Bearing of "Shinshu Loam" on the Pleistocene Geology of Matsumoto Basin in Central Japan

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Introduction

This is the second paper which is to follow the first published in 1958, both forming a part of my discussions on the Pleistocene history of basin and range district of Central Japan. Among many publications on this line of discussions is a voluminous monograph published by HOMMA (1931) who concerned with the Cenozoic geology and geomorphology of the central part of Shinshu district. Unfortunately his discussions include many conclusions that are now hard to accept, but certain suggestions presented in his discussions are not always of little worth.

Outlines of geomorphic settings and development of the structural frameworks of Matsumoto basin and its surroundings were sketched out in my previous papers (KOBAYASHI, 1951, 1954 and 1958a).

One of the most outstanding superficial deposits in the Pleistocene sections is the volcanic ash formations that cover wide areas of land surfaces in Japan. The formations thus originating from the Pleistocene showering of volcanic ash are so conspicuous in appearance that they are popularly called "Loam". Although its consistency is not always corresponding with "the loam" in strict sense, the so-called "Loam" serves as an excellent time-marker only in the sense of aeolian Pleistocene volcanic ash. Taking advantages of this mode of occurrences, we may be able to investigate the events that happened during Pleistocene time (KOBAYASHI, 1959 and 1960).

The area I am to deal with in the present paper forms an upland as a whole being situated within altitudes ranging from the level of Matsumoto basin of 500 m to the summit regions of about 3,000 m and is covered extensively by the Pleistocene volcanic ash formations.

Matsumoto basin is situated between the Hida Ranges (the so-called "North Japan Alps") and the mountain ranges occupying the western part of the "*Fossa Magna*" – a peculiar Tertiary orogenic belt. The latter ranges with NS trend will, in this paper, be called the Hachibuse Ranges. Matsumoto basin may be a structural basin bordered by faultlines on both east and west sides and has been filled up by the Pleistocene graveliferous deposits which can, in broader sense, be classed as those of Younger and Older fans.

In the western portion of the basin where the eastern steep slopes of the Hida Ranges face eastward, steep piedmont slope fashioned by faulting is buried under the fill top of Younger fans, so that an abrupt change of gradient is strikingly exhibited along the mountain foot. In contrast with this feature on the west, the eastern border of Matsumoto basin is marked by a series of step-like surfaces of both erosion and deposition. Many fans flanking upon the surrounding mountains are illustrated in Fig. 5–9.

I Loam Formation as the Pleistocene volcanic Ash

1 Sources

The stratigraphic units which characterize the superficial deposits in the Pleistocene land sections of Shinshu district are the volcanic ash formations which are, in general usage, called "Shinshu Loam". The showering of ash might have taken place principally since the later half of the Pleistocene, so that they afford, in particular, a priceless clue to identify the time of terrace-building in this area.

Several volcanic centers belonging to the Norikura Volcanic Chains (Kozu, 1908 and 1911; Sameshima 1958) and to the volcanic chains in the so-called *Fossa Magna* have introduced, in many parts of Shinshu, a widespread distribution of the Loam formations.[(1)] Basing upon my surveys hitherto made in Central Japan, I should like to presumably attribute the sources that caused the ash showers to such volcanoes as:

Ontake Vol., Norikura Vol. and Tateyama Vol. (Norikura Volcanic Chains)
Hakusan Vol. or Tomuro Vol. (Hakusan Volcanic Chains)
Iizuna Vol., Kurohime Vol., and Myoko Vol. (Fossa Magna)

Fig. 1 is to indicate tentatively volcanic centers and occurrences of the Loam formations in Central Japan. This is rather a mental picture drawn based, in parts, upon my knowledges obtained from short trips for Loam huntings and upon various publications.

2 Special Remarks on Lithology

Loam is usually fine-grained, brownish in color. Remarkable parallel joint sets are indicated upon desiccated exposures. Stratified appearance is at times due to the intercalation of dark band, cracky zone and pumice bed, but no laminated structure is indicated within main part of Loam.

a *Dark band* (or *Black band*) The dark band is a visible sign of buried soil layer. The darkness is due to mixing of carbonaceous materials of organic origin and also of weathered mineral grains. It may be an indication of a prolonged duration of vegetation growth. It is loose in consistency, even in the case when sign is less distinct and hard to be detected. Evidence in weathering is also recognized in the fact that within Dark band are detected more amounts of grains of weathered minerals and limonite than the other parts. There will be no objection to call the well-developed Dark band "fossil soil", as "fossil soil" is defined as "a soil developed upon an old land surface and later covered by younger formations" (*Glossary of Geology and Related Sciences*, 1957, p. 115).

As Dark band is less coherent, it is easily weathered and collapsible at exposures. It is often marked by vertical joint sets smaller in scale (Fig. 2 and Pl. 2, Fig. 3).

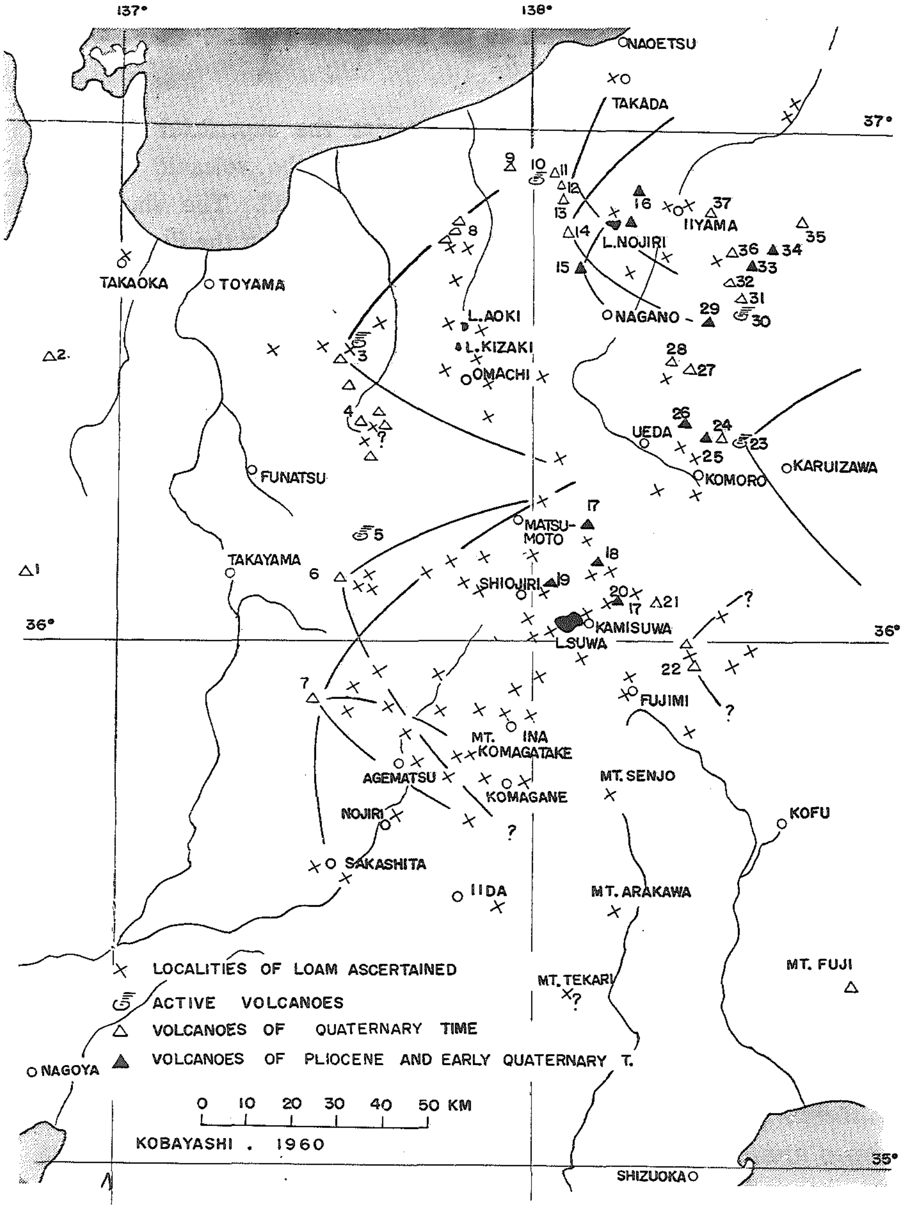


Fig. 1 Distribution of Pleistocene volcanic ash in Central Japan.
× localities from which I collected samples of Loams, partly based upon literatures concerned with Loams in northern Shinshu (SAITO et al., 1960 ; TAKANO et. al., 1960) (3), and upon personal conversation with Iijima. *Names of volcanoes* 1 Hakusan, 2 Tomuroyama, 3 Tateyama (active), 4. Jiidake, Warimodake, Washiba-ike and Momisawadake, 5 Yakedake (active), 6 Norikuradake, 7 Ontake, 8 Shirouma Norikuradake, Kazefukidake and Ebiradake, 9 Nokogiridake and Kimenzan, 10 Yakeyama (active), 11 Hiuchiyama, 12 Myokosan, 13 Akakurayama, 14 Kurohimeyama, 15 Iizunayama, 16 Madaraoyama, and Kenashiyama 17 Utsukushigahara, 18 Mitsumine, 19 Higashiyama, 20 Kirigamine, 21 Tadeshinayama, 22 Yatsugatake, 23 Asamayama (active), 24 Kurofuyama, 25 Takaminesan and Sambogamine, 26 Eboshidake, 27 Azumayasan, 28 Nekodake, 29 Omeshidake, 30 Shiranesan (active), 31 Yokoteyama, 32 Shigayama, 33 Iwasugeyama, 34 Eboshidake, 35 Naebayama, 36 Yakebitaiyama, 37 Takayashiroyama.

b *Cracky zone* This may be a weathered zone as an indication of former land surface of prolonged duration. It is recognized at desiccated exposures as dark zone marked by characteristic growth of joints sets(Pl. 3, Fig. 7). Although Cracky zone is usually covered by another unit of Loam formation, it may be generated from authigenic transformation that lasted chiefly before the succeeding deposition of overlying unit. The feature may demonstrate a prolonged pause of ash falls, when land surfaces underwent a subaearial weathering. There is, however, no marked indication of former luxuriant growth of vegetation upon the surface. Considering the values of hiatus suggested by Cracky zone, we may ably separate two units of Loam lying one upon another. The generation of Cracky zone and Dark band are recognized also upon an older gravel bed and other rock units when they retain a cover of Loam.

c *Pumice bed* Pumice bed embedded in Loam exhibits a striking appearance tinted often in bright red color and carries the name "Miso tsuchi" (3) in aboriginal word.

Although very weak distinction of tincture affected by oxidation of various degrees is expressed from the top downward in the Loam section, striking difference of tinctures is often indicated by those of pumice beds. As is often observed, when three pumice beds are enclosed in the Loam section, the upper one is altered to bright red, the middle so to yellow and the lower remains white in color. This distinction of tinctures of pumice beds seems likely to have originated from the differences of degrees of oxidation which took place from ground surface downward.

A certain member of the Loam formations is characterized by the occurrence of several pumice beds and abundant pumice fragments, accordingly pumice bed serves as usable key bed for identification of stratigraphic situation of the carrier (Fig. 2-3; Pl. 2, Fig. 4).

II Stratigraphy and Modes of Occurrences of Shinshu Loams

Forewords The so-called Shinshu Loam is to be defined as "the mainly aeolian ash formations that have originated from the Pleistocene volcanisms and distribute roughly over a whole extent of Shinshu district". As the primary materials have been supplied from many volcanic sources, several types of stratigraphic succession of Loam are discriminated. A type of Loam succession which I am to concern with here is observable in the environs of southwestern part of Shinshu and consisted of such four units as Hata Loam, Osakada Loam, Nishibayashi Loam and Enrei Loam in descending order (Table 1.) In the area near the type locality at Osakada east of Shiojiri, the Loam formations are as thick as 7 m or more. They are much thicker westward up to more than 10 m and lessen the thickness thinning away toward the north and the south.

At many places are observed fluviatile deposits being associated more or less with ash falls.

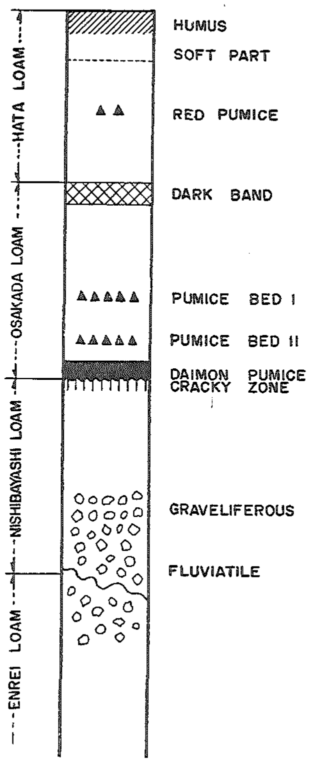


Fig. 2 Schematized columnar section of Shinshu Loams

1 Hata Loam (4)

a Modes of occurrences At type locality, Hata Loam covers with no remarkable hiatus the gravels of Younger fan, the fill top of which is called "Hata terrace" that is, at the same time, the fill top of the piedmont alluvial fans extending widely over Matsumoto basin. The thickness is about 2 m or more upon the Hata terrace at type locality and is fairly uniform upon this terrace and its correlatives, but the thickness is less than 2 m then often down to less than 1 m upon the Moriguchi terrace and its correlatives. No covering of Hata Loam is recognized upon the terraces lower than the Moriguchi terrace and of course upon flood plains. The varied thickness of Hata Loam upon these terraces varying in altitudes should naturally be understood as an indication of subaearial deposition of primary materials of Loam. Table 5 gives an illustration of every Loam unit upon various land surfaces. Similar mode of occurrence of Loam upon terraces will accordingly afford crucial criteria in identifying the contemporaneity of the times of terracing.

b Lithology Hata Loam is a little more reddish brown than the other Loams. The upper part of about 20 cm is loose, without jointing and is usually called "*Soft Loam*". In the lowest part, fine-grained scoriaceous materials are scattered in patches, but no pumice grains is usually visible. At the middle horizon is observed on very rare occasions scanty amount of pumice fragments of red pumices (Red pumice horizon). Upon the Kakizawa terrace which will later be mentioned, scattered pumice fragments are included in Hata Loam being characterized by the excess of hypersthene over magnetite. Hata Loam is covered by black humus, the base of which seems in many cases to overlie conformably the former. Archaeological finds with Palaeolithic aspests characterize the human cultures prospered during the time of deposition of Hata Loam.

c Heavy mineral composition Loam as originated from the Pleistocene volcanic ash consists essentially of rock-forming minerals found in normal volcanic rocks,

Table 1 Stratigraphic succession of the Loam members and associate formations in the southwestern part of Shinshu district.

