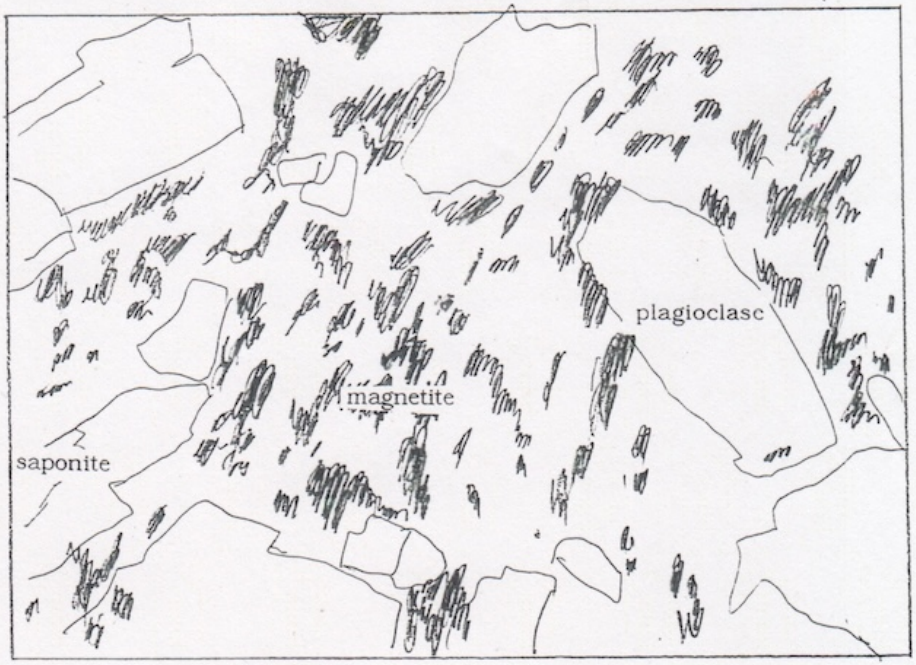
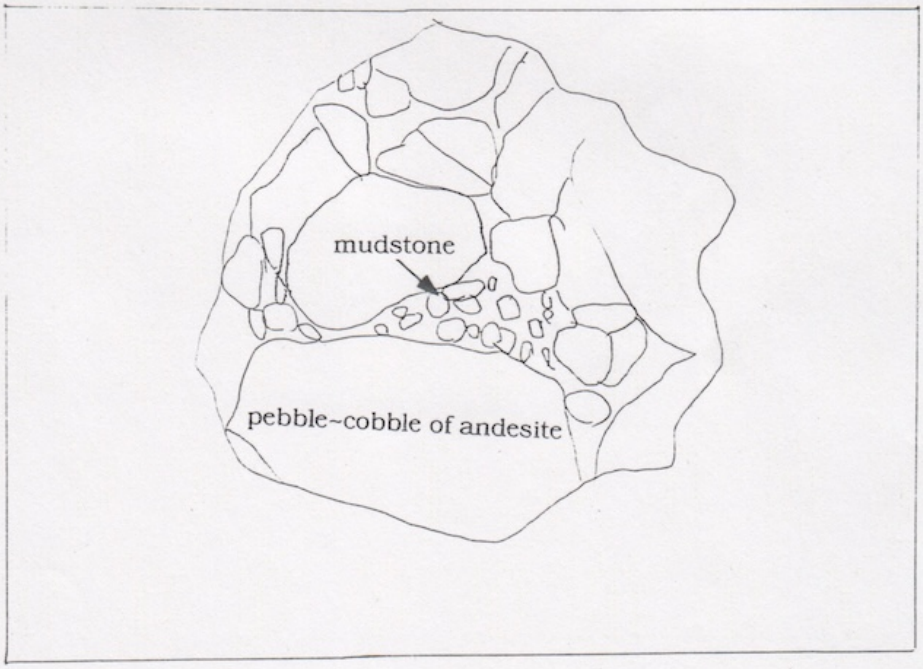
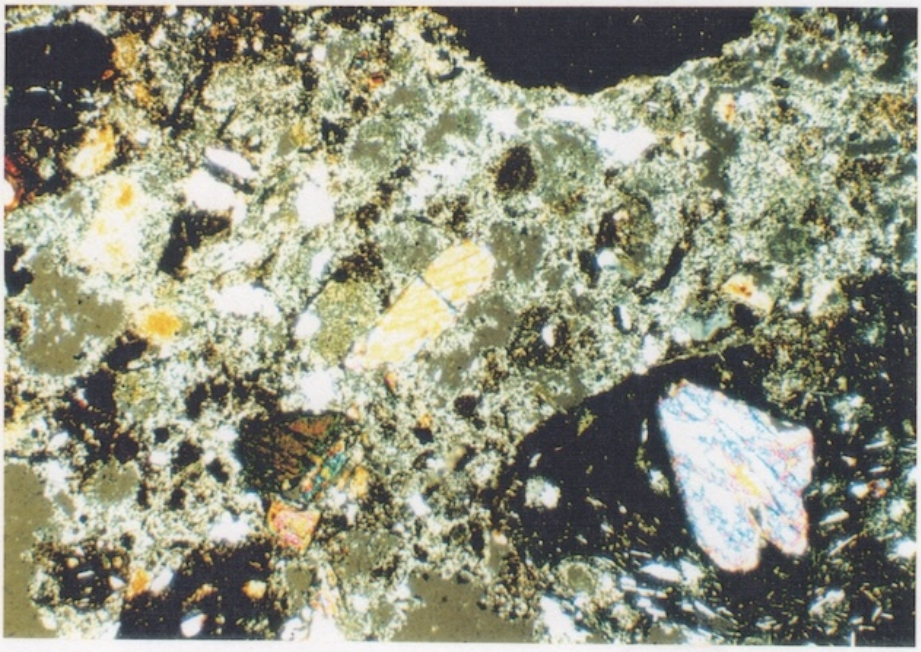
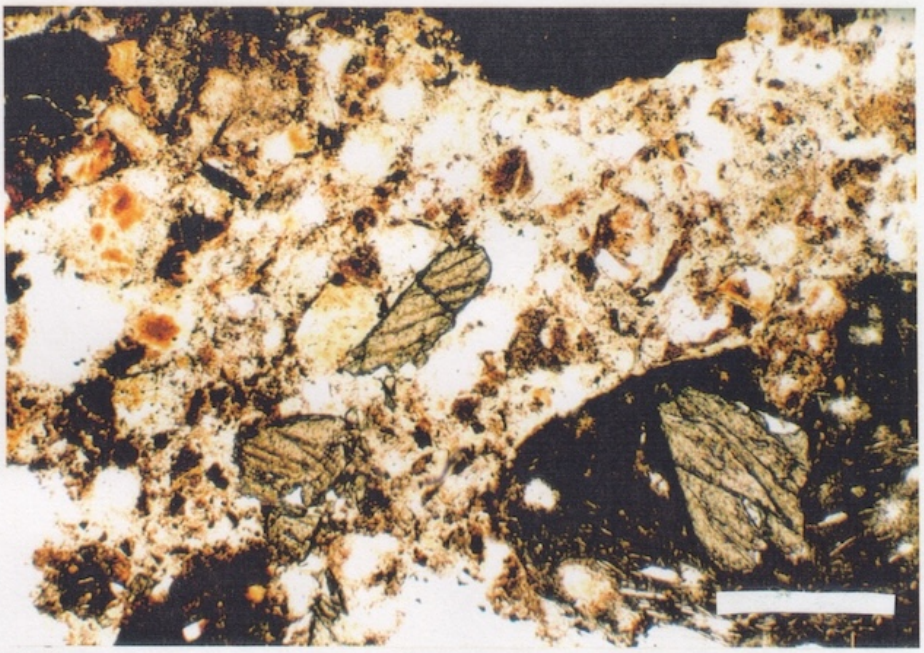


Plate 6. Volcanic conglomerate (94080610).

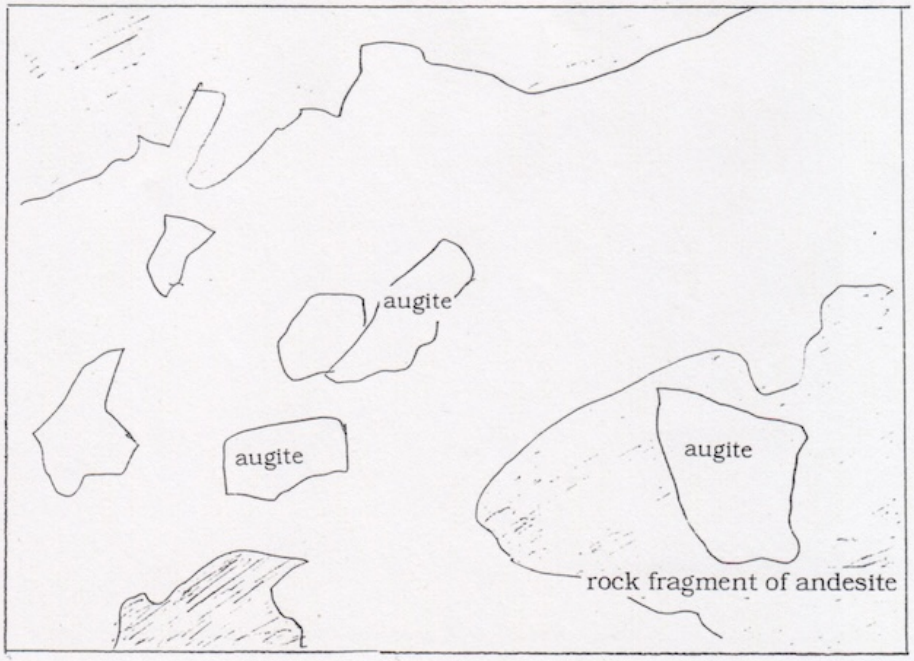


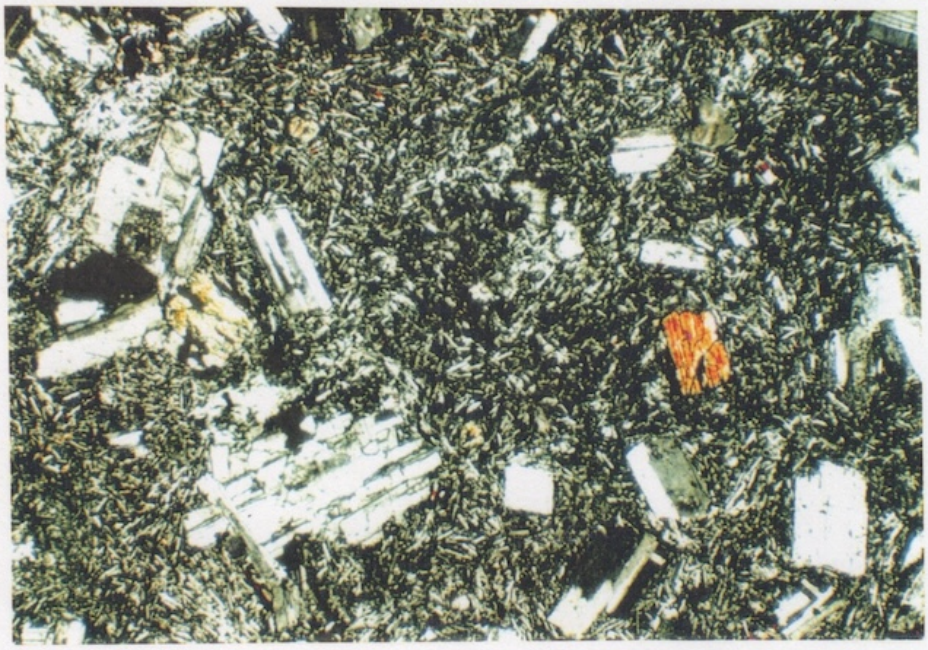


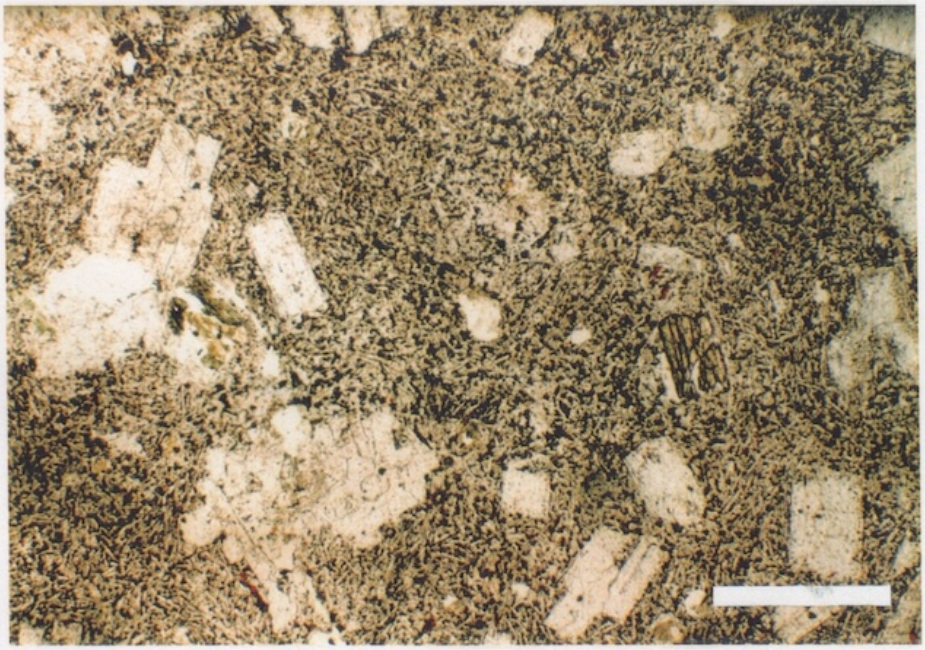


No. :94080102M
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture :
principle minerals :
plagioclase, augite
Accessory minerals :
magnetite
Altered minerals :

Plate 7. Matrix in the volcanic conglomerate (94080102M).







No. :94080102C
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : porphyritic, glomeroporphyritic
principle minerals : plagioclase(An26%), amphibole
Accessory minerals : augite, magnetite
Altered minerals : saponite, epidote, hematite

Plate 8. Pyroxene andesite in the volcanic conglomerate (94080102C).