	Stratigraphic units	Lithology	Prehistoric cultures etc.
Holocene	Humus		Jomon Culture——Ceramic Earliest Jomon { Gotobayashi, Hizawa, Yanagimata } (Magnetic direction Normal)
Würm glacial	Hata Loam	Soft part (Soft Loam) Hard part (Hard Loam)	(Mesolithic ?) Non-Ceramic { Mikoshiba, Koyashiki, Omegura I, II, III, Uenotaira ?, Chausuyama } (Magnetic direction Normal)
Würm glacial	Dark band	humus	Little Interval
Würm glacial	Osakada Loam	Pumice bed III Pumice bed II Pumice bed I (Daimon pumice bed)	Magnetic direction : Normal
			Erosion Interval
Mid. Pleistocene	Nishibayashi Loam	chocolate-colored Cracky zone non-graveliferous	Magnetic direction : Normal
Mid. Pleistocene	Osakada formation (fluviatile bed)	loamy and graveliferous	Akagiyama flora
			Big Erosion Interval
Pliocene	Enrei Loam (Enrei formation)	Loam-like appearance in the upper part	Magnetic direction : Reversed *Metasequoia disticha* (lowest part)

·················conformity ——————disconformity

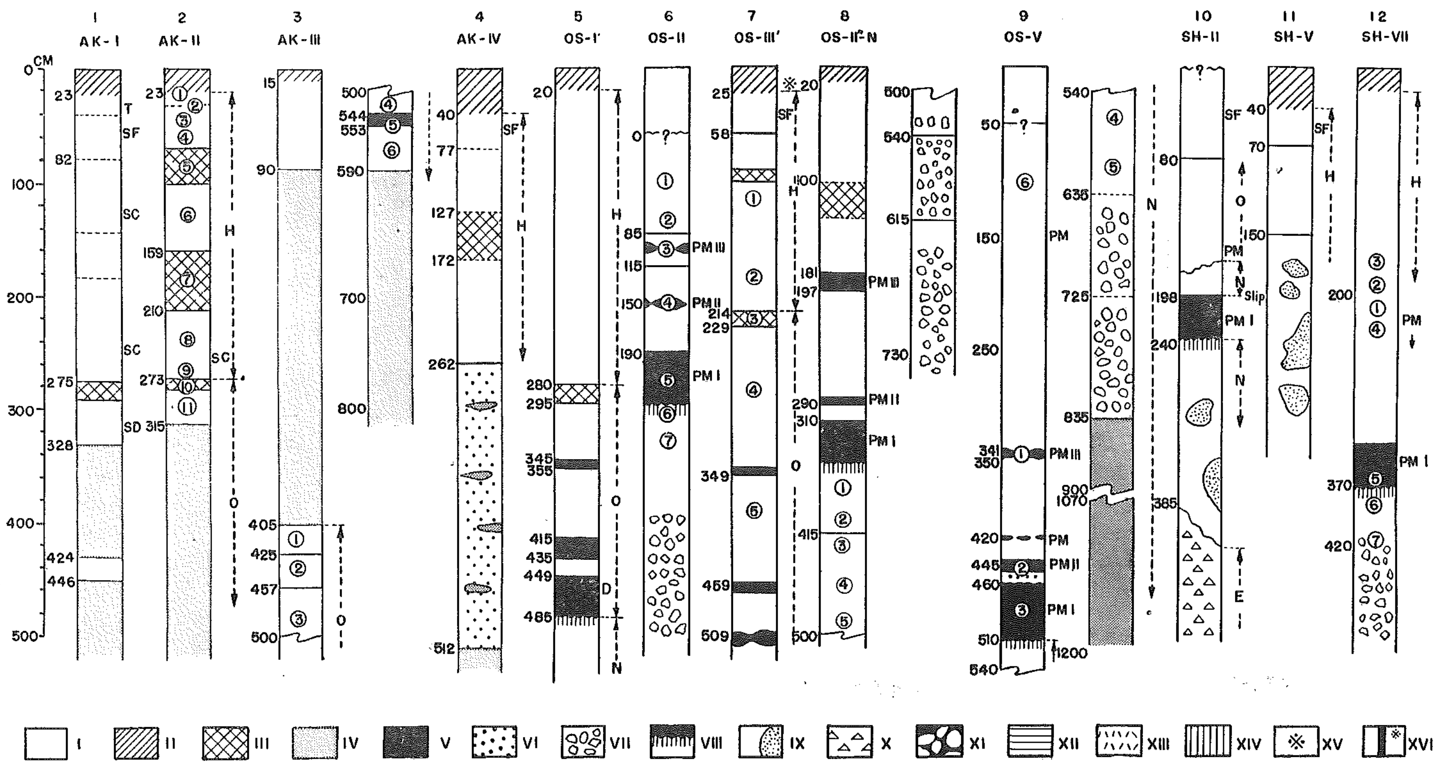

1 AK-I
2 AK-II
3 AK-III
4 AK-IV
5 OS-I'
6 OS-II
7 OS-III'
8 OS-II'-N
9 OS-V
10 SH-II
11 SH-V
12 SH-VII
0 CM
100
200
300
400
500
I II III IV V VI VII VIII IX X XI XII XIII XIV XV XVI

Fig. 3a Columnar sections of Shinshu Loams at various localties

Localities are put in Fig. 5, 8 and 9.

I : Loam, II : humus, III : Dark band, IV : Gravels, V : Pumice, VI : Sand, VII : Breccias VIII : Cracky zone, IX : Boulders, X : Tuff-breccias, XI : Gravel veneer, XII : Sandy clay, XIII : Tuffaceous clay, XIV : Disturbed zone, XV : Cultural layer, XVI : Depth range of stone implements

T : Transitional zone, SF : Soft Loam, SC : Scoriaceous, SD : Sandy Loam, H : Hata Loam, O : Osakada Loam, N : Nishibayashi Loam, PM : Pumice bed, D : Daimon pumice bed, E : Enrei formation, OU : Upper Onozawa formation, OL : Lower Onozawa formation, RPM : Red pumice horizon

Explanations of columns 1 : Akasakabashi I (AK-I). Fig. 5, east of Koikebarashinden, type locality of Hata Loam situating upon the Hata terrace. Dark band is shown in the middle part of Loam. /2 : (AK-II) a site upstream from AK-I. Dark band is shown. Numbers encolsed in small circles denote the numbers of samples collected. /3 : (AK-III) Osakada Loam enclosed within gravels. /4 : (AK-IV) Dark band. /5 : Osakada I'(OS-I') three Loam units upon the Osakada terrace near Osakada Park. /6 : (OS-II) Three pumice beds, Pm I, Pm II and Pm III in ascending order. /7 : (OS-III') Stratigraphic relation of Osakada Loam with Hata Loam. /8 : (OS-II"-N) graveliferous lower part of Nishibayashi Loam. /9 : (OS-V) Osakada formation underlying conformably Nishibayashi Loam. /10 : Shiojiritoge II (SH-II) A site near Nishibayashi. Landslide happened after the deposition of Pm I (D), "slip" indicates the slip plane/11 : (SH-V) A site at Onodachi. Boulders included in the lower part of Hata Loam. /12 : (SH-VII) Weak traces of Dark band. Graveliferous part of Nishibayashi Loam.

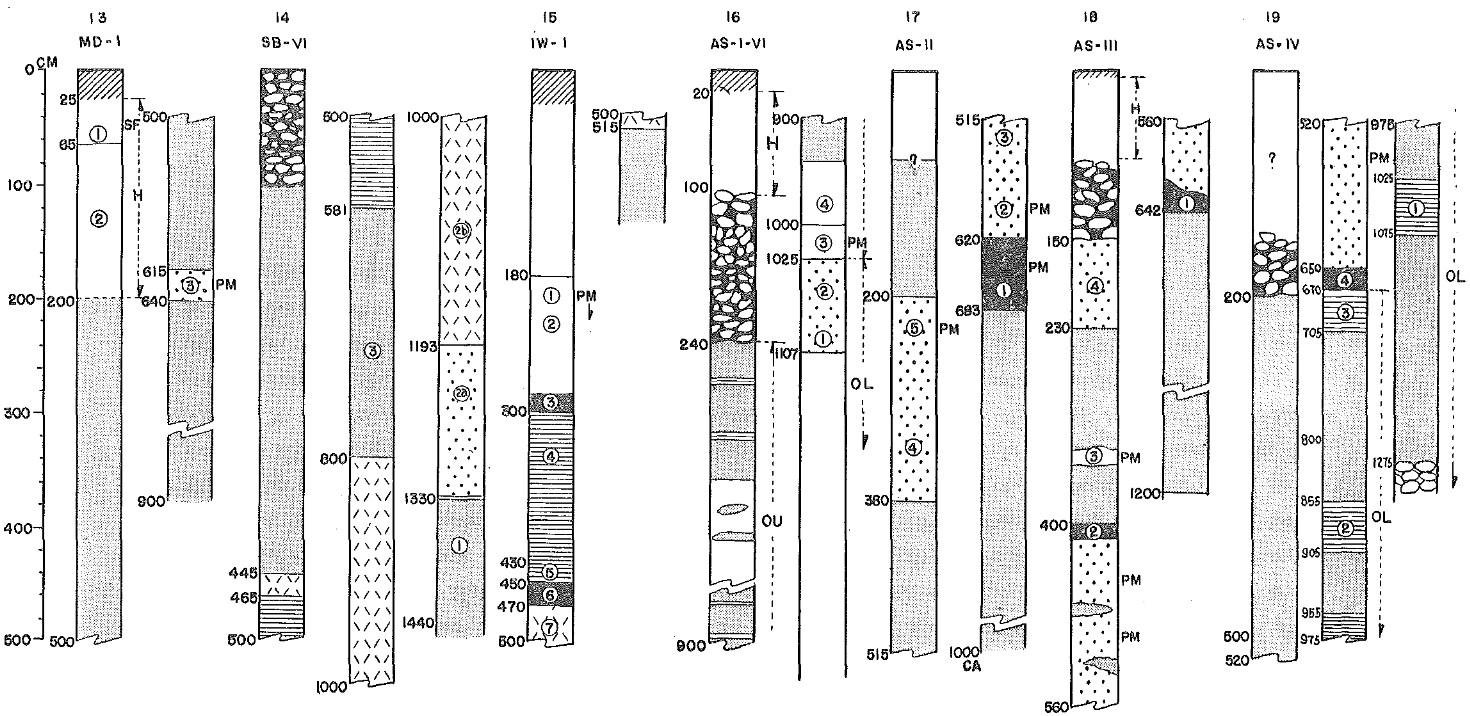
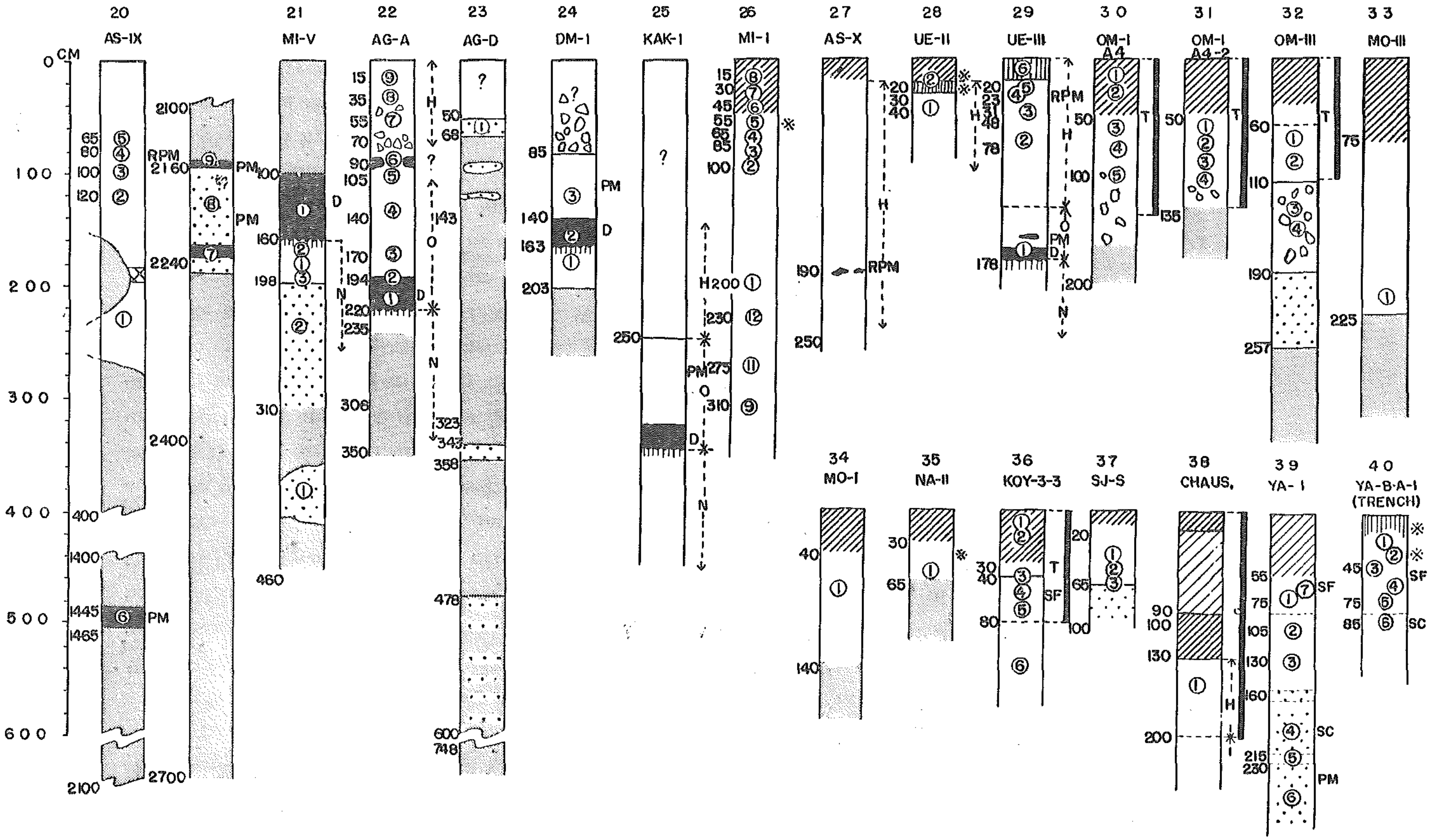


Fig. 3b *Explanations of Columns.*

13 : Midori-ko I (MD-I) Pumiceous sand embedded in the Kakizawa formation, the correlative of the Upper Onozawa formation. /14 : Seba Ogake VI(SB-VI) A cliff lacking of covering of Hata Loam, the correlative of Osakada Loam. Below the Gobara terrace tuffaceous sand layers are shown. /15 : Iwadare I (IW-I) Loam and pumice bed with water-deposited facies at an exposure on the right bank of the Kosobugawa. /16 : Asahi I-VI (AS-I-VI) The upper Onozawa formation and the gravel veneer. The upper part of this column is sketched from the site I, the lower part from the site VI. /17 : (AS-II) The occurrence of pumice is shown in the Upper Onozawa formation, whereas the absence of pumice is shown in the Lower Onozawa formation. /18: (AS-III) the same. /19 : (AS-IV) Loamy clay layers embedded in the Lower Onozawa formation.



20 AS-IX
21 MI-V
22 AG-A
23 AG-D
24 DM-1
25 KAK-1
26 MI-1
27 AS-X
28 UE-II
29 UE-III
30 OM-I A4
31 OM-I A4-2
32 OM-III
33 MO-III
34 MO-I
35 NA-II
36 KOY-3-3
37 SJ-S
38 CHAUS.
39 YA-1
40 YA-B-A-1 (TRENCH)
CM
0
100
200
300
400
500
600
RPM
PM
D
H
O
N
T
SF
SC

Fig. 3c *Explanation of columns*

20:Asahi IX (AS–IX) Pumice in the Upper Onozawa formation. Red pumice horizon is also indicated in Hata Loam. /21 : Mikoshiba V (MI–V) A exposure at Yakushido east of Mikoshiba site, showing pumice bed and weathered zone that might perhaps be former desiccated river floor. /22:Akagiyama A (AG–A) An exposure by a destroyed dam, showing the sections resembling those illustrated in the figure 3–8, 9 and 12. /23 : (AG–D) Water-deposited graveliferous part below Nishibayashi Loam. /24 : Daimonzawa 80m terrace (DM–I) An exposure not dissimilar to those illustrated in the figure 3, 8, 9, 12 and 22. /25 : Kakumashinden I (KAK–I) An exposure near Kakumashinden north of Suwa,. Difference in tincture and the presence of pumice permit to discriminate Osakada Loam from Hata Loam, even in the case that no dark zone is indicated. /26 : (MI–I) Cultural layer of Mikoshiba site. /27 : (AS–X) Red pumice horizon near Ujigami. /28 : Uenotaira II (UE–II) The stratigraphic situation of obsidian flakes obtained from test boring made at Uenodaira site. Immediately below the disturbed layer, is the top of hard Loam. /29 : (UE–III) A cliff close to the site, dark zone is not recognized. Hata Loam is distinguished by its tincture from Osakada Loam. /30:Omegura I (OM–I) The 4th section of Trench A. Trace of mass-movement is shown below the depth of 50cm. /31 : (OM–I) the same. /32 : (OM–III) A section revealed through excavation upon the higher terrace above the terrace of OM–I. The lower part is gravel bed of fluviatile origin. /33 : Moriguchi III (MO–III) Hata Loam near Hata railway station. /34 : (MO–II) Hata Loam near Anyoji east of Hata. /35 : Nakamura II (NA–I) Reworked Loam with sandy composition, it yields fragments of potteries of the middle Jomon. The site locates upon the Lower Imaihara terrace. /36:Koyashiki 3–3 (KOY–3–3) Hata Loam and contained cultural layer, east of Ontake Volcanoes. /37 : (SJ–S2) Loam covering the glacial moraine in the Senjojiki cirque of Mt. Komagataka in the Central Japan Alps. / 38:Chausuyama (CHAUS). A section sketched by SUGIHARA, showing the disturbed succession. /39 : Yanagimata I(YA–I) A typical section near Yanagimata site. The lower part is very scoriaceous. /40: (YA–B • A–I) A section revealed through excavation, at Trench A of Site B. Two cultural layers are indicated.