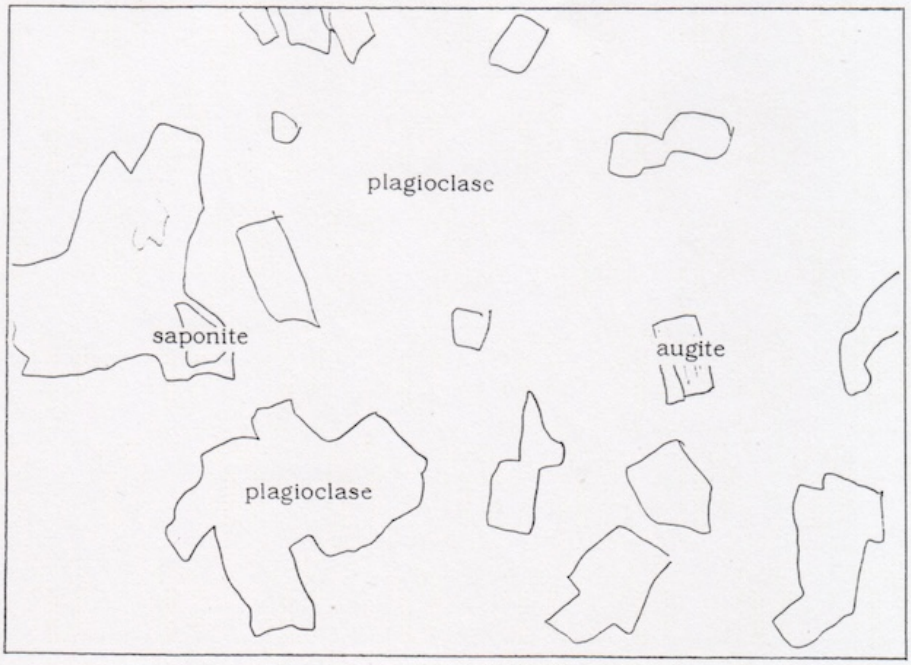
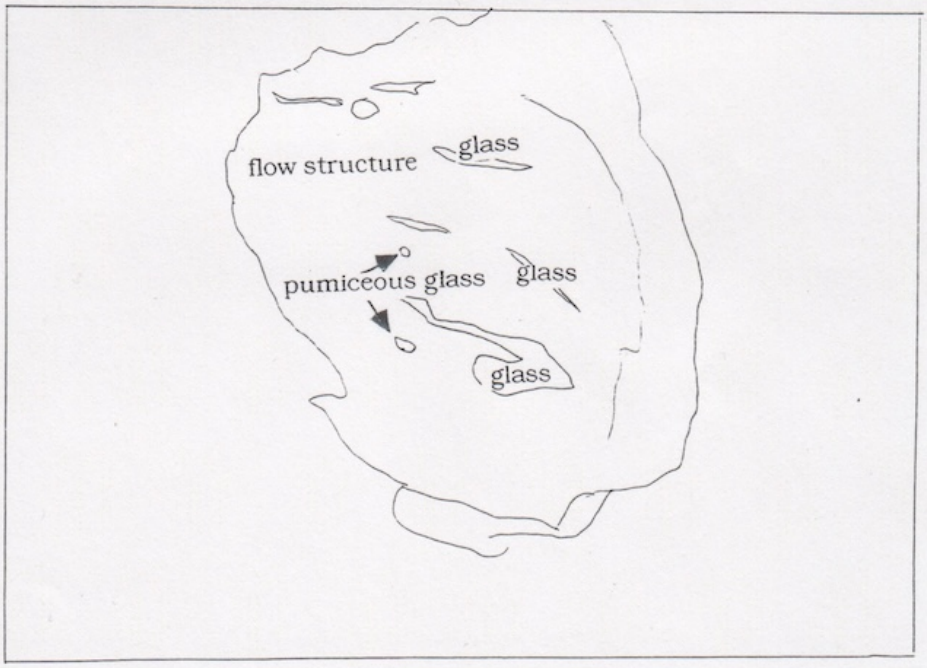
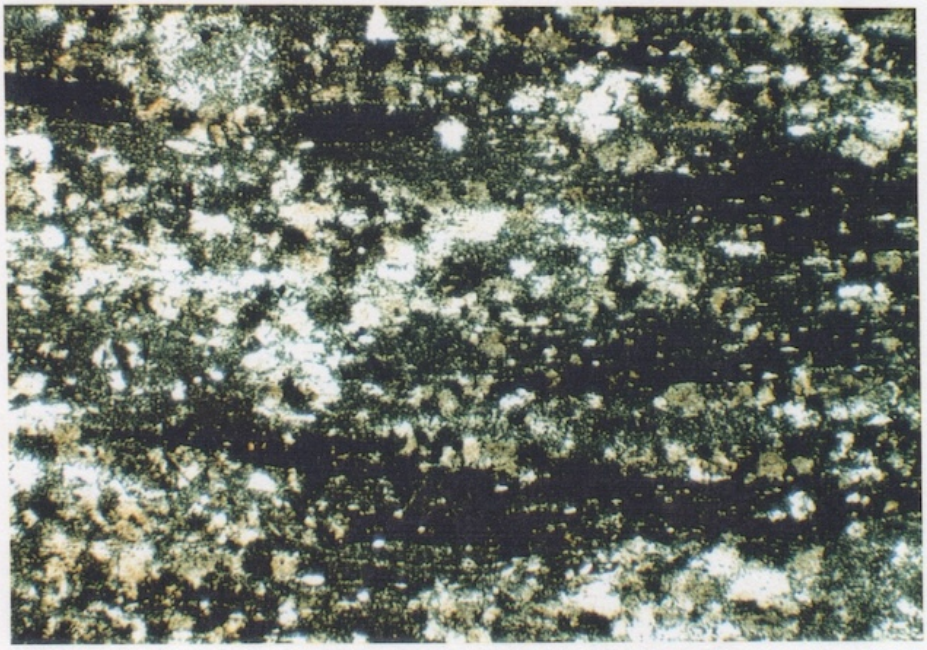


Plate 9. White dacite (94080106). Photomicrograph of this rock is shown in Photo. 10.

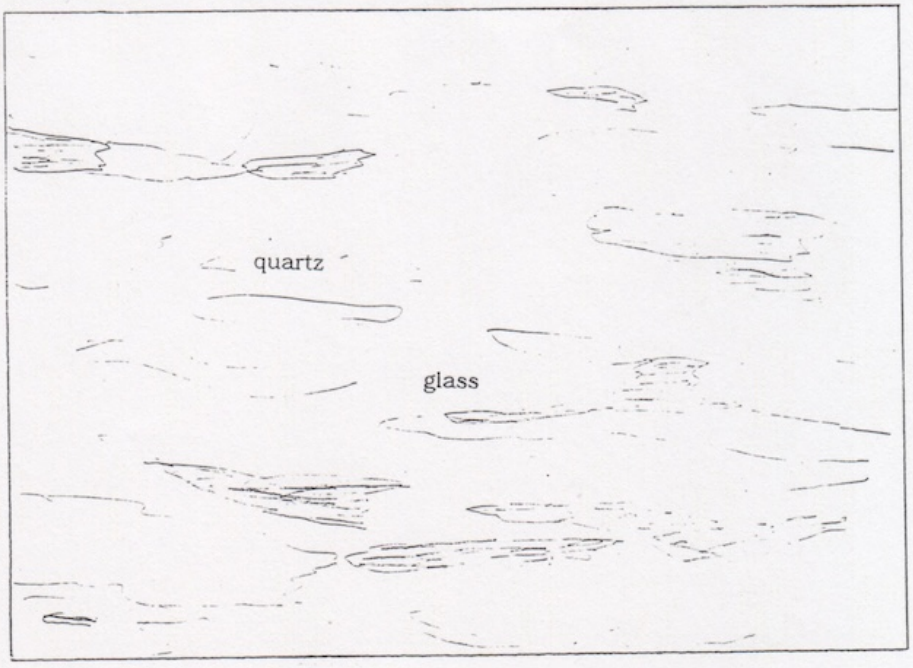


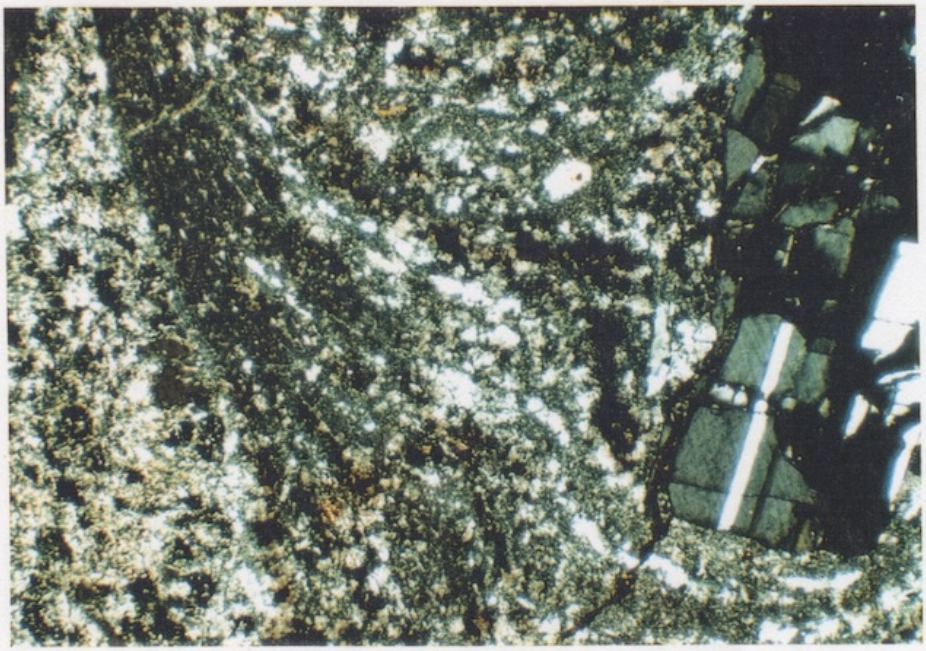


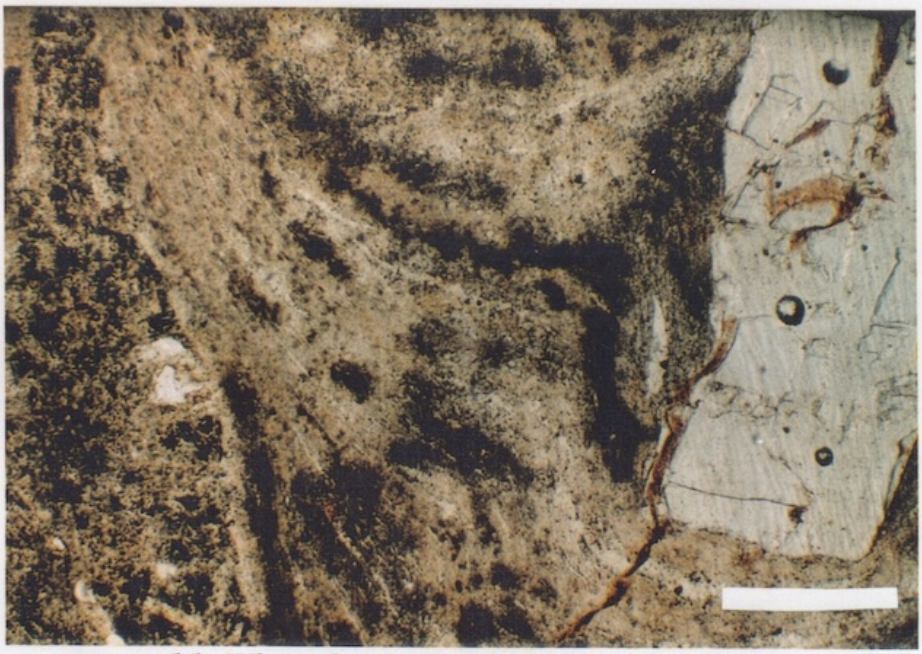
No. :94080106
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : fluidal
principle minerals : plagioclase(An25%), quartz
Accessory minerals :

Altered minerals : saponite

Plate . 10. White dacite (94080106).