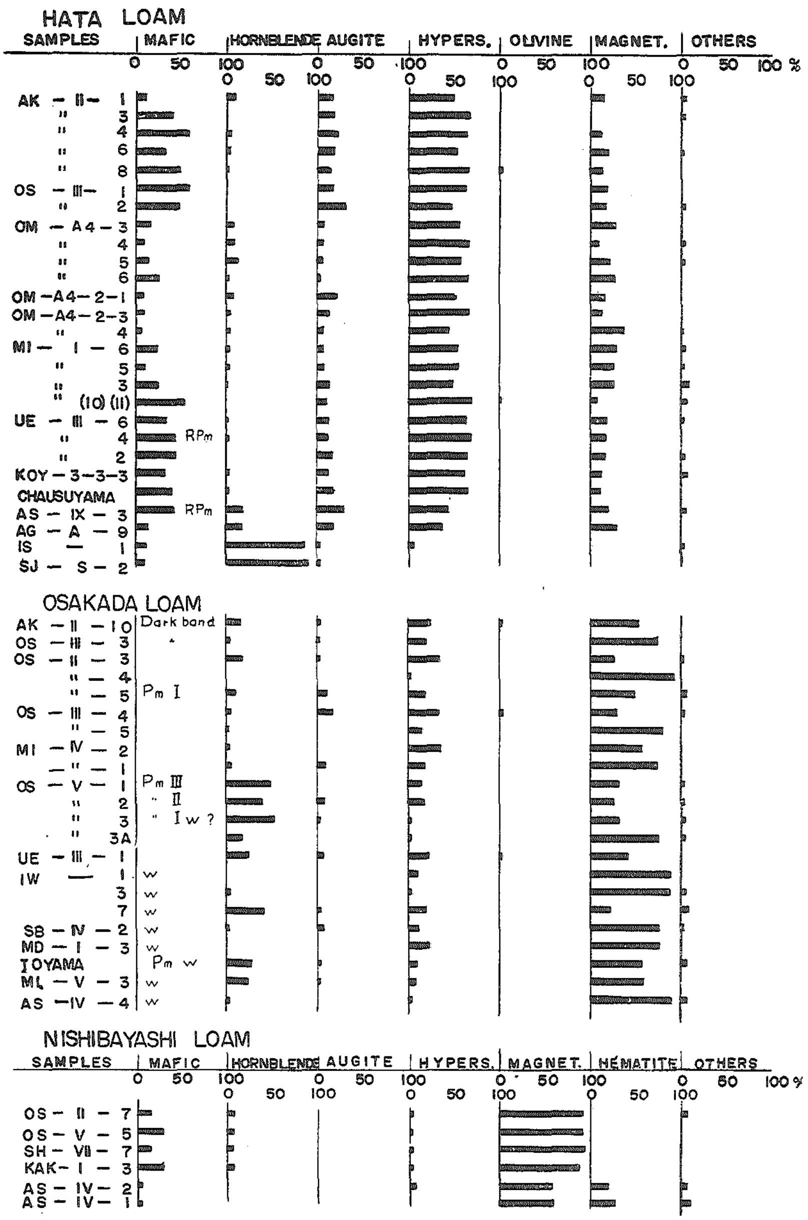


Fig. 4 Heavy mineral compositions of Shinshu Loams (in grain-size composition 1/8–1/16 mm), IS : Thin bed of Hata Loam covering conformably the gravel terrace at Isedaki locating downstream the Nogaike cirque, SJ : Hata Loam upon the terminal moraine in Senjojiki cirque. In both IS and SJ, intermingled hornblende from bed rocks is indicated. JOYAMA : Pumice that can be assigned to that of Osakada Loam, enclosed in clay at Joyama northwest of the town of Matsumoto.

except for those supplied from disintegrated basal rocks of various kinds. The results of heavy mineral analysis carried out for samples of grain-size fraction from 1/8 to 1/16 mm, will be given in Fig. 4. Hata Loam is characterized by the strong excess of hypersthene (50–70% in numbers) over augite and so by about 10% of magnetite. The excessive amount of hypersthene merits the discrimination of Hata Loam from the other Loams. The upper 10–20 cm of Hata Loam corresponding to the so-called "Soft Loam", is less sticky and contains much glass of shard type. The amount of glass shards seems to indicate a tendency in which it decreases from the top downward (5).

d Refraction indices of glass

Refraction indices of glass of shard type and of pumice contained in various Loams measured by means of immersion method. Abbe refractometer was used basing the calibration through which the refraction index of nD of distilled water should be read 1.3335 at roughly 18°C. Refraction indices of glass of pumice which includes usually numerous minute crystallites which may be those of plagioclase is hard to be measured, but seem to be higher up to 1.504. Refraction indices of the majority of glass of shard type common in various Loams are within the range of 1.492±0.005. Some of the samples show they are varying from 1.487 to 1.504. Most glass fragments of the same sample, however, have the indices within the range above-cited. The results obtained are put in Table 2, from which we recognize that refraction indices of glass may not be useful to discriminate a Loam unit from any other units.

Table 2. Refraction indices of glass contained in Shinshu Loams. N : Index of normal type (mainly shard type) N′ : Index of rare type, D : Glass from Daimon pumice bed

HIS 1 (Hata Loam)	N 1.492±0.005	
HIS 1 (Hata Loam)	N 1.492±0.005	
3 (〃)	N 1.492±0.005,	N′ 1.5005±0.0035
6 (〃)	N 1.492±0.005,	N′ 1.5005±0.0035
Sakashita in Gifu prefecture		
IV (upper Loam above tuff-breccia)	N 1.492±0.005 (very rare)	
V (lower Loam below tuff-breccia)	N 1.492±0.005 (very rare)	
Ujinori 3 (Upper Loam, east of Iida)	N 1.492±0.005	
Arakawa cirque in the South Japan Alps		
8 (Loam on the central moraine)	N 1.492±0.005,	N′ 1.5005±0.0035
OS-KII-5 (Osakada Loam-D)	N 1.492±0.005,	N′ 1.5005±0.0035
OS-KII-4 (〃)	N 1.492±0.005,	N′
OS-KII-3 (〃)	N 1.492±0.005,	N′ 1.503±0.001
Uenotaira I (〃)	N 1.492±0.005	N′ 1.5005±0.0035

e Magnetic polarity of Loams MOMOSE of Geophysical Institute of our university measured magnetic polarities of Shinshu Loams in the environs near Shiojiri and Kamisuwa. The results (Table 3) show that the direction of magnetisation of Loams seems to be useful for identification of the contemporaneity of Loams being located separately with one another.

Table 3. The direction of magnetisation of Shinshu Loams measured by MOMOSE in 1959. All samples were taken from Osakada

Loams	Localities	D	I	Average
Osakada Loam	West site OS—II′	1°42′E	33°	50cm above Pm III for 3 samples
	West site OS—II′	3°W	26°	just below Pm III for 2 samples
	〃	0°	26°	50cm above D (Pm I) for 2 samples
Nishibayashi Loam	East site OS—II—N	19°E	49°	just below D (Pm I) for 7 samples
	West site OS—II″	17°E	37°	just below D (Pm I) for 4 samples
	East site OS—IV—N	16°E	48°	140cm below D (Pm I) for 2 samples

2 Osakada Loam

a Modes of occurrences Osakada Loam lying with less marked hiatus below Hata Loam is on the terraces higher than the Hata terrace. Aeolian Osakada Loam can be traced over higher bench-like terraces on the western side of the Hachibuse Ranges. The terraces have been dissected by the former streams that have built Younger alluvial fans at the base of the western slope of the Hachibuse Ranges. The distribution of Osakada Loam and the terraces associating with Osakada Loam are illustrated in Fig. 9 and 13. Water-deposited facies of Osakada Loam, on the other hand, are often observed within the gravel beds forming Younger alluvial fans. Both subaerial and subaqueous modes of occurrences of Osakada Loam may be compatible if we presumed to correlate the events as indicated in Table 5 and 8.

b. Lithology At the top is sometimes indicated Black or Dark band to which I referred in the foregoing chapter. The heavy mineral composition of Dark band proves that its mineral composition is similar to that of Osakada Loam. The time of vegetation growth, accordingly, should be placed before the deposition of Hata Loam (Fig. 4).

Osakada Loam is more clayey and less brownish than Hata Loam. It has pumiceous appearance in which three or four pumice beds are intercalated, and are designated respectively as Pumice bed I (Daimon pumice bed), II and III in ascending order. The lowest pumice bed is characteristically thicker often up to 30 cm or more and is the most excellent key bed among those of Osakada Loam (Pl. 2, Fig. 3).

c Heavy mineral composition In contrast to the composition of Hate Loam, in which hypersthene exceeds over magnetite, that of Osakada Loam is characterized by the excess of magnetite over hypersthene (Fig. 4), However, in certain samples taken from the upper part is included more hypersthene than magnetite. Hornblende is variable in amount, it is rich in a certain horizon of upper part and especially in pumice beds. The three pumice beds contain the highest amount of hornblende when they are thick and bear less loamy matrix, while the amount of hornblende in pumice fragments separated out from pumice bed I (OS-V-3A) does not always exceed over magnetite. Magnetite seems to increase in the pumice beds with water-laid facies.

Hata Loam is thought to have been supplied from the eruption of Norikura Volcanoes, whereas Osakada Loam seems to be the product of Ontake Volcanoes.

3 Nishibayashi Loam

a Modes of occurrences It is covered with a rather marked hiatus directly by Daimon pumice bed. Nishibayashi Loam with typical facies bears no gravel and has the thickness ranging from 50 to 200 cm. Subangular gravels increase from non-graveliferous top of Nishibayashi Loam downward, and the top facies grades thus into that of graveliferous deposits of fluviatile origin. The gravel bed which contains much clay materials in the matrix and is brownish, seems to indicate the maximal thickness of some tens of meters in the valley flat area.

I applied the name "Osakada formation" to this graveliferous bed, upon which Nishibayashi Loam should be understood to rest conformably.

The Osakada formation might have deposited during the fall of volcanic ash which might have lasted for a while even after the final deposition of Osakada formation, resulting that the fill top of the Osakada formation—Osakada terrace, was covered by volcanic ash from which Nishibayashi Loam originated.

There is no terrace that is covered by Osakada Loam but lacks of Nishibayashi Loam upon it.

b Lithology Nishibayashi Loam is chocolate-colored and much more sticky owing to its much clay content. Daimon pumice bed covers always directly the erosion surface of Nishibayashi Loam. At exposures, the surface of this Loam is often much even, except for the indication of little runnel-shaped depressions sometimes observed. At the top is dark-clored Cracky zone whose appearance is striking (Pl. 2, Fig. 4; Pl. 3, Fig. 7).

c Heavy mineral composition Mineral grains contained in Nishibayashi Loam are highly altered and less identifiable, but the Loam is possible to be recognized by the excess of magnetite over both hypersthene and augite. Dominance of hematite is also characteristic, as hematite is nearly absent within the other aeolian Loams.

4 **Enrei Loam**

Description on the geology of the Enrei formation was already detailed in the preceding paper (Momose et al., 1959). The formation is consisted essentially of tuff-breccias and much less amount of lava flows. The upper part of the formation carries often facies of water-deposition and is oxidized to have been tinted in brown and looks like the so-called "Loam" in appearance. Seeing that it is consisted of volcanic materials and that it has a lithology resembling Loam, I employed the name "Enrei Loam", but the calling may not always be adequate because the so-called Enrei Loam might not have originated from ash showers. Noteworthy is the fact that contained andesite breccias in that part are utterly decayed owing to the intensive weathering.

III River Terraces

1 **Terrace Terminology**

In the beginning, several remarks on terrace terminology will be made in the following. River terraces is defined as the remanent surfaces of former river floors. We know that there are in nature such two kinds of river floors as floors of deposition and erosion. Howard has stressed in 1959 that binomical system is needed for the genetic classification of river terraces. Basing upon this proposal, I should like to call the Hata terrace at type locality "fill top terrace", then the other lower terraces "fill strath terraces". The term "accumulation terrace" which may be a synonym of "fill terrace" and of "depositional terrace" should not be applied to "fill strath terrace".

The term "erosion terrace" also should in this sense include both "bed rock terrace" and "fill strath terrace". Although most terraces are in nature to be assigned to "strath terraces" or "erosion terraces", which often are underlain by a veneer of residual gravels for which I should like to employ a word "gravel veneer" or "veneer of alluvium", the latter of which is used also by Thornbury (1954, P. 157).

We are prone to diagnose a fill strath terrace errorneously as a fill top terrace, when graveliferous facies of the former is covered by a gravel veneer or by none.

Kawada (1942, P. 141) failed to detect that Moriguchi terrace which will later be discussed, is virtually a fill strath terrace instead of a fill top terrace.

On the other hand, no alluvial deposit is often recognized upon the terraces which can doubtlessly be assigned to erosion terraces. In this connection, as not a few terraces are both terraces of erosion and deposition, and as the alluvial deposit lying upon terraces of this sort, may be variable from a thin bed to a considerable thick deposit, there will be a case when we can hardly give a proper term. For such a problematic case when the thickness of alluvium exceeds over, for instance, some ten meters, I should like to discard both names "fill top terrace" and "fill strath terrace".

"Terrace gravel bed" currently used conventionally, is also, in principle, much equivocal as genetic name, because the term does not distinguish whether the gravel bed might be attributed to veneer of alluvium or to valley fill.

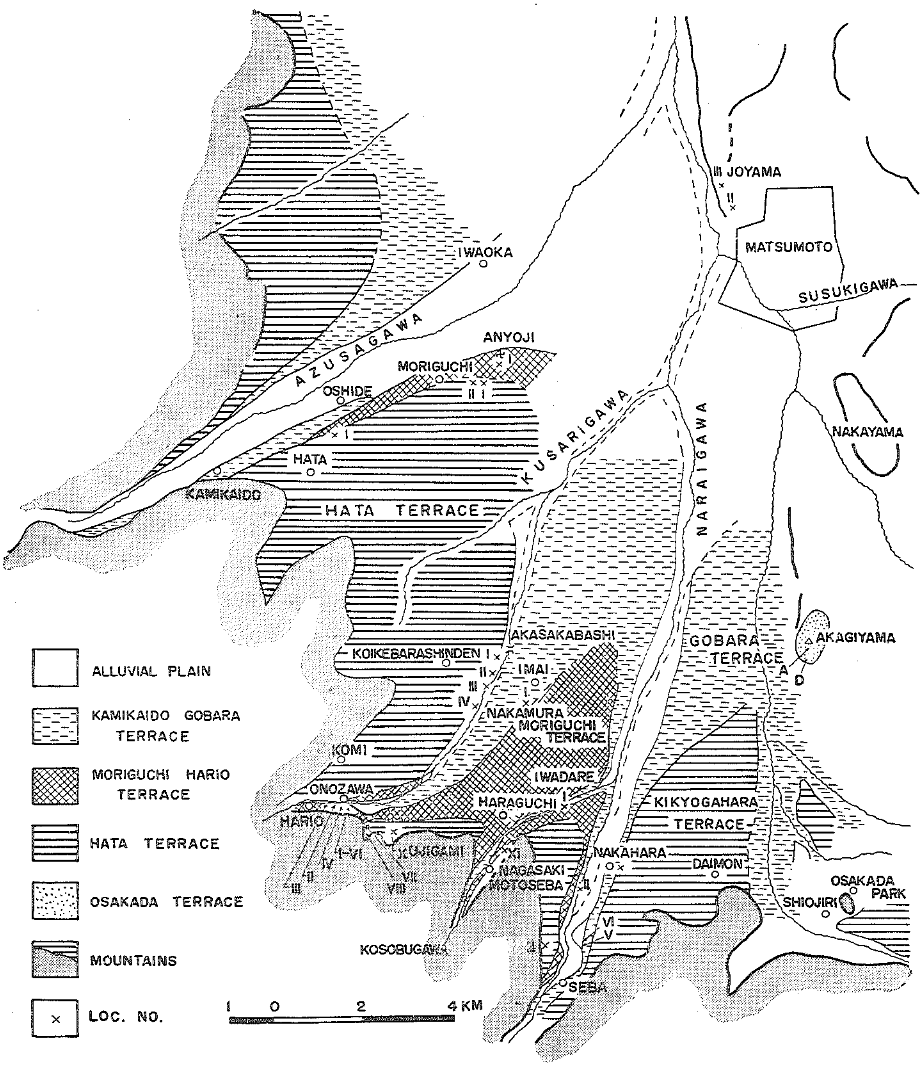


Fig. 5 Classification of river terraces in the southern part of Matsumoto basin, basing the modes of occurrences of Loams. Localities of Loam samples are also put.

2 Classification of River terraces

By means of distinctive modes of occurrences of Shinshu Loam in this district, river terraces are classified into several groups.

a Terraces of Azusa-gawa fan

Three group of terraces as type terraces are adopted from those that are built upon the Azusa-gawa fan which is especially magnificient and fine-shaped (Fig. 6).

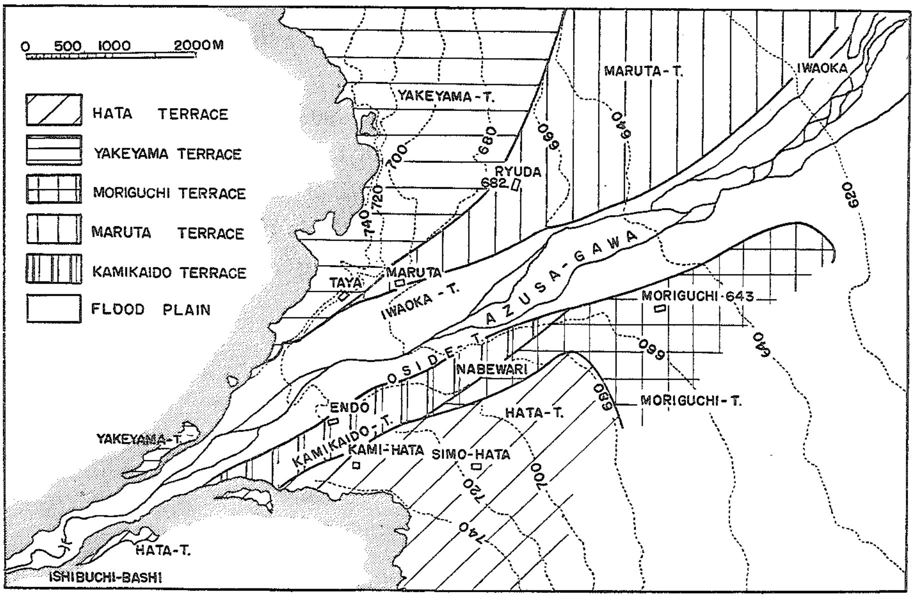


Fig. 6 Typical development of river terraces of the Azusagawa fan.

(*i*) *Hata terrace—the highest fill top terrace.* It is underlain by a single covering of Hata Loam. Upon this terrace, the virtual thickness of Loam as a whole represents approximately the total thickness of Hata Loam. Below Hata Loam, the uppermost part of Osakada Loam of aeolian origin is at times exposed upon this terrace (Fig. 3a–AK–II).

This is the highest fill top terrace that is considered to indicate an intensive valley filling took place before the deposition of Hata Loam.

(*ii*) *Moriguchi terrace* It is covered by a thin bed of Hata Loam, which is equal to the upper part of Hata Loam. Hata Loam covering upon this terrace is often found to rest upon the veneer of alluvium with the thickness of about 1 m (Fig. 3b–AS–III–IV; SB–IV; Pl. 4, Fig. 11).

(*iii*) *Kamikaido terrace* No covering of Loam *in situ* is found upon the terrace. Colluvial or secondary deposition of Loamy materials is at times found to have taken places at the base of terrace scarps rising above this terrace.

b Terraces in the southeastern part of Matsumoto basin

The southeastern portion of Matsumoto basin which is at the same time the area occupying the upper reaches of several tributaries of the river Tagawa, is rather peculiar in geological constitution as compared with the other parts of Matsumoto basin. The area occupies the southwestern foot of Higashiyama Volcano of which the age of eruption may be the late Pliocene or the early Pleistocene. Three major topographic surfaces are discriminated as illustrated in Fig. 8. Topographic illustration that I have tentatively given in Fig. 2 on page 37 of *Journal of Geological Society of Japan* (Kobayashi, 1961) should be revised.

Above the highest terrace is a slope dissected to a high degree, which assigns itself to a volcanic accumulation.

(*i*) *Enrei surface* The highest even topographic surface. It may be a depositional surface formed through the water-deposition of the Enrei formation. The flat surface may be indicative of the higher situation of lake level during the final phase of Enreian volcanism. The Enrei surface stands at the level of about 1,000 m, fairly dissected, and bears at times the covering of Nishibayashi Loam and its successors.

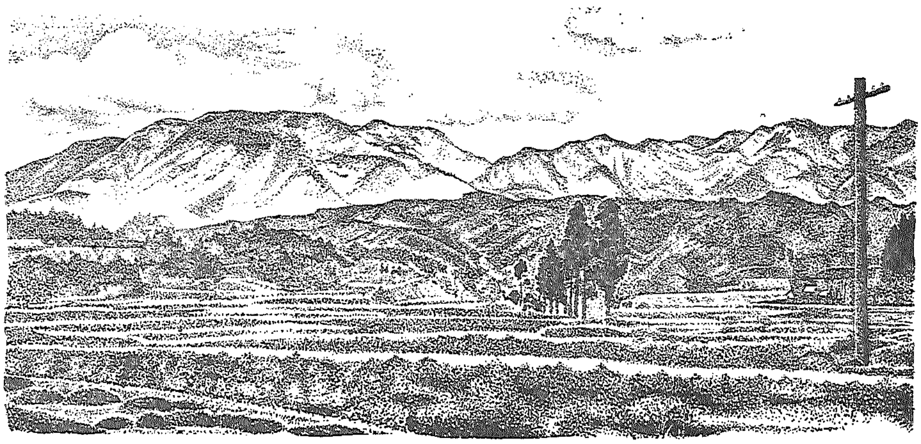


Fig. 7 A sketch of the southern foot of the Hachibuse Ranges. The highest erosion surfaces on the left, Higashiyama Volcanoes (perhaps of the latest Pliocene age) on the right, bench-like Enrei surface of deposition and a marginal part of the Osakada terrace on the left are indicated.

(*ii*) *Osakada Terrace* The terrace occupying only the bases of mountain slopes surrounding the flat area of the basin. It is well-developed at the base of Mt. Hachibuse and is assigned really to the fill top terrace of Older fans whose constituent materials are named as "Osakada formation". Osakada terrace of depositional character changes rapidly toward higher mountain slopes into the terrace of erosion veneered by coarser materials of torrent-deposits or scree type. The terrace is only about 10 m higher above the Kakizawa terrace near Kakizawa at a little distance from Osakada. Upon this terrace rest three units of Shinshu

Loams, namely Nishibayashi, Osakada and Hata Loams. As mentioned in the foregoing chapter, Nishibayashi Loam may in a sense be the top member of the Osakada formation, the actual presence of Nishibayashi Loam, therefore, is an indication of the depositional surface of the Osakada formation occurs uneroded.

(*iii*) *Kakizawa terrace*

The Kakizawa terrace is the fill top of the Kakizawa formation—a correlative of the Upper Onozawa formation. It is covered by Hata Loam (see p. 51).

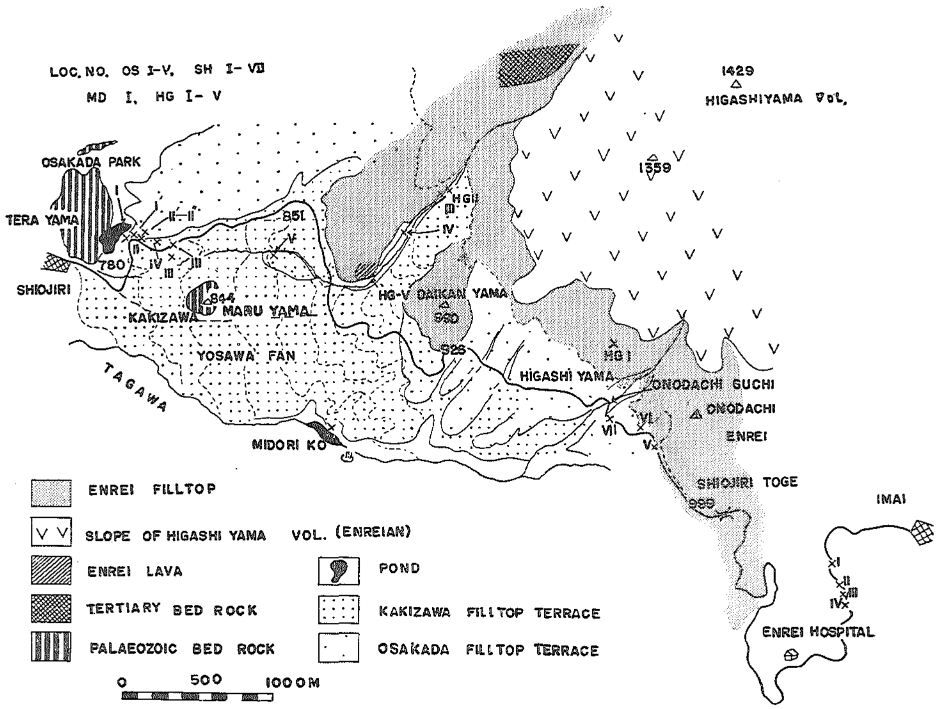


Fig. 8 Geomorphic map of the southern foot area of the Hachibuse Ranges. Localities of collected samples are indicated.

c Terraces on the western slope of Hachibuse Ranges On the western slopes of the Hachibuse Ranges are exhibited several steps of pediment-like benches in appearance as illustrated in Fig. 9 and 13. The modes of occurrences of Loam units upon these land surfaces are as follows:

(*i*) *The 1300 m terrace* Remanets of terraces or dissected pediment. Upon this terrace, debris accumulation from the slope behind is outstanding. The three units of Loam should naturally be presented upon this terrace. Hata Loam covers, however, directly the debris piles in many cases. Both Nishibayashi and Osakada Loams are absent, perhaps as a result of downslope movement of Loams older than Hata Loam. The absence of older Loams seems likely to have been caused by former intensive superficial mass-movement or rubble supply.

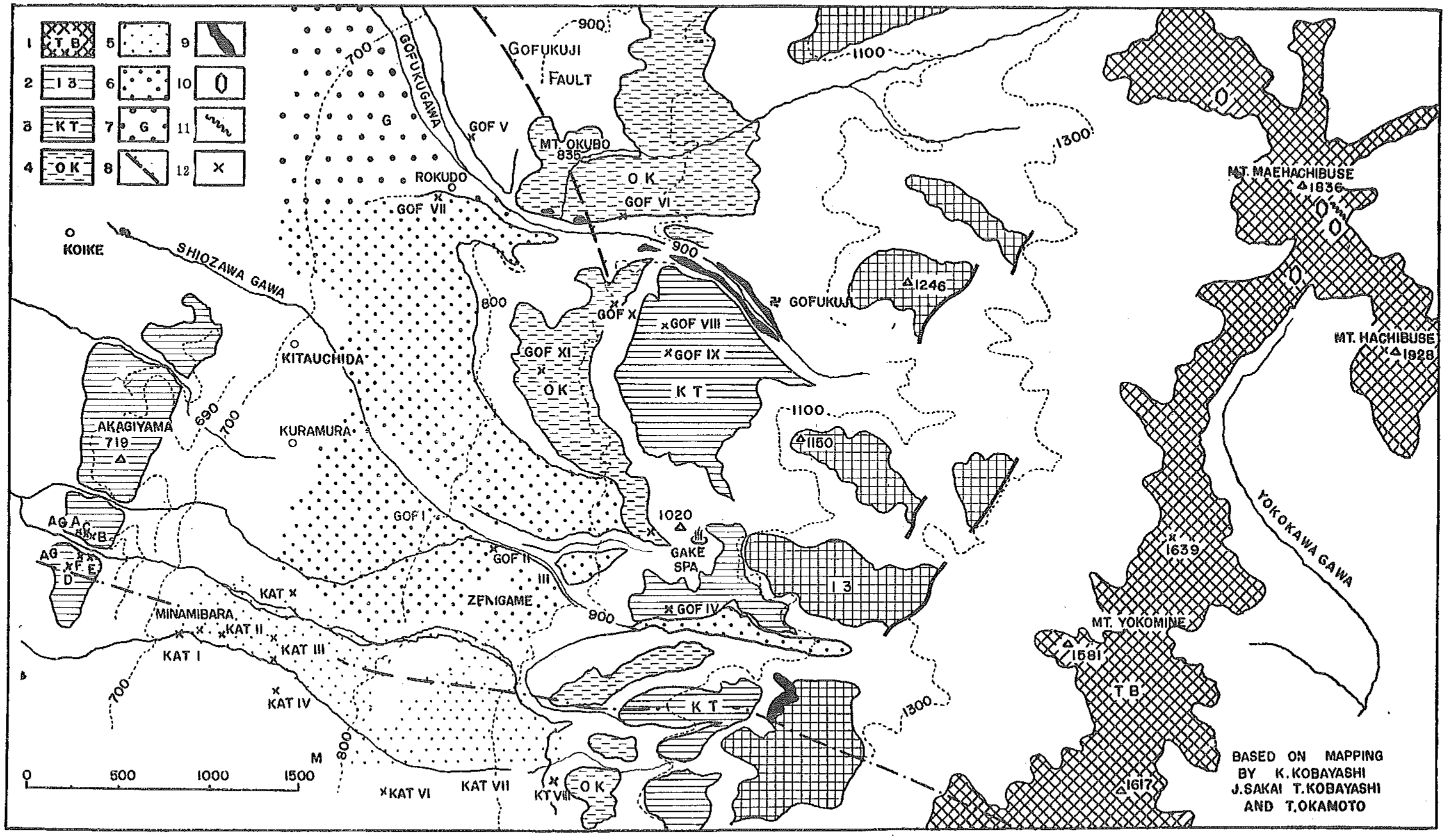


Fig. 9 Geomorphological map of the western slopes of Mt. Hachibuse showing seven groups of topographic surfaces of erosion and deposition, based on field maps drawn by Kobayashi, Sakai, T. Kobayashi and Okamoto. 1 : The highest erosion surface generated during Pliocene time (the Takabocchi surface), 2 : Erosion terrace called "the 1,300m terrace" (the latest Pliocene or the earliest Pleistocene) 3 : Keitoyama terrace, somehow depositional capped by the three units of Loams, 4 : Okubo terrace of depositional origin, capped by Hata Loam—a correlative of the Hata terrace, 5 : Minamibara terrace capped by the upper half of Hata Loam, 6 : Zenigame terrace capped by the uppermost part of Hata Loam, 7 : Gofukuji terrace, Loam is absent, 8 : Gofukuji fault, 9 : Bed rocks, 10 : Patterned grounds, 11; Turf-banked terraces (active and numerous), 12 : Localities of collected samples.

(*ii*) *Keitoyama terrace* This terrace group comprises more than a terrace. For instance, the Shibakiri-daira terrace a little higher than the Keitoyama terrace is to be included in this terrace group. Owing to the covering of Hata Loam and the absence of good exposures and especially to the former intensive downslope mass-movement took places before the deposition of Hata Loam, actual occurrences of both Nishibayashi and Osakada Loams seem to have been obscured. In rare cases the three units of Loams are observable in discontinuous patches remaining upon this terrace, for instance, at an exposure of Loc. Gof.-IV (Pl. 4, Fig. 12).

As Hata Loam occurs everywhere and also good exposures are few upon the Keitoyama terrace, the presence or absence of older Loams are impossible to be detected. A bit of Nishibayashi Loam was observed only at Loc. Gofukuji IX to overlie the gravel bed of Keitoyama terrace. The Keitoyama terrace at type locality seems to be built by a gravel bed perhaps less than 30m in thickness. This may be a correlative of the Osakada terrace.

(*iii*) *Okuboyama terrace* The fill top terrace to be identified with the Hata terrace in the sense of both time and origination. The thickness of the Gofukuji gravel bed which forms the terrace in question seems unlikely to exceed over 20 m in the area downstream from the temple of Gofukuji. As suggested above, Hata Loam rests upon the terrace, whereas neither pumice fragments nor pumice bed have yet been found within the Gofukuji gravels.

(*iv*) *Zenigame terrace* This terrace is covered by a thin bed of Hata Loam that may possibly be equivalent to the uppermost part of Hata Loam. The gravel bed building the Zenigame terrace encloses loamy materials (Loc. Gofukuji Ⅲ). The surface of Younger fans flanking upon the foot of the Hachibuse Ranges are steeply inclined than those flanking upon the western foot of the Japan Alps on the west. Surface gradients of several terraces are measured in the central portions of fans as shown in the following in comparison with the correlatives of the Azusagawa fan.

Table 4 Surface gradients of Younger fans and the associate lower terraces at the foot of the Hachibuse Ranges (A) as compared with those of the Azusagawa fan (B).

(A)			(B)
		······	Hata terrace 18.4×10^{-3}
		······	Moriguchi terrace 16.6×10^{-3}
Zenigame terrace	84×10^{-3}	······	
Minamibara terrace	84×10^{-3}	······	
Gofukuji terrace	19×10^{-3}	······	Recent terrace 10×10^{-3}

The steeper gradients as such seem to imply that these fans on the east may not essentially be similar to those built on the west. The chronologic situations of the river terraces relative to Loams are shown in Table 5.

LOAM		AZUSAGAWA FAN	KUSARIGAWA FAN UPPER COURSE	KUSARIGAWA FAN LOWER COURSE	NARAIGAWA FAN	KOSOBUGAWA FAN	SUSUKIGAWA FAN	WEST OF MT. HACHIBUSE
POST GLACIAL		OSHIDE F. (FLOOD PLAIN)	ONOZAWA F.	IMAI F.	OTA F.	IWADARE F.	FLOOD PLAIN	FANS
		KAMIKAIDO T.			GOBARA T.		MIYABARA T.	FANS
GLACIAL	HATA LOAM	MORIGUCHI TERRACE	HARIO TER.	IMAIHARA T.			OWAGO T.	ZENIGAME T.
HIDA	OSAKADA LOAM	HATA TER. (FILL TOP)	KOMI TER.		KIKYOGAHARA	NAGASAKI T.		OKUBO T. (800 M)
MID. PLEIST.	NISHIBAYASHI LOAM	OSAKADA T. (FILL TOP)					DAIMONZAWA T.	KEITOYAMA T. (950 M)
								SHIBAKIRI T. (1,100 M)
								1,300 M T.
UP. PLIO.		(ENREI FORMATIONS)						TAKABOCCHI (1,500M+)

Table 5. Classification and correlation of river terraces in Matsumoto basin.

IV Fluviatile Gravels

1. Enrei formation

To the east of the Hachibuse Ranges extending northsouthward is the Enrei formation which consists largely of tuff-breccias and lava-flows. MOMOSE and others (MOMOSE et al., 1959) have made geological and in particular palaeomagnetic surveys over the area, the results of which show the formation being characterized by the occurrence of reversely magnetized lava-flows may be the Upper Pliocene or the Lowest Pleistocene in age. The even topographic surface with approximate altitudes of 1,000 m is understood as indicative of the depositional surface of the Enrei formation, whose upper parts show at many places the signs of water-deposition. The volcanic conglomerate as such contains andesitic boulders and gravels which are highly decayed through weathering, and the matrix is much loamy. Decayed gravels are the marked signs in weathering of conglomerate bed being situated near to the sufaces of deposition or erosion, of which the age may be assigned to the time about the Plio-Pleistocene boundary.