No. :94082503
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : fluidal
principle minerals : plagioclase(An25%), quartz
Accessory minerals :

Altered minerals : sericite

Plate 11. White dacite (94082503).

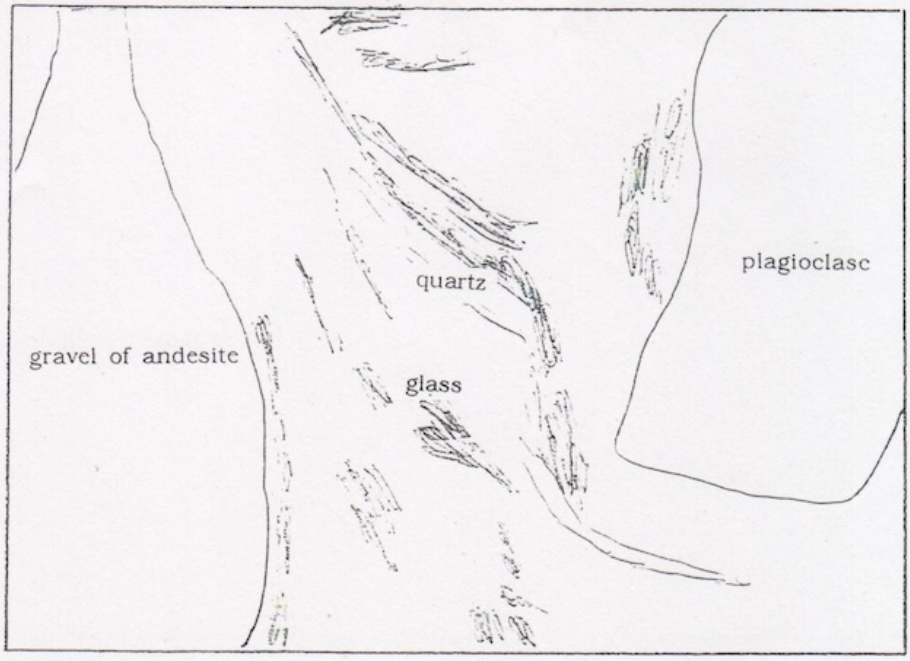
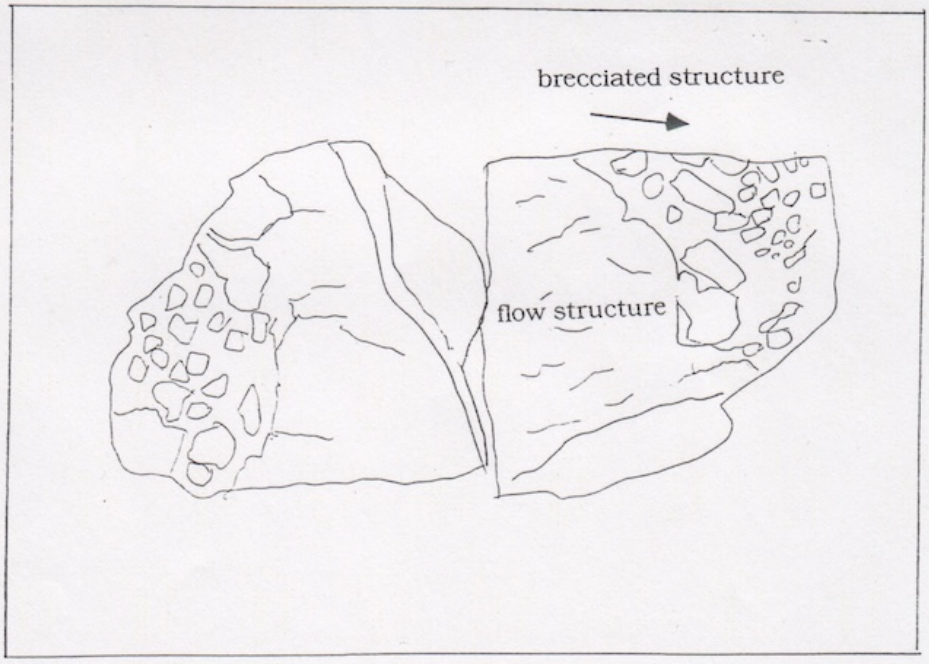
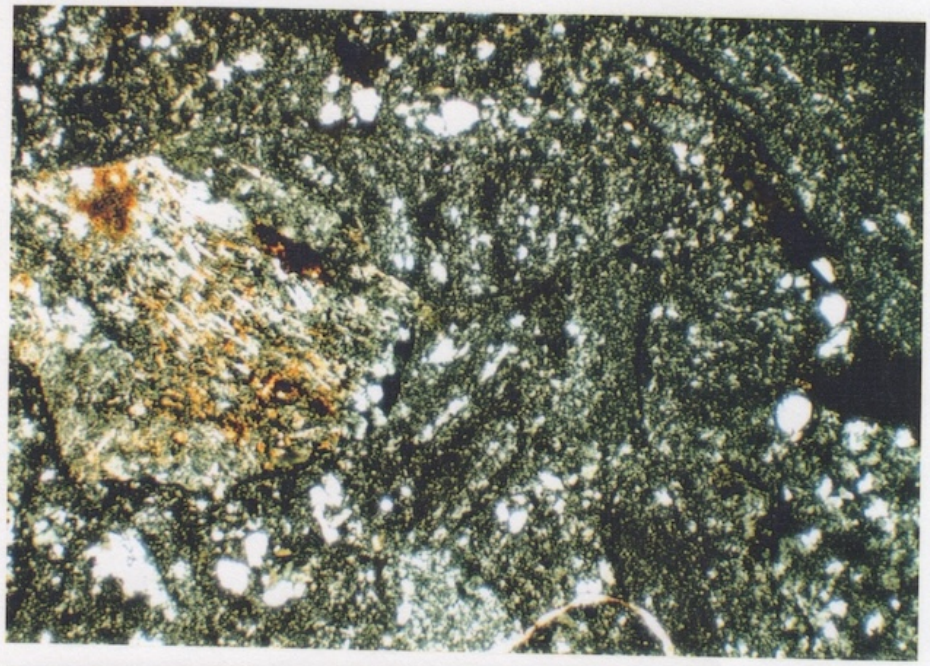
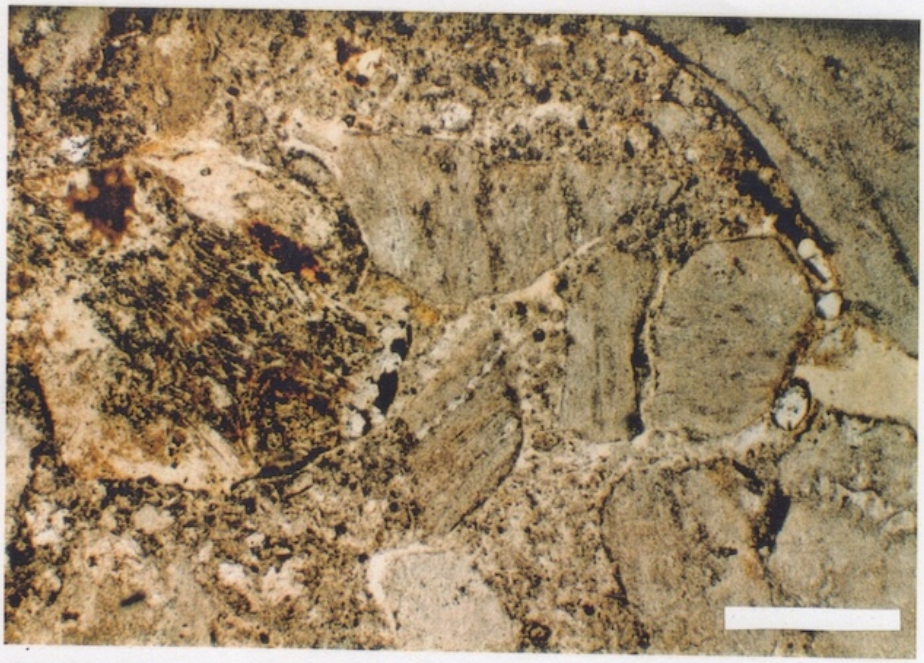


Plate 12. Autobrecciated lava of the white dacite (94090311).



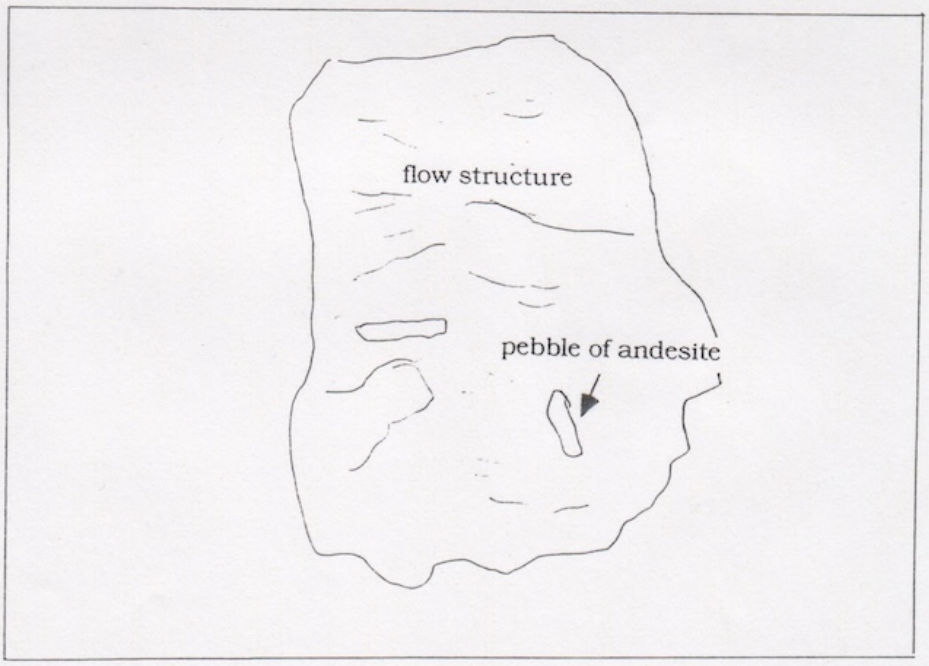


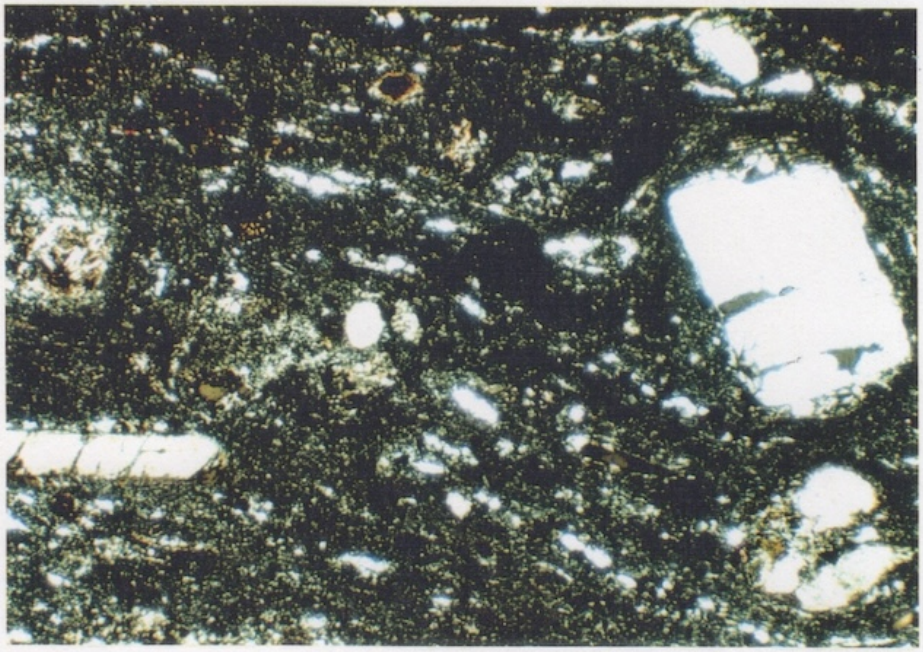


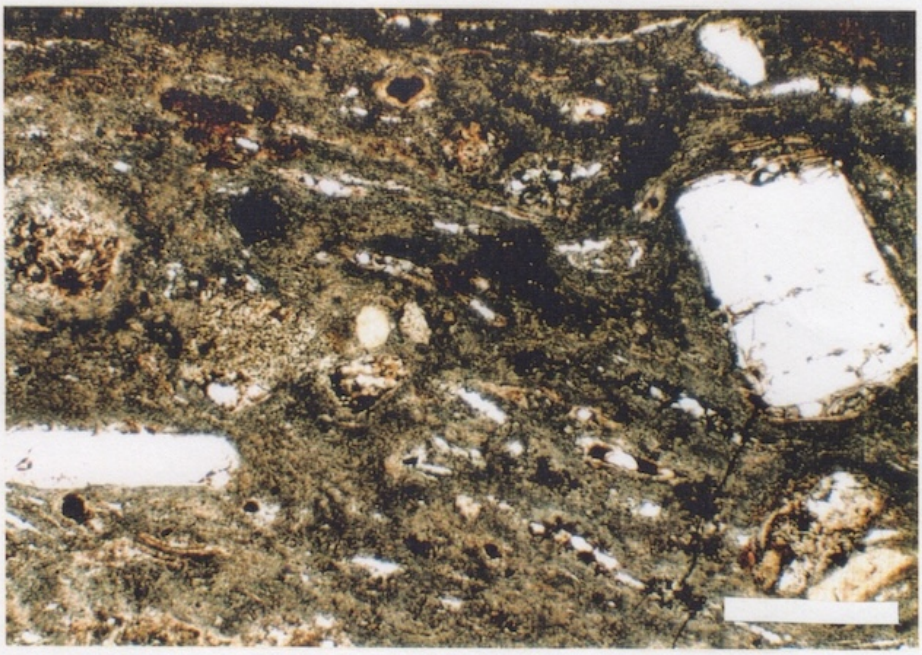
No. :94080105
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : fluidal
principle minerals : plagioclase(An25%), quartz
Accessory minerals : hypersthene
Altered minerals :

Plate 13. Autobrecciated lava of the white dacite (94080105).

Plate 14. Brown dacite (94090314). Photomicrograph of this rock is shown in Photo. 15.