In the lowest horizon, both non-volcanic and volcanic gravel beds (unlithified) of fluviatile origin predominate. Fossils are very scanty throughout the formation, except for a single find of *Metasequoia disticha* (*M. japonica*) in the lowest mud layer at the horizon being exposed at the valleyhead of the Yosawa.

Stratigraphic relation of Nishibayashi Loam with the Enrei formation is worth discussing, because the graveliferous top of the latter has undergone a rather intensive oxidation and is marked by browning of the materials, therefore a close resemblance with the lower graveliferous part of Nishibayashi Loam being also marked by oxidation and brown color is indicated.

(i) An exposure suggesting the disconformable relation between the both is observed at a locality near Shiojiri-toge. (ii) Another evidence justifying this interpretation is to be found in the fact that Nishibayashi Loam blankets the configuration of land surfaces that were formed through the dissection of the Enrei formation. (iii) Nishibayashi Loam, on the other hand, overlies in a case the fluviatile gravel bed being situated upon the higher terrace along the river Susukigawa (Loc. Daimonzawa-I), in another case at Akagiyama (Loc. AG-A. B. C) it overlies torrential deposits comprising breccias of quartz-diorite and Tertiary sedimentary rocks.

In view of these factual evidences, stratigraphically the Enrei formation is separable from Nishibayashi Loam.

2 Osakada Formation

I would correlate the Osakada formation with the Lower Onozawa formation. Type locality was adopted at Loc. OS-V (Fig. 3a) near Kakizawa east of Shiojiri as indicated also in Fig. 8, where both Osakada and Hata Loams lie disconformably upon Nishibayashi Loam. Subangular and subrounded gravels increase gradually from Nishibayashi Loam with aeolian facies and non-gravelly, downward to the Osakada formation with fluviatile graveliferous facies. Gravels of this formation comprise various sedimentary rocks, quartz-diorite and andesite of Tertiary times and are cemented by brown Loamy matrix.

At many exposures, the formation outclops within a few meters cliffs but the total thickness seems likely to attain to some tens of meters according to the results of borings made near Kami-Kakizawa.

The depositional surface of the Osakada formation is well-recognized in the area near Osakada where the surface forms the Osakada terrace dipping rather steeply toward the flat of the basin (Pl. I, Fig. 1).

Hence, we may reach a conclusion that the Osakada formation is a fanglomeratic deposit of older accumulation which predates the deposition of Younger fan.

The fact may be important in the sense that the flatness of Younger alluvial fan with rather small thickness has never resulted at a time but has resulted through at least two stages of deposition, namely the first of thick accumulation and the second of lateral extension of gravel cover (Fig. 10).

Mud and sand layers are intercalated at several places in the formation as known from Loc. AG-D at Akagiyama and also from Kami-kakizawa where numerous fragments of drift wood were picked up by boring activities from the sand layers in the depth of some 50m.

In the last, I have to disagree with the opinion offered by Suzuki and others

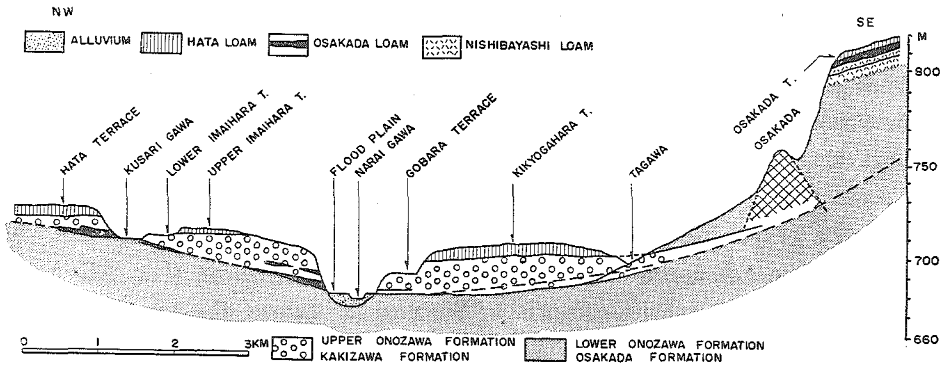


Fig. 10 A profile from east to west, showing the relation of the Upper Onozawa formation with the Lower Onozawa formation (the Osakada formation) in a basin flat.

(1954) who grouped such four units as Hata, Osakada, Nishibayashi Loams and even as the Osakada formation into a single unit and interpreted it to be a type of volcanic mud flows. They described these units under the name "Akagiyama volcanic gravel bed" basing their field observations at Akagiyama—a foothill east of the central flat of Matsumoto basin.

The fallacy of this argument is recognized in that scree supply indicated in the lower part of the cliff at Akagiyama (Loc. AG–ABC) was directly made from the western slope of the Hachibuse Ranges, whereas the finer materials of volcanic ash origin are considered to have been supplied chiefly from the source on the west. There ought also not to be existed any causal relation between the Enreian volcanism of the latest Pliocene or the earliest Pleistocene ages and the deposition of rubbly debris took place a little before the ash fall of Nishibayashi Loam of which the age could presumably be inferred to be the middle Pleistocene.

3 Onozawa Formation

The Onozawa formation at a continuous cliff near the vomitory of the river Kusarigawa, consists of brown graveliferous beds with fluviatile facies. A veneer of alluvium consisting of far larger–sized boulders than the lower formation and carrying the name "Hario gravels" lies disconformably upon the surface eroded into the Onozawa formation. Recognition of a veneered gravels of this sort may reason out the assumption that Hario terrace is never a fill top but is a fill strath terrace.

The upper part at the outcrops near Onozawa is marked by dominant inclusion of pumice beds and pumice fragments, whereas pumice fragment is in no case found in the lower half. The profile at that cliff is shown in Table 6.

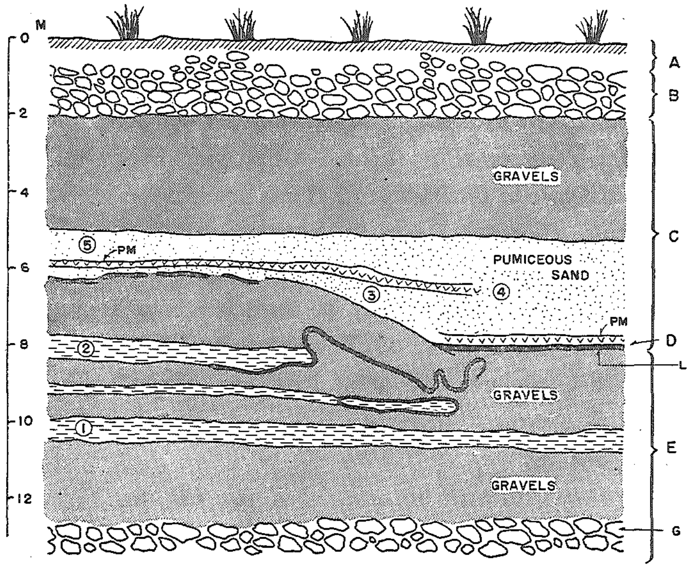


Fig. 11 A section exposing below the Hario strath terrace near Onozawa. Disconformable relation between the Upper and the Lower Onozawa formations and a certain abnormal depositional structures are indicated. A : A part of Hata Loam, B : Hario gravels (veneer of alluvium) C : Upper Onozawa formation D :Disconformity, E : Lower Onozawa formation, L : Limonite, G : Boulder gravels, Figures enclosed in small circles denote the points from which samples were taken, 1–2 brown sandy clay, 3–5 pumiceous sand.

Table. 6. Stratigraphic profile of the cliff near Onozawa

Hario terrace	
Humous soils	
Hata Loam	an equivalent of the top of Hata Loam
Hario gravels	veneer of alluvium
~~disconformity~~~	
Upper Onozawa formation	a correlative of the Onozawa formation and Osakada Loam
~~disconformity~~~	
Lower Onozawa Formation	a correlative of Nishibayashi Loam

The pumice–bearing overlier is named as "Upper Onozawa formation" and the lower lacking of pumiceous facies is named as "Lower Onozawa formation". Phenomenal boundary between the both is marked by an indication of sharp base line of pumice bed but the marking inhibits to evaluate the value of time–break. The Upper Onozawa formation is unquestionably considered to be equivalent of the beds that build Younger alluvial fans, being supported also by the mutual stratigraphic relation between Osakada and Hata Loams.

To this assemblage of several stratigraphic units at Onozawa, SUZUKI and others (1954) gave the name "Lower Anchiku formation", basing upon their belief that these units I mentioned above should be grouped into a single unit which may underlie eleswhere the deposits of Younger alluvial fans. The arguments however are not justified because two or at least one disconformity is overlooked within the section.

a Lower Onozawa formation

Facies of the Lower Onozawa formation is varying but graveliferous as a whole. It intercalates sandy clay and mud layers tinted in brown. Gravels are also varying in size, often boulderly and consist of Palaeozoic sandstone, chert, slate, granite etc. The distribution of the formation is confined mainly within the upper reaches of the Kusarigawa upstream from Onozawa. Below the lowest pumice bed of the Upper Onozawa formation outcrops the Lower Onozawa formation at several places at the level a little higher above the river beds (ASI–VI, IW–1, SB–VI).

The Lower Onozawa formation seems to attain to a considerable thickness of at least 100m or more, as known from results of geophysical prospectings and borings. According to seismic explorations (KURATA, 1947,) deep occurrence of the surface of underlying bed rocks is suggested. KURATA classified by means of the transmission speeds of elastic–waves the subsurface stratigraphic units in the southern part of Matsumoto basin into the following units :

Surface soils		300 m/sec
G – bed	(20 m thick)	1000 m/sec
W – bed	(25 – 35m thick)	1, 500–1, 600m/sec
D – bed	(less than 45 m thick)	2, 100–2, 500m/sec
Bed rock	(Palaeozoic)	4, 030–4, 150m/sec

I can agree with KURATA who believes that G–bed might coincide with the gravel bed outcropping at the cliffs of the Hata and the Moriguchi terraces that is designated as "Upper Onozawa formation" by myself. W–bed may perhaps coincides partly with the Lower Onozawa formation being concealed almost under the ground. Kurata suggested that the total thickness of the Pleistocene formations was measured to be thick enough as much as 250m at a point a little south west of Imai. It however is hard to accept his opinion that at a locality immediately west of

Hiro-oka railway station, the Pleistocene formation is to be only 17m thick situating upon the Palaeozoic bed rocks. The results obtained by our electrical prospectings do not justify the reality of his opinion.

b Upper Onozawa formation

Despite an extensive distribution of top flat of Younger alluvial fans, exposures of their contents are much few and scattered. The formation is utterly graveliferous and generally less variable in lithology. Pebbles are well-rounded large-sized, loosely cemented and comprise sandstone, chert, slate, porphyrite, andesite, granite, hornfels, limestone etc. At the vomitories of fans, gravels are often boulderly and are as large as 1m or more in diameter.

The Upper Onozawa formation and its correlative formations are characterized by the presence of water-deposited pumiceous layers as have been observed at Loc. AS-I-IV; Iwadare-I; Akasakabashi-III; Midori-ko-I; Seba-IV; Mikoshiba-V. As an outstanding instance, crystal tuff and pumiceous layers are exposed at Ogake (Seba-VI) near the railway station of Seba. The mineral compositions of these tuffaceous layers prove that they are identifiable with that of the fallen pumice contained in Osakada Loam (Fig. 4).

The thickness of the Upper Onozawa formation and its correlatives seems to be less than 50m and it does not averagely exceed much over 20m. The thickness was measured by not only direct observation but also by means of our electrical prospectings carried out hundreds of times over the basin bottom.

Although electrical method has been used for sounding ground water resources, the method is an indirect one and not always sufficient to analyse subsurface structure below the depth of over 60m, sometimes it is incompetent for any purposes. The results obtained, however, are characterized generally by a tendency that below the bed with higher electric resistances are the bed with lower electric resistances, and the former bed seems to be corresponding with the Upper Onozawa formation. The upper free water layer is always recognized to be existed within the lower part of the overlying bed with higher electric resistances. In reality, the results of borings have justified the interpretation that the thickness calculated from electrical prospectings should represent that of the Upper Onozawa formation. The Lower Onozawa formation with much clay content might form a non-permeable bed as are suggested at several exposures.

Yagi (1928) gave the name "Anchiku formation" to my "Upper Onozawa formation" to which I (Kobayashi, 1951) later applied the name "Azusagawa fanglomerate", but any type locality was not authorized in both papers.

4. Kakizawa Formation

The Kakizawa formation—a correlative of the Upper Onozawa formation, distributes east of Shiojiri (Type locality MD-1) and consists of coarse materials such as boulderly gravels, coarse sand and pumice seams. The deposits form the

Yosawa fan, of which the fill top is called "Kakizawa terrace" and is covered by Hata Loam (see descriptions in paragraph 2 of Chapter III in this paper). Along the upper reaches of the Yosawa upstream from the highway leading from Shiojiri to Suwa, are exposed the Enrei formation with the facies of tuff-breccia and that like Loam, upon which lies disconformably the Osakada formation with the facies of typical style, and again upon this formation lies disconformably the Kakizawa formation. Here, modern gravel veneer is also recognized upon lower terrace.

V Mass-Movement of Former Times

1 Present Periglacial Climatic Regime

(1) As I already mentioned (KOBAYASHI, 1955, 1956 and 1958), periglacial environment prevails currently in Japan being restricted within the summit regions of high mountains. The lower limit line of the patterned grounds coincides virtually with the forest limit line whose altitudes in this district stands approximately at the level of 2,500m above sea level. The lower limit line of patterned grounds or *Strukturbodengrenze* decreses its height northward from 2,500m down to 1,700 m in the northern part of Hosnhu (Main Island of Japan) in the distance from Lat. 35° 30′ to Lat. 40° 30′.

(2) The patterned grounds in Japan are phenomenologically to be divided into two types (KOBAYASHI and MORI 1956; SAKO et al., 1958), namely the dry soil type —a miniature form and the wet soil type. Genetical difference between both types may have no connection with difference of climate *in situ* but with the amount of water in the soils. I agree with Steche's arguments (1933) that there is a tendency in which the size of polygonal and striped soils enlarges as the availability of water in the soils increases [6].

(3) The patterned grounds of the dry soil type are observed numerously on Mt. Hachibuse (Lat. 36°10′, Long. 138°4′; altitude 1,928m). The polygons and the stripes in which the boulder rows are 20–30cm apart were already illustrated in my previous paper (KOBAYASHI, 1954, Pl. IV, Fig. 3; 1955, Pl. I, Fig. 1–3, Pl. II, Fig. 5; Pl. III, Fig. 9; 1956, Pl. 1–4; and Pl. 6, Fig. 13, 14 in this paper). As I already gave details especially in the paper of 1956, the forest limit on Mt. Hachibuse is often as low as 1,600 m. The active patterned grounds are, accordingly, formed upon bare soil surface lacking of vegetation. Such lower situation of the forest limit is thought to have been influenced by severe souther throughout most of the year and less snowfalls during winter months. These facts seem likely to favour naturally the condition in which such a modern patterned grounds as stone polygons, stone stripes and turf-banked terraces could be formed.

(4) Climatic records at the top of Mt. Kurumayama, altitude 1,925m, of

Kirigamine Volcanoes 15km east of Mt. Hachibuse may be usable for my purpose to infer the yearly progress of climate at higher altitudes in this region. Detailed meteorological observations were made at the weather station once situating on the top of Mt. Kurumayama for three years from 1944 to 1946. FUNATSU (1959) discussed recently the climatic features of Kirigamine Volcanoes basing upon the three years records above mentioned.

The monthly averages of air temperature, amounts of precipitation, and the velocities and directions of the prevailing wind calculated from the data will be cited in Table 7 (CENTRAL METEOROLOGICAL OBSERVATORY, 1951). Fortunately Chino, (co-worker) made an effort to draw the thermoisopleths at the top of Mt. Kurumayama basing the above-cited data (Fig. 12).

Table 7. Some weather records obtained from three years (1944–1946) observations made at the top of Mt. Kurumayama of Kirigamine Volcanoes.