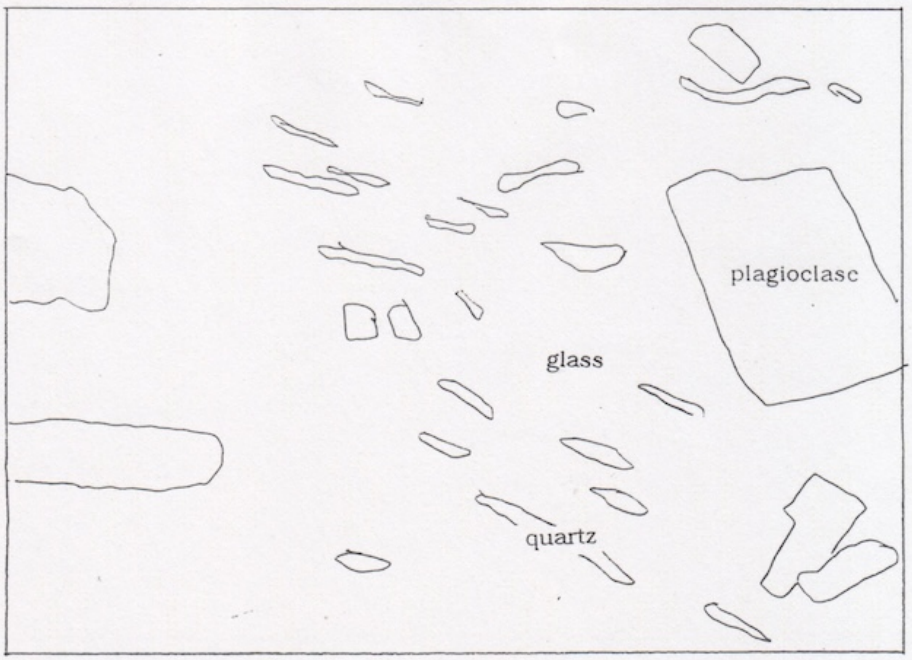


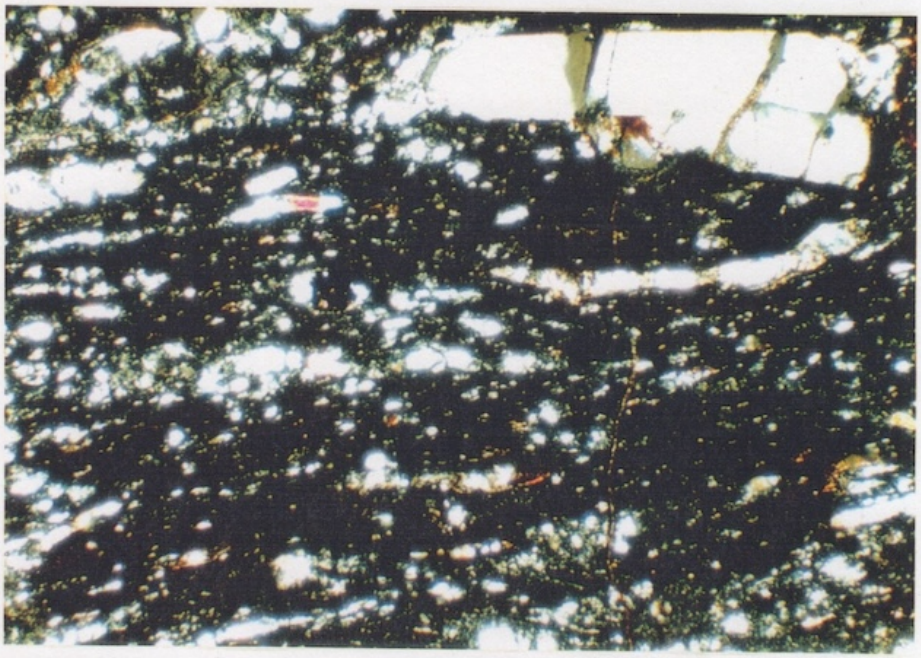


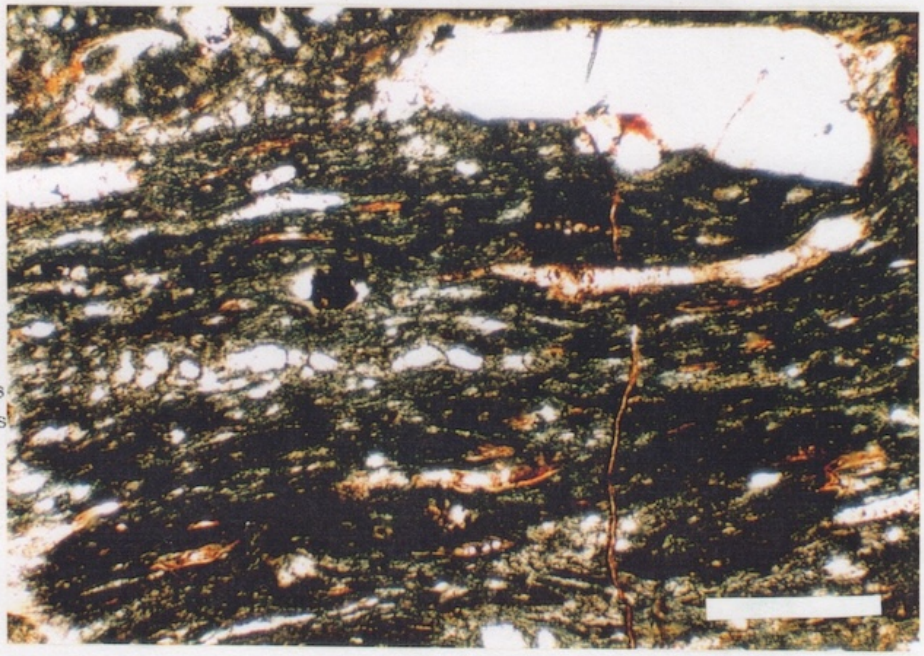
No. :94090314
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : fluidal
principle minerals :
plagioclase(An25%).
quartz
Accessory minerals :

Altered minerals :
sericite

Plate 15. Brown dacite (94090314).



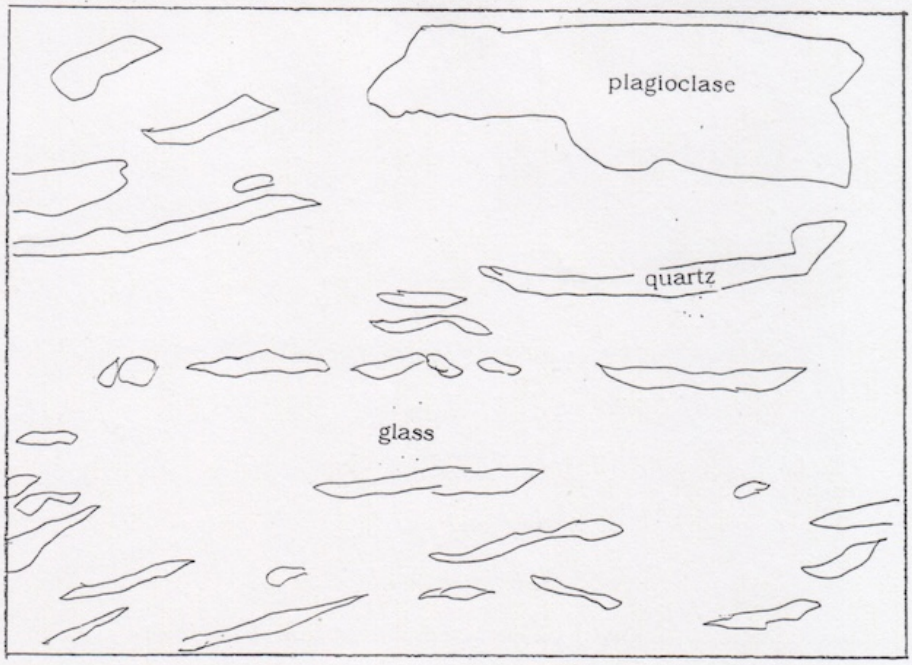


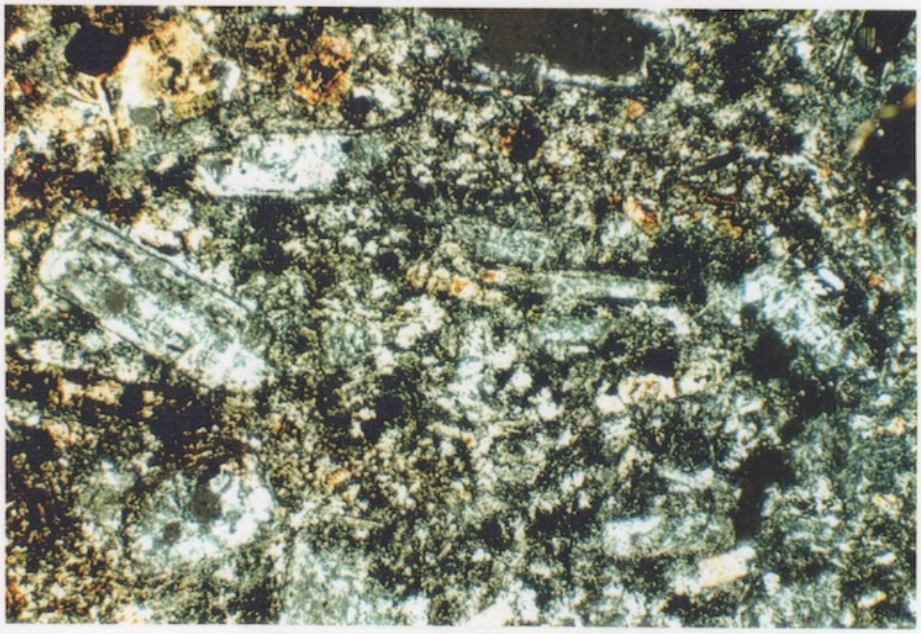


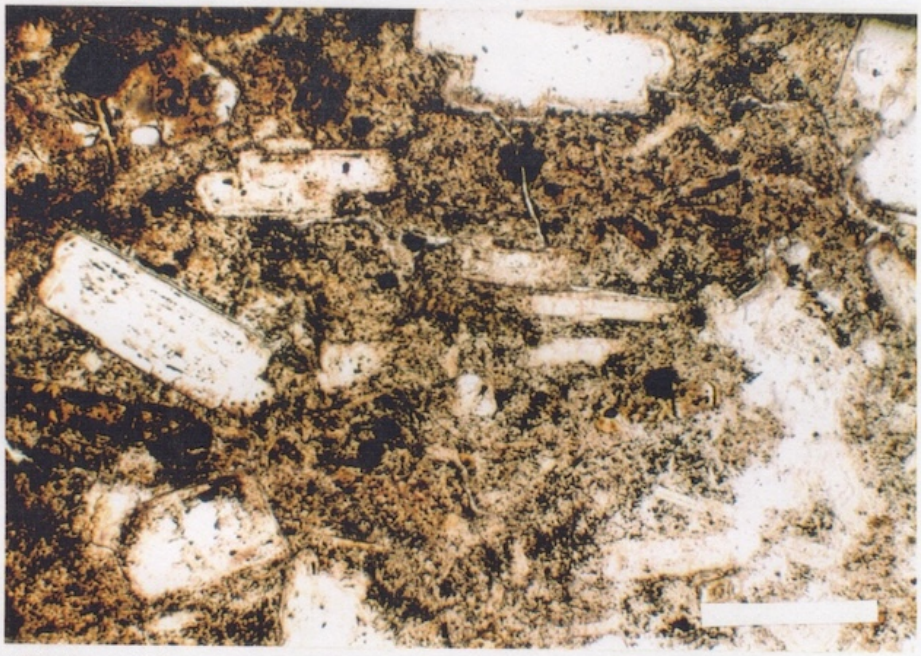
No. :94080211M
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : fluidal
principle minerals : plagioclase(An25%), quartz
Accessory minerals :

Altered minerals :

Plate 16. Brown dacite (94080211M).

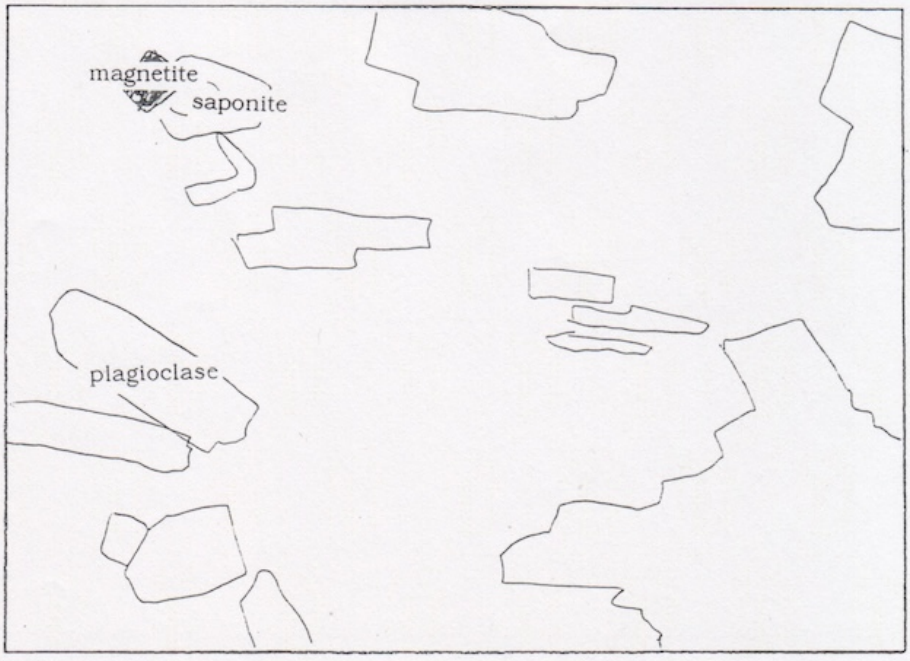


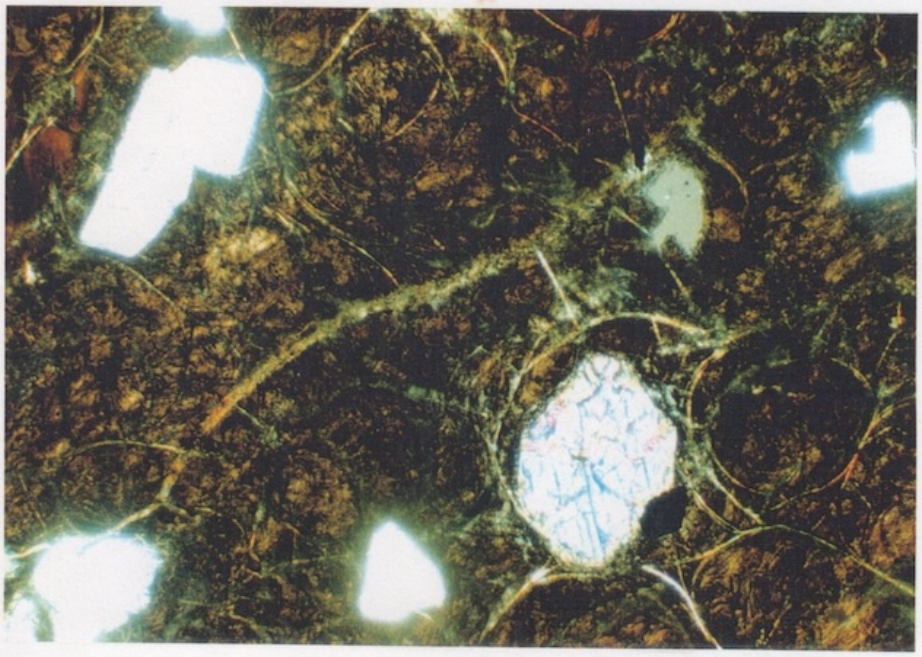


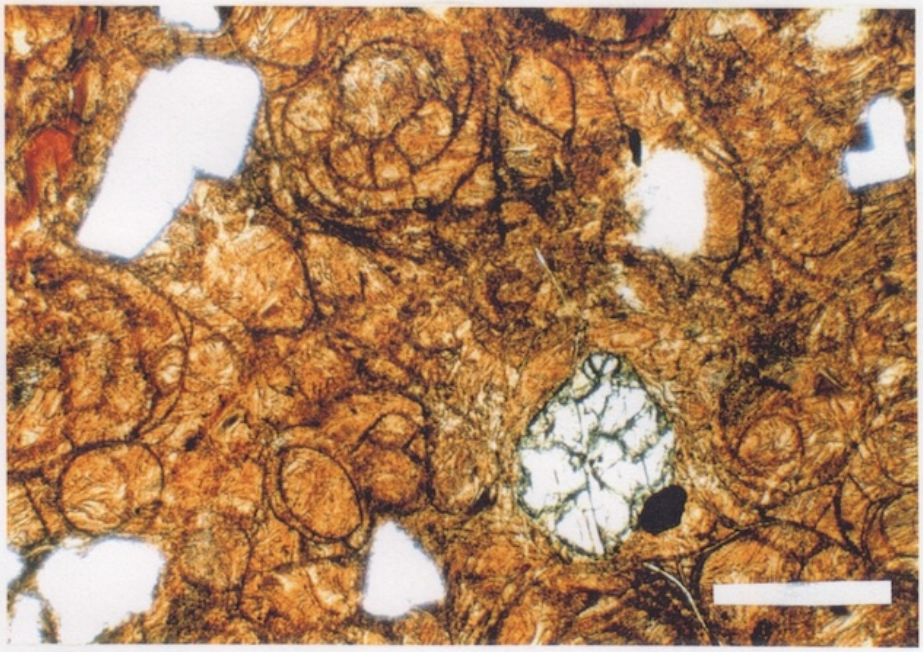


No. :94080211C
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : porphyritic
principle minerals : plagioclase
Accessory minerals : magnetite
Altered minerals : saponite. sericite

Plate 17. Gravel of andesite in the brown dacite (94080211C).