	J	F	M	A	M	J	J	A	S	O	N	O	Mean
Air temperature °C	−10.5	−10.7	−6.3	0.9	5.8	11.3	14.4	15.4	11.6	6.3	0.5	−8.6	2.5
Precipitation mm	22.8	232.2	87.2	130.4	135.9	194.1	240.4	166.6	142.4	282.8	88.3	98.5	
wind velocity m/s	8.4	8.4	8.8	8.8	7.4	7.1	7.2	5.4	6.7	7.4	7.4	9.0	7.7
wind direction	S-SSW	//	//	S-SSE	//	//	//	//	//	//	S	S-SS	

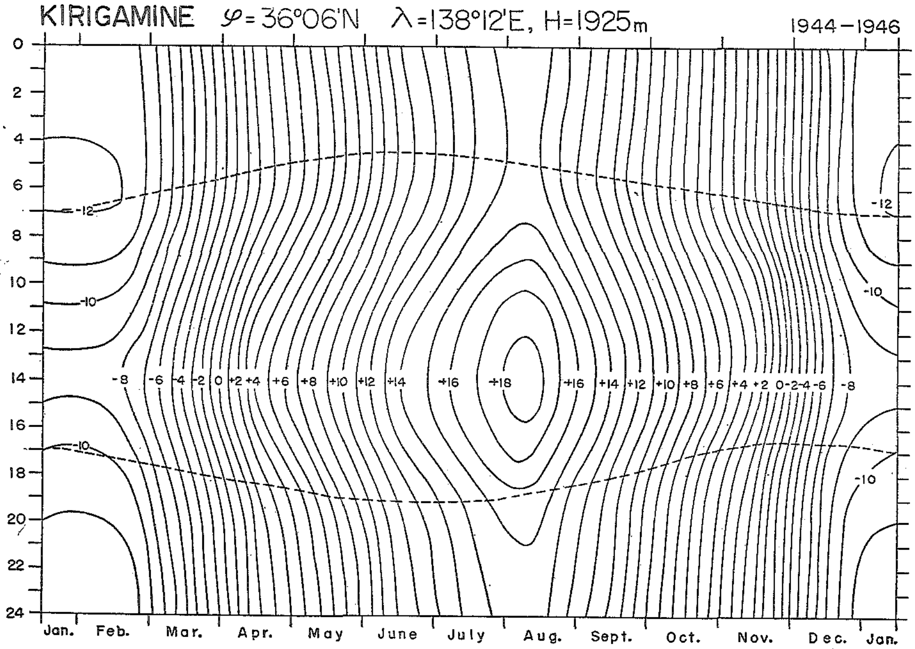


Fig. 12 Thermoisopleths of the highest peak Mt. Kurumayama of Kirigamine Volcanoes (After Chino)

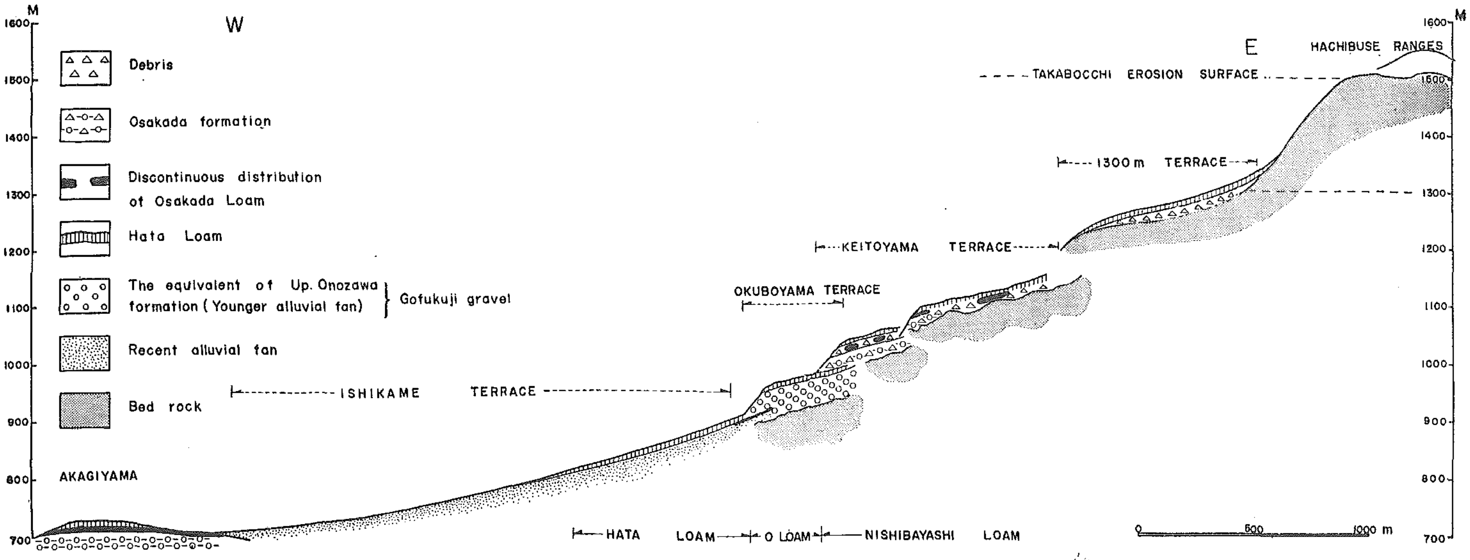


Fig. 13 Topographic and stratigraphic profiles of the western slope of Mt. Hachibuse, showing topographic surfaces, gravel beds, downslope movement of scree on the slope and modes of occurrences of aeolian Loams. Relation of both times of deposition of Loams and of terracing are indicated.

2 A Problem of Accumulation Terracing

(1) The summit regions of the Hachibuse Ranges are consisted of rounded hilltops and smoothed plains saved from the valleyhead erosion of the present climatic regime. The similar smoothed summits and mountain ridges are recognized over the even surface of Kirigamine Volcanoes, even if it has originated from a shield type of volcano. In Central Japan, on the other hand, mountains higher than 1, 500 m or more and lacking arboreal covers are characterized by smooth and rounded summits and ridges, the feature as such may, in parts, be responsible for the low relief of former peneplanation, but it appears in parts to have originated from more intensive congelifraction that worked under the different climatic regime.

(2) Generally speaking, it appears in this region of Central Japan that valley cutting might be intensive even during the time of glacial coldness and that no climatic regime under which periglaciation surmounted dominantly fluviatile agency could have prevailed.

(3) As is seen in Fig. 13, western slope of the Hachibuse Ranges is essentially the slope of erosion and any sorts of deposits at the base of the slope seem unlikely to exceed much over 20m in thickness. Below the summit region is a precipitous scarp down to the altitude of the 1, 300m terrace which is usually mantled with angular rubbles of varying sizes. Rubbly debris is usually covered directly be Hata Loam and sometimes it is exposed being intermingled with Loamy materials as a result of downslope movement. As I have given the detail modes of occurrences of Loams in paragraph 2c of Chapter III, Osakada Loam is absent below Hata Loam at many exposures. Such features as mentioned above appears to resemble very much those which PELTIER (1950) emphasized, in Missouri of North America, to be of periglacial origin.

(4) In view of the fact that the past snowline depressed below the present level by at least 1, 000 m during the last glacial age, for instance the buried forest at Totchu [(7)] 12 km north of Matsumoto (KOBAYASHI, 1958) suggests the former depression of vegetation zone attaining to at least 900m, it may be admissible to infer that the former forest limit of the Hachibuse Ranges could have depressed more or less lower than the present level of 1, 600 m.

(5) In the foregoing statements, I have discussed the rough coincidence of both times of deposition of Younger alluvial fans and of intensive mass-wasting took place over the slope of the Hachibuse Ranges. Such traces of former mass-wasting is of course recognized in the Japan Alps, for instance as seen on the Hata terraces near Inekoki.

(6) Then, what is the necessity of this coincidence of both times of mass-wasting and fan-building in this region? Otherwise may it be an accidental coincidence ?

Among Japanese geological scientists some are prone to apply the name "climatic terrace" to some fluviatile terraces. But no one has ever given any logical discussion basing upon factual evidences in which we can see the necessity of climatic terracing. The problem in search for the law that conditioning vertical erosion and accumulation in fluviatile agency, seems likely to have settled down in the proglacial foreland of the Alps (SOERGEL, 1924; TROLL, 1957).

Modern climatic regime prevailing in Japan differs of course very much from those known from periglacial regions. We know that yearly precipitation reaches up to much higher amounts in Japan and also crustal uplifting is said to have been too intensive to single out the climatic influence upon stream regimens in the mobile belt of Japan.

Summary As I already mentioned (KOBAYASHI, 1958 a c; and 1959), both time ranges of Hata and Osakada Loams may undoubtedly be correlated with that of the Hida glacial or the Würmian phase of the Alps and the time of deposition of the lower part of Hata Loam or a part of Osakada Loam may coincide also with the maximal subphase of the Würm (see KOBAYASHI et al., 1957).

Such being the case, I should like to stress that the building of Younger fans might have been somehow favoured by an increased mass-wasting caused by rather intensive mass-wasting during the time of glacial coldness when the covering of vegetation became poor at the higher altitudes.

VI Prehistoric Cultural Records in Loam

1 Chausuyama Site

a General remarks Several Non-Ceramic cultural sites are known from Loam beds lying upon the step-like foothills behind the town of Kamisuwa by Lake Suwa. The Chausuyama site is one of the sites that were discovered in the earliest stage of our Japanese palaeolithic studies. The site was first excavated by archaeologists in the autumn of 1947, before that time T. MATSUZAWA made for the first time a finding of stone implements within Loam.

b Stratigraphy Stratigraphic situation of the cultural layers at Chausuyama site seems to have been obscured by later artificial disturbances made in historic times. After the excavation made in 1947, the hill top where the site is located became a residential quarter within which many dwelling houses were constructed, so that scrutinies of stratigraphic sections became hardly possible now. SUGIHARA's sketches (1956) of the profile sections revealed through their excavation will be reproduced in Fig. 3c. Fortunately, Mr. FUJIMORI gave me a chance to examine the mineral composition of a bit of Loam within which an implement was enclosed. The material taken by himself during the time of excavation, was analysed mechanically by myself. The results put in Fig. 4 indicate that the

Loam is identified in mineral compostion with Hata Loam otherwise with the upper part of Osakada Loam, therefore the exact stratigraphic situation of the culture is not able to be determined.

Although stratigraphic situation of the Chausuyama culture is thus uncertain, the characteristic feature of the assemblage of implements in which it lacks exclusively of the tool-type of point, seems to denote the older age of that culture (SUGIHARA 1956).

c Imlements According to SUGIHARA (1956), stone implements mostly of obsidian are consisted of following forms:

Knife-blades 36, Side-scrapers 11, End-scrapers on blades 11, Notches 5, Hand-drills 2, Blade-flakes 95, Flakes 49, Cores 16 and abundant fragments. The assemblage is marked by the absence of any kind of point.

2 Uenotaira Site

a General remarks The Uenotaira site is located on a small table-like terrace standing isolated and higher above the topographic surfaces around it. Despite a little distance from the Chausuyama site, the Uenotaira site is characterized by the numerous finds of point-types, accompanied by various kinds of scrapers and knife-blades (SUGIHARA, 1956).

b Stratigraphy During my stay at Suwa in 1959, I was guided by Mr. FUJIMORI, an enthusiastic archaeologist at Kamisuwa and dug several pits to ascertain the stratigraphic situation of the cultural layer. I found numerous flakes of obsidian being contained within loose Loam which seems to have been somehow disturbed by ploughing. The Loam in which many obsidian flakes are included, is intermingled with humous materials and loose in consistency. In contrast to the abundance of flakes and fragments of obsidian within the Loam, much less fragments of obsidian were obtained from the underlying Loam *in situ*.

I have known from a brief conversation with SUGIHARA that my impression above mentioned are not inconsistent with his conclusion about the major cultural layer of Uenotaira site. Such an occurrence of implements may prohibit to induce a corollary about the exact stratigraphic situation of the culture, especially so with respect to the last limit of its time range.

Here, the Loam section is observable at an exposure close to the site, and the occurrences of the three Loam units are recognized to be identified with respectively Hata, Osakada and Nishibayashi Loams (Fig. 3c; Pl. 6, Fig. 18).

Each Loam unit is characteristically less in thickness as compared with that in the southern part of Matsumoto basin where each unit is more than 2m thick. For instance, Osakada Loam is less than 1 m here. The red pumice horizon occupies the uppermost part of the underlying undisturbed Loam bed. The loose Loam containing many implements, therefore, marks a sharp boundary against the top surface of the undisturbed Loam.

Heavy mineral composition was analysed to identify the Loam at Loc. UE–III, where the samples from No. 2 to No. 5 indicated the composition similar to that of Hata Loam.

c Implements Most of fine–shaped implements are bifaced foliate points. According to SUGIHARA (1956), following forms are classified: Points 40, Knife-blades 20, Side–scraper 30, End–scrapers on blades 6, Notches 5, Hand–drills 5, Blade–flakes 20.

3 Omegura Sites

a General remarks At the base of northern slope of Kirigamine Volcanoes—a type of old shield volcanoes, situates a sparsely inhabited village of Omegura whose altitude is at the level of more than 1, 200 m above sea level (Pl. 6, Fig. 15.). The village is embraced in a basin–shaped valleyhead flat of the Yodagawa flowing toward the north.

In this environs are known several Non–Ceramic cultural sites, such as the Yashima (TOZAWA, 1958), the Shirakaba-ko, the Omegura, among which the Omegura sites are the biggest as a whole and is located at the lowest altitude.

Before the members of Shinshu Loam Research Group set out the first excavation in 1957, KODAMA who is an enthusiastic collector living near the sites, frequented there and collected many stone implements worked upon obsidian. Big excavations have since been made several times by the members of Shinshu Loam Research Group.

Although a vast number of implements have been recovered, an inventory of finds have not yet been made. Brief reports were published in the journal of the group "*Shinshu Loam*" (2 and 3, 1957; 4, 1958; 5, 1959) during these years.

Omegura sites are unique in their location, because they are very close to the exposures of obsidian at Wada–toge which form, as a whole, one of the biggest locality of obsidian known in Japan.

b Stratigraphy

Omegura sites are located upon the terraces of torrential gravels which are covered by Loam with moderate thickness. Stratigraphic sections revealed through our excavation are summarized as in the following:

(i) Black humus (Top soil) Highly disturbed. Various kinds of stone implements of Non–Ceramic aspect and fragmentary potteries of Jomon aspect are found being accompanied by a vast amount of flakes and fragments of obsidian. Averagely 10 cm thick.

(ii) Chestnut humus. Somehow chestnut coloured rather black humus. Various kinds of stone implements of the Non–Ceramic aspect and others similar to those contained in the top soil are found. Fragments of potteries of the earliest Jomon (Oshigatamon type) are included in the depth of about 40 cm (Fig. 14). Average thickness 50 cm.

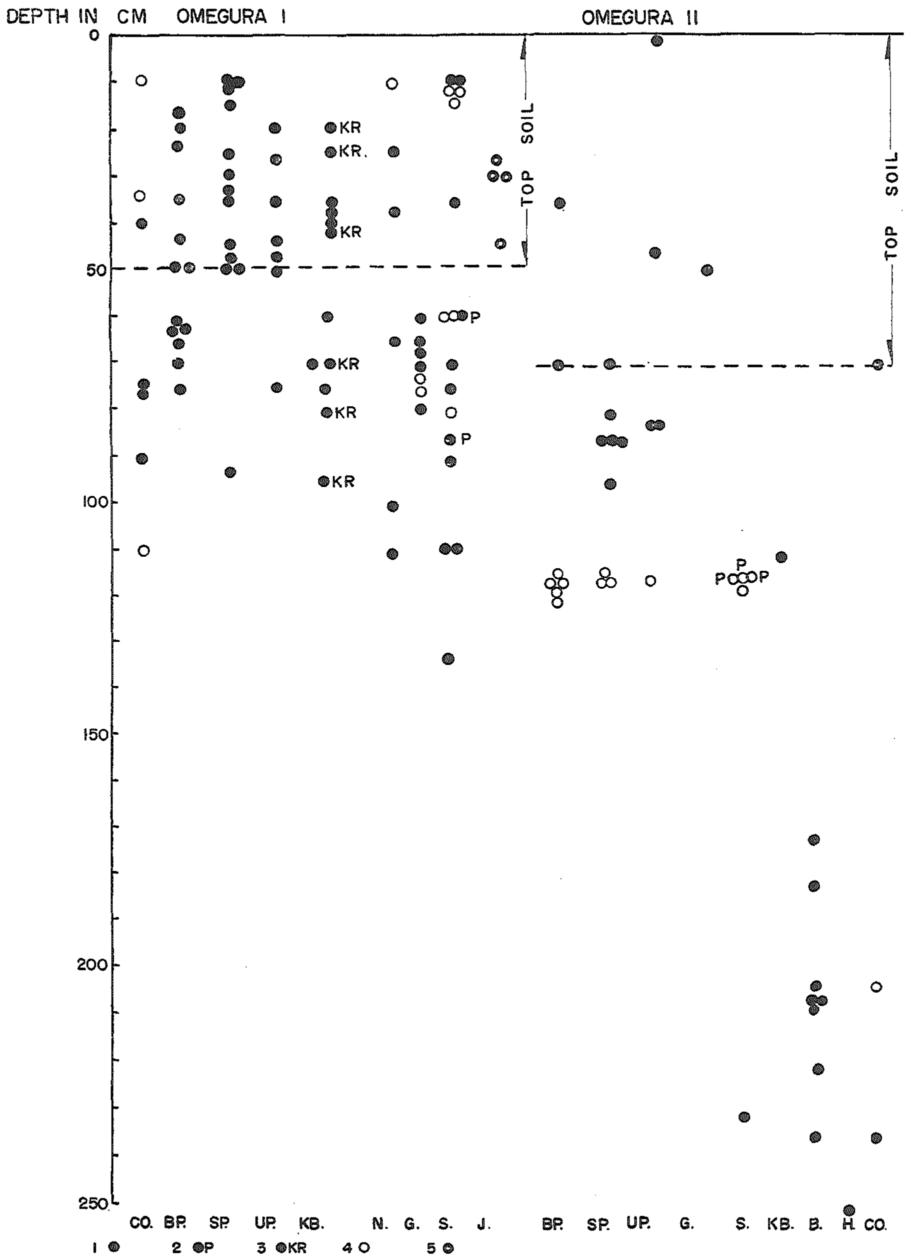


Fig. 14 Depth distribution of stone implements and Ceramic fragments found from the Omegure sites I and II., Illustrated by M. Suzuki and S. Fujisawa (Shinshu Loam Research Group)

CO : Core, BP : Bifaced point, SP : Semi-bifaced point, UP : Unifaced point, KB : Knife-blade, Kr : Knife-blade of Kiridashi type, N : Notch, G : Graver, S : Scraper, J : Implements of Jomom type, B : Blades, H : Point-shaped artifact, (Pl. 9, Fig. 22)

1 : Stratigraphic situation ascertained, 2 : Scraper or point, 3 : Knife-blade of Kiridashi type, 4 : Stratigraphic situation with depth range of $\pm$10cm. 5 : Implements of Jomon type including ceramic fragments.