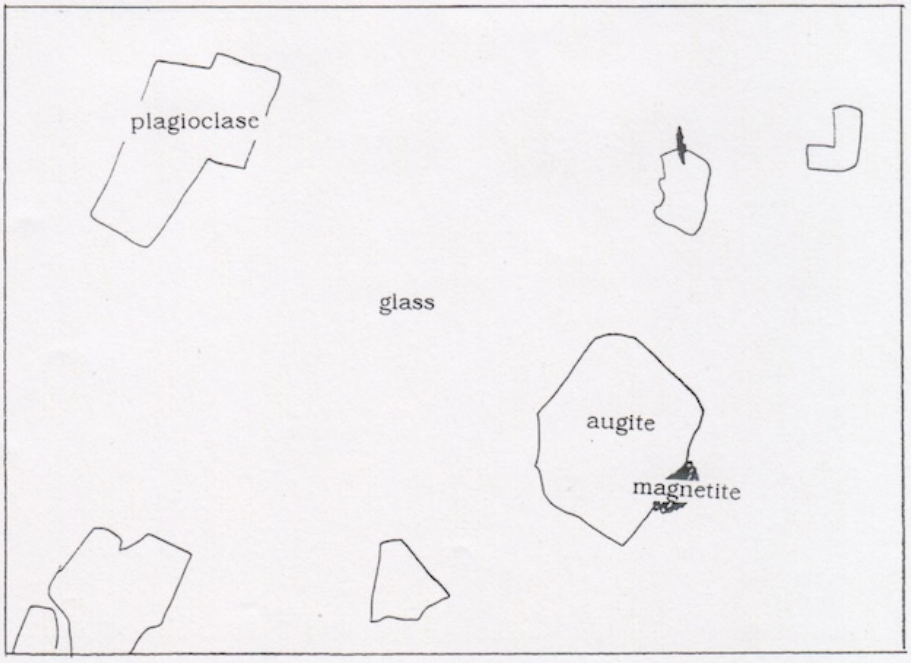


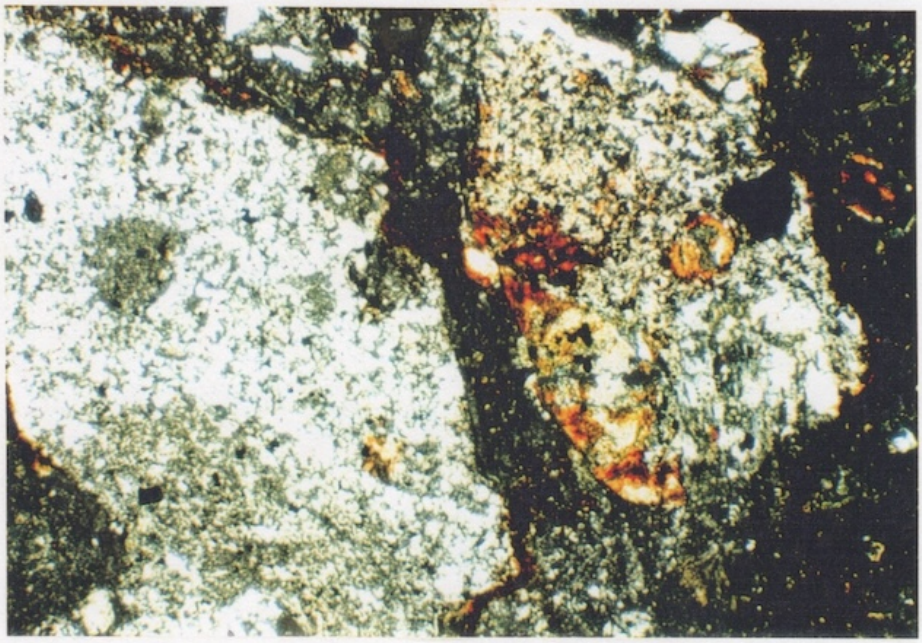


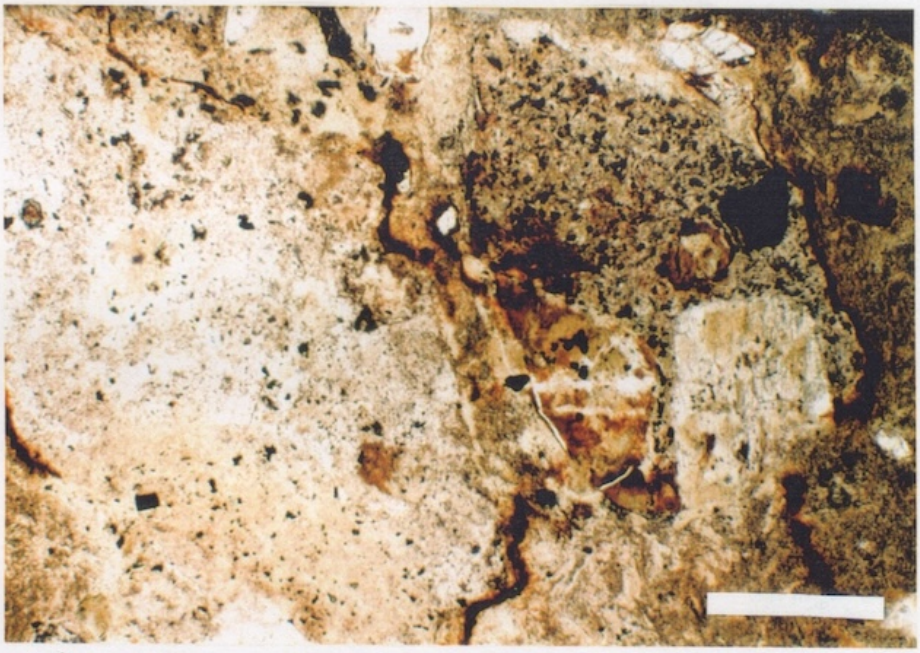


No. :94082706
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : perlitic
principle minerals : plagioclase, quartz
Accessory minerals : augite, magnetite
Altered minerals :

Plate 18. Perlite (94082706).

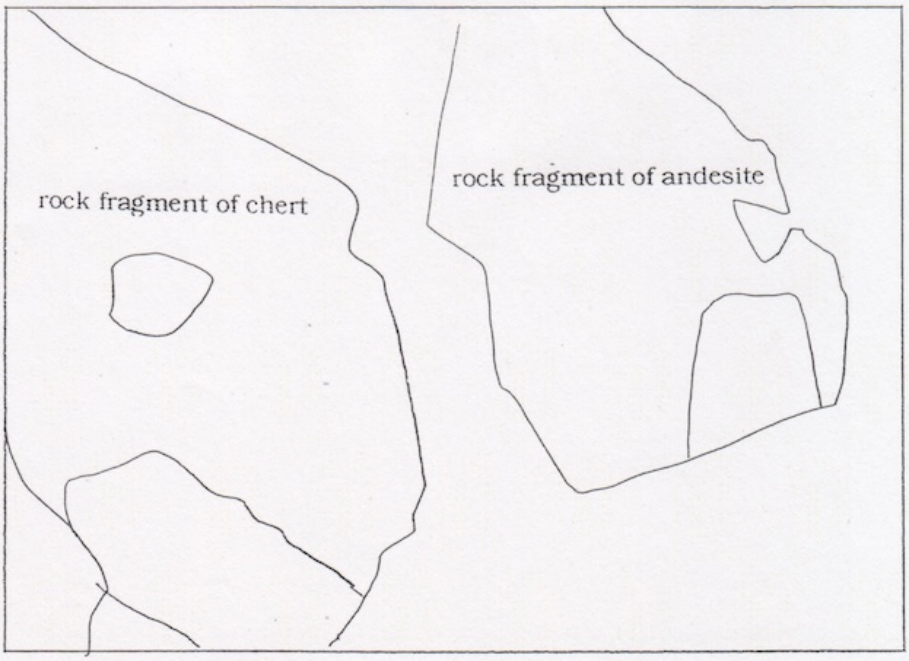


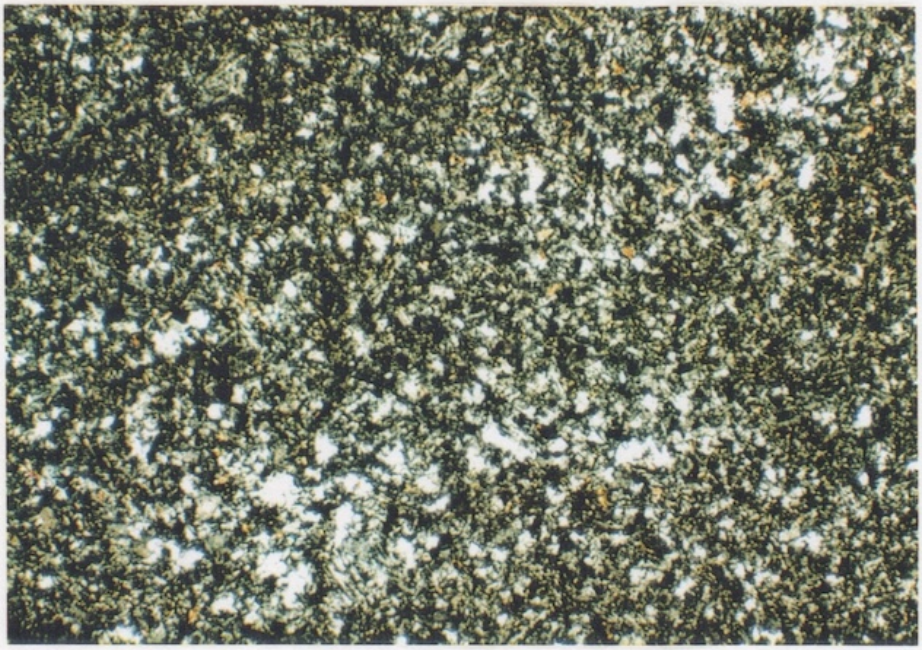




No. :94090309
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture :
principle minerals :
quartz
Accessory minerals :
magnetite
Altered minerals :

Plate 19. Lapilli tuff (94090309).





No. :94080316
Upper : crossed polars
Lower : opened polars
Scale bar 0.5mm.
Texture : aphyric
principle minerals : plagioclase, quartz
Accessory minerals : magnetite
Altered minerals :

Plate . 20. Dacite (94080316).