(iii) Loam. Stone implements alone. Occurrences of stone implements within the overlying humus beds are considered to have been derived from the Loam bed, by some causes such as frost-heaving and mass-wasting took places over the slope, artificial disturbances etc. since many years. The upper part of Loam is non-gravelly, whereas the lower part with rubbly facies seems to include some mass-wasted materials.

Near the site Omegura III, fluviatile gravels are exposed below the Loam bed indicating that accumulation terracing took place before the deposition of Loam (Fig. 3c). Heavy mineral composition of this Loam bed proves to be identified with that of Hata Loam as illustrated in Fig. 4.

c Implements As an inventory of finds has not yet been made, several stone implements belonging mainly to the forms that can be assigned to the groups of points, knife-blades and artifacts of Kiridashi type (see p. 69) are selected from a vast number of finds to illustrate in plates (Pl. 7–10). Although the implements hitherto recovered comprise various forms, the assemblage seems to be featured by the dominant occurrences of points not dissimilar to those from the Yashima sites (TOZAWA, 1958).

4 **Mikoshiba Site**

a General remarks The Mikoshiba site is located upon the highest terrace that can be assigned to the fill top terrace of the river Tenryugawa. It is located at a distance of about 9km northwest of Ina. This is one of the notable Non-Ceramic sites in Japan. SERIZAWA stressed several times the significance of this site, for instance as mentioned in his book (SERIZAWA, 1960). Big excavations were twice in 1958 and 1959 made under the leadership of FUJISAWA and HAYASHI (HAYASHI and FUJISAWA, 1959; FUJISAWA and HAYASHI, 1960), the latter excavation was co-worked by the member of Shinshu Loam Research Group.

The peculiarity of the Mikoshiba cultures lies in the fact that they are characterized by the tool types worked through the true technics of blade flaking and also by the polishing technics. It should be stressed polishing technics have hitherto been recognized only upon the tools of Jomon cultures.

b Stratigraphy The terrace upon which the site lies, will be called "Oizumi terrace", upon which rests conformably Hata Loam with the thickness more than 2m. Sometimes pumice beds are exposed covering directly fluviatile gravel beds that form the Oizumi terrace. Several pumice layers with water-deposited facies are included at several horizons within the gravel beds and seem to be corresponding with the pumice beds of Osakada Loam. Heavy mineral compositions of pumice bed at Loc. MI-IV and at MI-V, both near to the site, and those of the upper Loam (Loc. MI-I) that encloses the cultural layer are illustrated in Fig. 4. The latter compositions imply safely that the cultural layer situates at the highest level of Hata Loam (Pl. 6, Fig. 17).

c Implements According to the preliminary reports (Hayashi and Fujisawa, 1958; Fujisawa and Haysahi, 1959; Serizawa, 1960), the assemblage is as following :

Larger-sized points 17, Larger-sized stone axes (including half-polished ones) 11, grindstone 1, Scrapers on blades 6, Hand-drill 1, Cores 6, Flakes 6.

As stressed by Serizawa, the culture may seem to represent a final type of Non-Ceramic cultures. Traces of the development of true blade-flaking technics was also recognized as a sort of technics having developed again during the cultural stage of Tachikawa site in southern Hokkaido (Yoshizaki, 1959).

5 Yanagimata Site

a General Remarks At the eastern foot and on the right bank of a tributary of the river Kisogawa, are known several Non-Ceramic and Jomon cultural sites, among which the Yanagimata culture is the most noteworthy in the aspect of the earliest Jomon cultures. Mr. Higuchi of Kiso Higashi Higher School have long surveyed the site and its surroundings and have collected stone implements in rather peculiar styles.

Although somehow detailed article was in the nearest past given by himself (Higuchi, 1960) in "Shinshu Loam", certain remarkable facts will be mentioned in the following.

Finds from Yanagimata site seem to be composed of 2 groups, namely Non-Ceramic artifacts contained in the upper part of Loam and the assemblage of artifacts comprising crude points, tanged points and potteries, the last of which were for the first time found during the excavation made, under the leadership of Higuchi, in the summer of 1960.

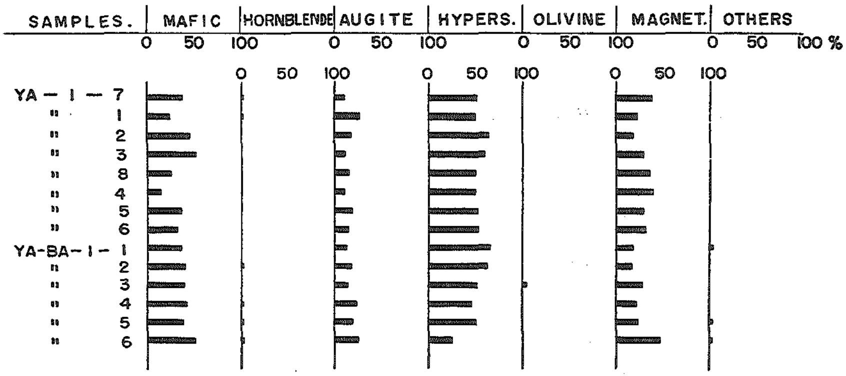


Fig. 15 Heavy mineral composition of the Upper Loam from Yanagimata (Kobayashi and Sakai). Stratigraphic situations of samples are shown in Fig. 3c-39 and 40, (YA-I, Immediately west of Yanagimata, YA-BA-I: A-Trench at Site-B of Yanagimata Remains) (in grain-size fraction 1/8-1/16mm).

b Stratigraphy Detail geologic and topographic settings in this environs will be mentioned in another opportunity by the research group for Quaternary geology of the Kiso valley, as geologic and topographic investigations have been now in process. The site is located upon the fill strath terrace and covered by Younger Loam (Fig. 3 c YA–I), of which the lower part is scoriaceous and much coarser. Typical Loam section near the site and a section of Trench A at Site B afforded Fig. 15 showing heavy mineral compositions of several samples of Loam. A bit of Loam taken from Koyashiki site a little distant from the Yanagimata site was analysed to identify the Loam (Fig. 4 and 3c). The samples from both Koyashiki and Yanagimata sites seem to be identifiable with each other and so with Hata Loam.

c Implements According to HIGUCHI (1959, 1960) and MORISHIMA (1959, 1960), a few of knife–blades, end–scrapers, round scrapers and blade–flakes are known to be included within the Loam bed *in situ.* Another group of implements included in the disturbed bed covering the Loam bed, comprises crude unifaced and bifaced points. Besides the group above–mentioned, tanged point is rather unique as compared with the known forms of point of Non–Ceramic cultures. HIGUCHI (1960) proposed to call it "Yanagimta–type point". A point group comprising this type of tanged point is said to have been recovered from such other sites as the Kosegasawa (NAKAMURA, 1960), the Hananoko and the Tachikawa sites (YOSHIZAKI, 1959).

All these cultural layers are said to be referred to the latest Non–Ceramic or to the earliest Jomon cultures respectively.

Such being the case, it should be pointed out in conclusion that any cultures being contained within the primary Loam bed of Shinshu district does not accompany any kind of potteries.

6 Conclusion

(1) Most Non–Ceramic cultural layers hitherto found from various sites including many others to which I have not referred in this paper, are situated within Hata Loam otherwise within the Loam bed seemingly correlative of Hata Loam.

(2) The top horizon of Hata Loam is characteristic in the human cultures coinciding with such final aspect of Non–Ceramic cultures as that represented by the Mikoshiba site and is also demarcated by the lowest horizon of humus at the level of which we have ascertained the situation of the cultures marked by the earliest presence of earthenware industries.

(3) The stratigraphic demarcation between Hata Loam and the overlying humus are placed at the horizon coinciding accidentally or necesarily with the border line drawn between Non–Ceramic and Ceramic cultures.

VII Summary and Conclusion

(1) As I am to give at another opportunity a historic scope of the Pleistocene crustal movements took places in this region, I now am to offer a conclusion mainly with respect to the Pleistocene physiographic records basing the modes of occurrences of Shinshu Loam.

(2) As have been discussed, it became clarified that Matsumoto basin was twice filled up by two graveliferous deposits building respectively Older fans and Younger fans, resulting that two groups of fill top terraces, i. e. the Osakada terraces and the Hata terraces, were formed. The older terraces are recognized at the base of the slopes of surrounding mountains as indicated in Fig. 16. Many terraces that are extending over both basin and valley-flats have originated from the fill top once formed in former time.

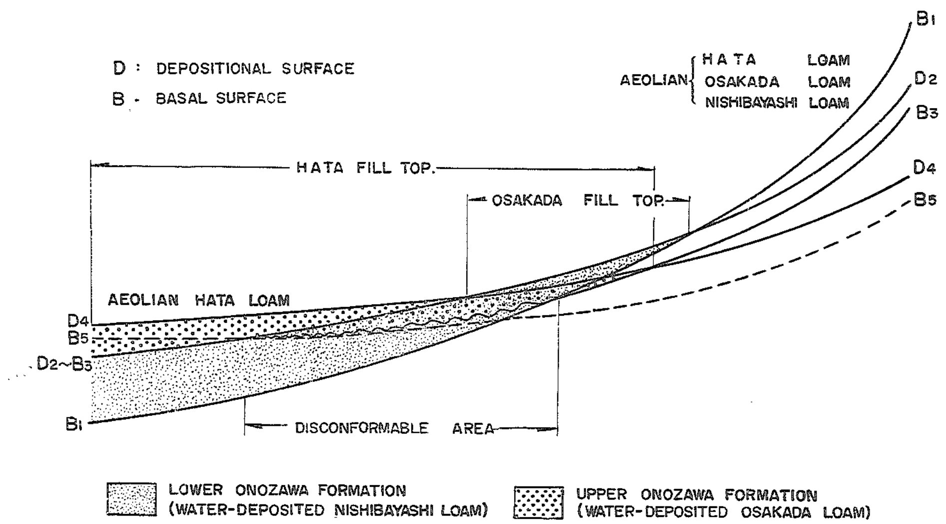


Fig. 16 Schematic profile of two sorts of valley fills in Matsumoto basin. The mutual relations between Shinshu Loam, river terraces, and gravel beds are indicated.

(3) One of the most outstanding fact is that the lower part of Hata Loam grades usually into graveliferous beds, sometimes into fluviatile gravels, sometimes into downslope debris and even so into glacial moraines (KOBAYASHI, et al., 1957; KOBAYASHI, 1957). The time of these rubbly deposits may be about the last phase of Osakada Loam. These facts may seem to imply that the debris supply in various manners might have taken place roughly simultaneous with the time of morainic accumulation that took places in glacial cirques on the Japan Alps. It may not be too much to say that such a contemporaneity as that revealed in the former debris accumulations of various manners might be influenced by

glaciation at the higher altitudes, and so by periglaciation prevailed in the mountain foot areas surrounding the summit regions that were under the glaciation.

AGE	LOAMS	GLACIATION PERIGLACIATION	DEPOSITS	TERRACES	VEGETATION	FOSSIL RECORDS	CLIMATES
H				FLOOD PLAIN	PREDOMINATE		WARM
WÜRMIAN	HATA LOAM	HATA LOAM ?	VENEER	MORIGUCHI T.		TOTCHU FAUNA & FLORA	COLD
	DARK BAND	↑ SENJOJIKI MORAINE	UPPER ONOZAWA FORMATION	HATA TERRACE	PREDOMINATE		WARM ?
	OSAKADA LOAM	INTENSIVE MASS-WASTING					
?	? PM I						
MID. PLEISTOCENE	PAUSE		EROSION INTERVAL		WEATHERING		WARM ?
	NISHIBAYASHI LOAM ?		LOWER ONOZAWA FORMATION ?	OSAKADA T.		AKAGIYAMA FLORA	

Table 8. Late Pleistocene correlation chart of Shinshu district. The Komaglacial may be placed close to the lower part of Hata Loam.

(4) Although the reality of the assumption which I would presumably to justify for my observations is now opened to question, the time of such accumulation of debris is proved, in a different manner, to be contemporaneous with the Würmian glacial. In the last of this line of disccussions, I am to introduce a correlation chart concerning with various events that have taken places in Shinshu district since middle Pleistocene time (Table 8).

(5) As the occurrence of Dark band and Cracky zone within the Loam section indicates the former land surfaces remained uneroded for a while before the depositions of Loams, it may represent a certain physiographic condition of significance. Weathered land surfaces before the deposition of Osakada Loam are recognized extensively over my field. But the matters await further studies.

(6) Dark band enclosed within the Loam section should rather be an indication of the prolonged growth of vegetation, instead of the prolonged pause of ash falls.

(7) Human cultural records in Shinshu Loams are known from the depth less than 50 cm below the surface of Hata Loam. The Mikoshiba cultures somehow with the Mesolithic aspect may seem to represent the finality of the so-called Non-Ceramic cultures that characterize Hata Loam.

(8) Our present knowledges concerning with the prehistoric studies, seem likely to tell that close relation might be placed between Non-Ceramic and Ceramic cultures. Assuming that both cultures might be in close connection, the demarcation between humus and Hata Loam could never bear a prolonged time-

interval, and means the both might exist in a conformable relation even in the strict sense. A tentative correlation chart put in the last of this paper is based partly upon this conception.

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and

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Notes

(1) p. 25 In the present state of my knowledges, the Loam unit called "Hata Loam" is thought to have originated from volcanic ash supplied by the eruption of Norikura Volcanoes, and Osakada Loam so of Ontake Volcanoes. Hata Loam is thicker than the average at the eastern foot of Norikura Volcanoes.

(2) p. 26 Loams in the northern part of Shinshu have been somehow clarified by Saito, Mizukami, Takano and others. See the paper entitled : Saito, Y., Mizukami, T., and Tsukada, M. (1960) Stratigraphical and pollen analytical studies of the Pleistocene deposits in northern part of Nagano Prefecture, Central Japan, *Sci. Rep. Tohoku Univ.*, 2, Special volume 4, pp. 345–355. Takano et al. (1960) Quaternary deposits of Takada Plain, *Jour. Geol. Soc. Japan*, **66**, p. 458. Several knowledges about the Loams in that district are obtainable in a book entitled : "Nature and Surroundings of Lake Nojiri" (1960) published by Arai Higher School in

Niigata Prefecture.

(3) P. 27 "Miso" is the most popular pasty seasoning made from beens, reddish brown in color, and is used to make a sort of Japanese soup called "Miso-shiru". The Japanese word "tsuchi" means "soil" in English.

(4) p. 28 Grain-size compositions of Hata Loam are already described in my previous paper presented in 1960. A sample taken from Loc. KOY-3-3-3 is composed of 6.23% of sand, 77.20% of silt and 16.64% of clay (see Fig. 3 c).

(5) p. 36 The amount of glass of shard type is observed with respect to the samples taken from a columnar section of Hata Loam at Loc. AK-II near Akasakabashi and at Loc. MI-I closed by the trenches of the Mikoshiba site. The results are shown in the following: AK-II-1:50%, 3:11%, 4:8%, 6:6%, 8:7%, MI-I-6:33%, 5:33%, 3:34%, 10:5% in descending order. See Fig. 3 a c (in grain-size fraction 1/8-1/16 mm).

(6) p. 52 Steche's arguments are introduced in a paper by Washburn. See Washburn, A. L. (1956) Classification of patterned ground and reviews of suggested origins, *Bull. Geol. Soc. Amer.*, **67**, pp. 823-866

(7) p. 55 As I mentioned in the previous paper (1958 b), a bit of rooted tree of Totchu conifer bed was sent to Osborne Geochronological Laboratory in Yale University to make Radiocarbon dating. By courtesy of Prof. R. F. Flint, Prof. E. S. Deevey and perhaps many others including Mr. S. Horie. The age of the sample (Y-641) was measured to be $1,590 \pm 140$ C^{14} years B. P.

The communication of the 25th of January of 1960, sent from the laboratory states in part that: "Obviously too young to be acceptable. Probably the deposit resulted from mixture of materials of widely varying age."

About the stratigraphic situation of the fragment of rooted tree, I mentioned already in a rather detailed description (1958 b, p. 55-58, Pl. 12). The deposit as a whole overlies the middle terrace that may be correlated with the Moriguchi terrace, so that the age of deposition may seem to have started since some time after the terracing——perhaps since the time that assigned to the upper part of Hata Loam.

After I received the communication, reexaminations were made by us if the deposits might have built by the recent colluviation otherwise by landslide. The results, however, indicate that the lower part containing wooden fragments appears to be overlain by the bed with the facies of water-deposition, which somehow seems to demonstrate the former higher water level by about 15 m above the present.

400 cm above the bed including buried forest and remains of extinct giant deer (*Sinomegaceros ordosianus minor*) is the bed containing the fragments of potteries of the oldest Jomon type, of which the age is now widely accepted to be roughly 7,000 C^{14} years B. P. It is, therefore, possible but not probable that the rooted trees with the date of $1,590 \pm 140$ C^{14} years could be covered accidentally by the Neolithic bed with the tentative date of 7,000 C^{14} years. B. P.

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Explanation of Plates

Pl. 1, Fig. 1 Osakada terraces with the road-cuts at Osakada (OS-IV), Enrei terrace of deposi tion is seen on the right, the highest erosion surface (altitude, 1,500m ca) upon the southern end of the Hachibuse Ranges.

Fig. 2 Loam landscape near Osakada. The total thickness of Loams in this environs reaches up to about 10m (Os-II"-N)

Pl. 2, Fig. 3 An exposure at Osakada (OS-III) showing Dark band which forms the uppermost part of Osakada Loam.

Fig. 4 Three Loam units at Osakada (OS-II"-N)

Pl. 3, Fig. 5 Hata Loam upon Hata terrace at a site southeast of Koikebarashinden (AK-IV). Faint sign of Dark band is indicated. Sand layers occupying the top of the Upper Onozawa formation.

Fig. 6 Crystal tuff and tuffaceuos clay layers embedded within fluviatile gravels of the Upper Onozawa formation north of Seba.

Fig. 7 Cracky zone at an exposure near Kakumashinden south of Kirigamine Vol., Cracky zone is directly covered by Daimon pumice bed.

Fig. 8 Nishibayashi Loam covering boulder gravels upon the Daimonzawa terrace that can be correlated to the Osakada terrace. O:Osakada Loam, D:Daimon pumice bed, N: Nishibayashi Loam

Pl. 4, Fig. 9 Enrei topographic surface and Kakizawa fan southwest of the Hachibuse Ranges, The Hida Ranges With the altitudes of more than 2,500 m is seen over these.

Fig. 10 Kikyogahara terrace (fill top terrace) and Gobara terraces (fill strath terrace) viewed from a site northwest of Seba.

Fig. 11 Hario terrace (fill strath terrace) and gravel veneer at the vomitory of the Kusarigawa fan (AS-I)

Fig. 12 Three Loam units at Loc. Gof.-IV south of Gakenoyu Spa. O:Osakada Loam, Cr: Cracky zone, N. Nishibayashi Loam

Pl. 5, Fig. 13 Stone stripes at the level of 1,650m of Mt. Hachibuse (Dec. 15)

Fig. 14 Stone stripes at the level of 1,650m of Mt. Hachibuse

Pl. 6, Fig. 15 Non-Ceramic site of Omegura at the level of 1,250 m

Fig. 16 Soil profile at the site I of Omegura.

Fig. 17 Soil profile at Mikoshiba site. Stone inplements are recovered being placed in situ.

Fig. 18 An exposure at a cliff of Uenotaira site. H: Hata Loam, O: Osakada Loam, D: Daimon pumice bed, N. Nishibayashi Loam. A measure is 1m long.

Pl. 7-Pl. 10

Stone implements of Palaeolithic aspect from Loam at Omegura sites, collected by the members of Shinshu Loam Research Group. These artifacts are preserved in the Department of Anatomy, School of Medicine, Shinshu University. Most implements are made of obsidian except for three. Following names are tentative ones. A measure indicated in the plates is 1cm long.

Pl. 7, 1 Bifaced foliate point (0 III-151)

2 〃 (0-127) Surface find

3 〃 (0 VI-10)

4 〃 (0 III-71)

5 〃 (0 III-217)

6 Bifaced asymmetric point (0 III-425)

7 Unifaced foliate point (0 III-487) Blue chert

8 Knife-blade or artifact of Kiridashi type. Weathered yellow chert (0 I-10)

9 Unifaced foliate point (0 III-311) Basalt ?

10 Semi-bifaced foliate point (0 III-43). Bifaced point with flat triangular section.

11 Unifaced foliate point, rather high bakced. (0 III-505)

12 Parti-bifaced foliate point (0 III-153)

13 Semi-bifaced foliate point (0 III-372)

14 Parti-bifaced foliate point with triangular section (0 I) Surface find

15 Parti-bifaced foliate point ? (0 III-214)

16 Parti-bifaced foliate point (0 III-329)

17 Crude point or pointed tool like-chopper, worked directly upon unprepared pebble. (0 II-59)

18 Unifaced side-scraper ? (0 III-588)

19 High backed artifact upon unprepared pebble ? (0 III-403)

20 Side-scraper upon unprepared pebble ? (0 III-439)

21 Unifaced side-scraper (0 III-231 ?)

22 Crude point-shaped artifact uppon pebble (0 II-181)

Pl. 10, Knife-blades and artifacts of Kiridashi type. Artifact of Kiridashi type may be a knife-point, I am rather inclined to think if it might be used as a blade of composite tool being handled like microlith.

23-26, 28, 29, 31, 32, 35 and 37 : Artifacts of Kiridashi type

23 (0 I-86), 24 (0 III-299), 25 (0 III-1), 26 (0 I-8), 28 (0 IV-15), 29 (0 ?), 31(0 I-5), 32 (?), 35 (0 III-364) and 37 (0 IV-11)

27, 30, 34, 36 and 41 : Knife-blades or artifacts of Kiridashi type

27 (0 IV-50), 30 (0 IV-70), 34 (?), 36 (0 III-25) and 41 (0 IV-57)

33, 38, 39 and 40 Knife-blades : 33 (0 III), 38 (0 II-37), 39 (0 III) and 40 (0 II-368)

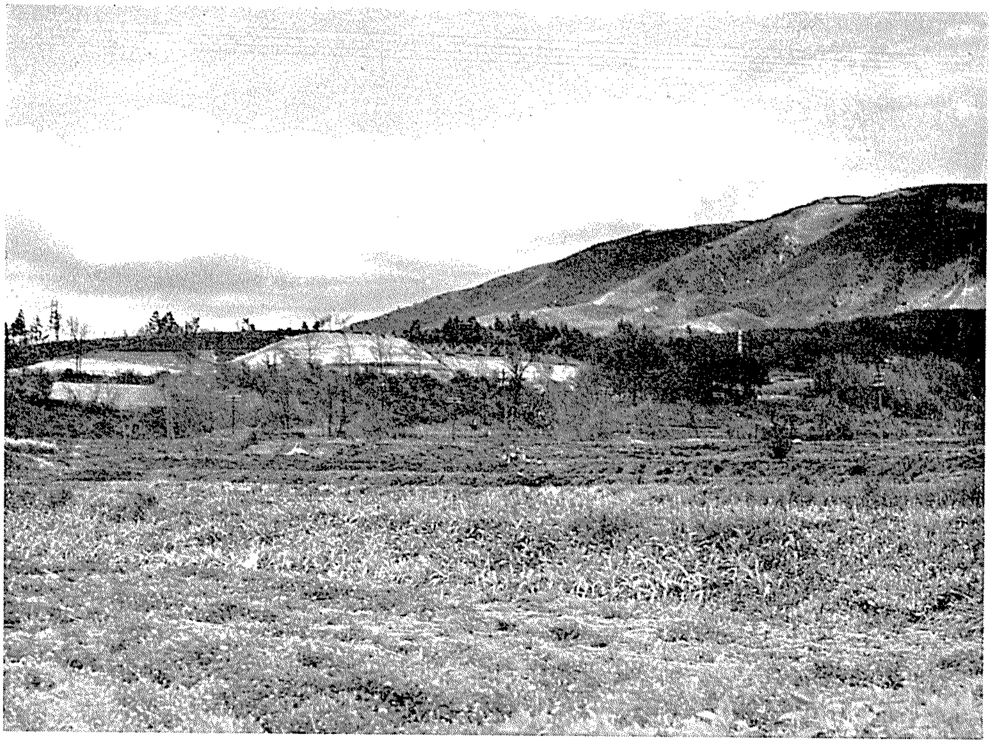

Fig. 1

Fig. 2


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Fig. 3

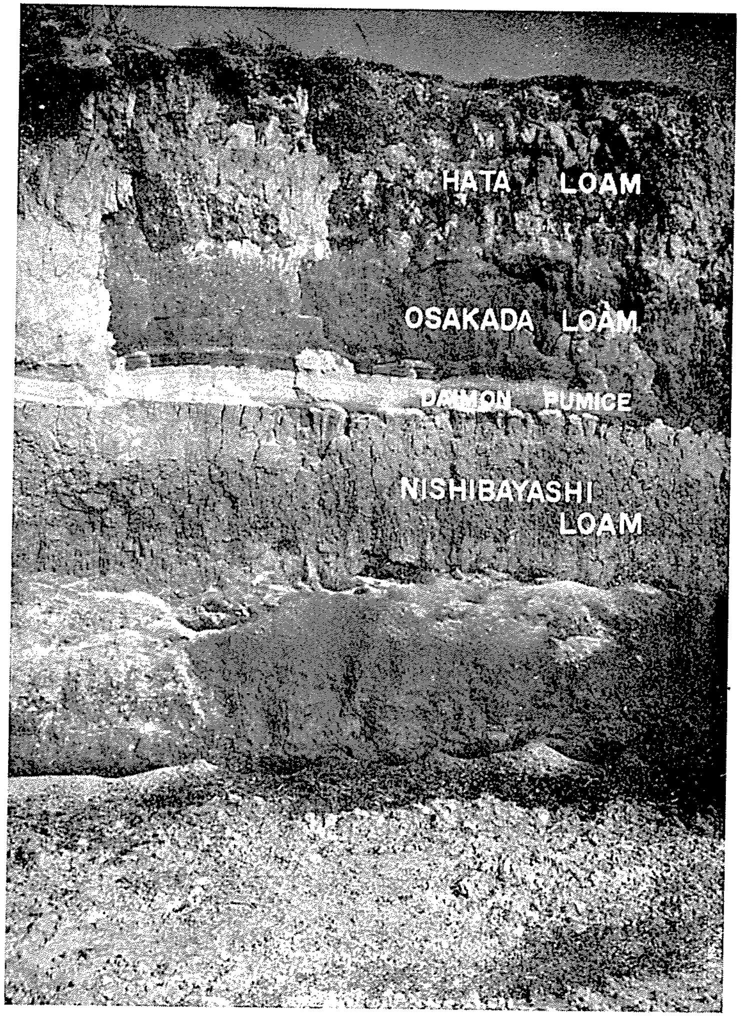
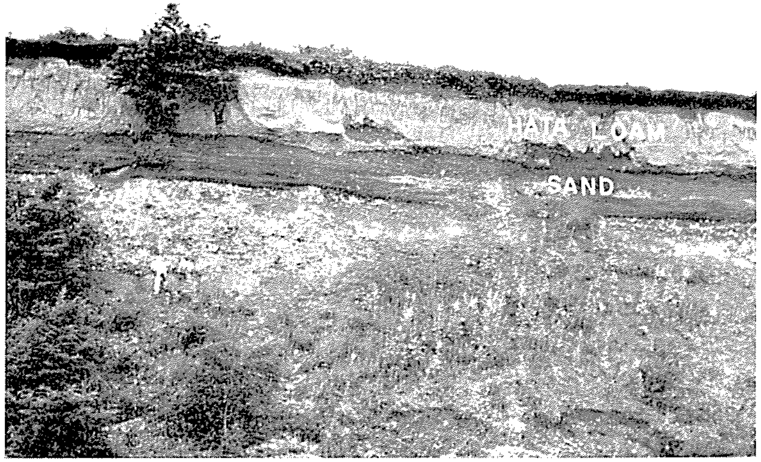

HATA LOAM
OSAKADA LOAM
DAIMON PUMICE
NISHIBAYASHI
LOAM

Fig. 4



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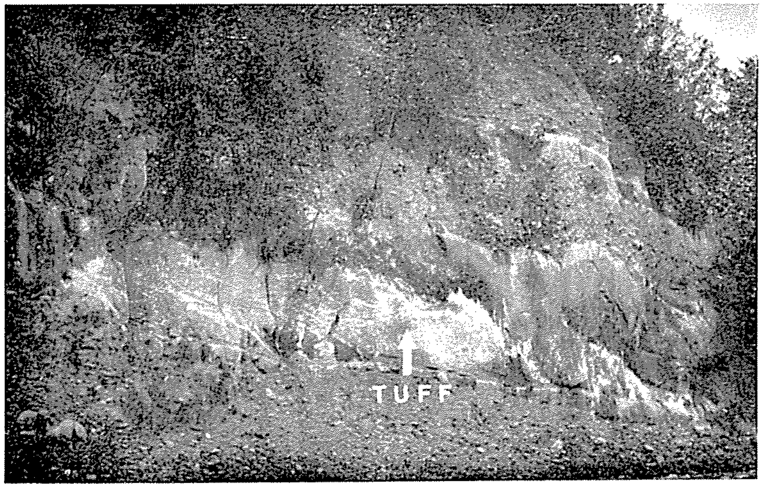

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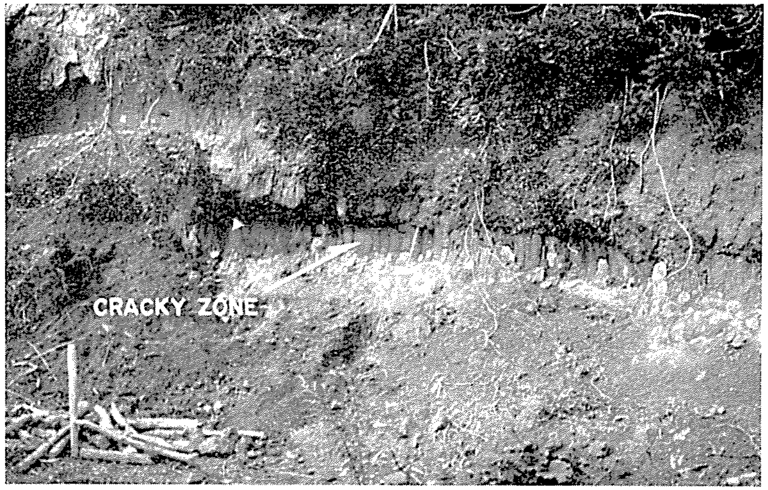
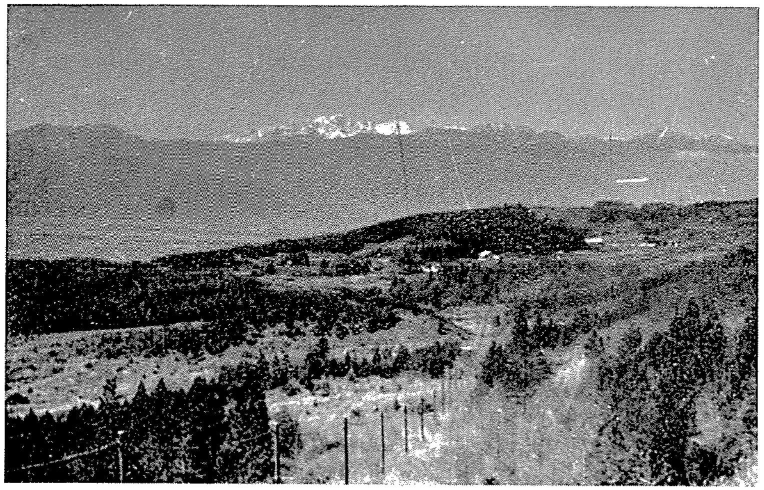


Fig. 7

Fig. 8



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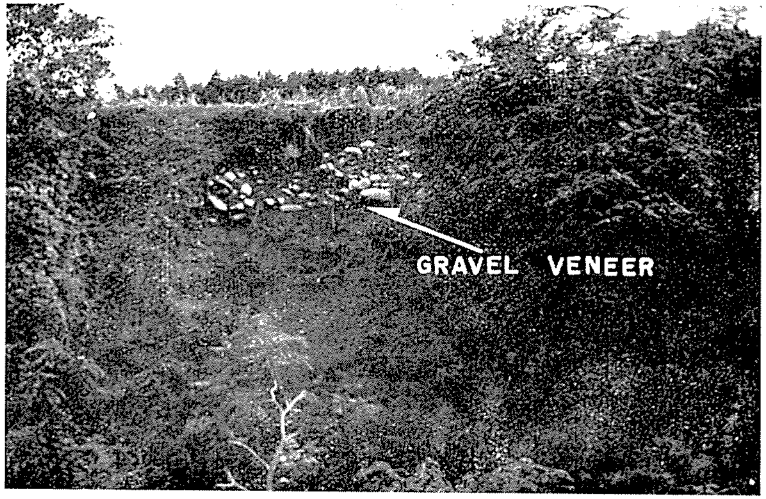

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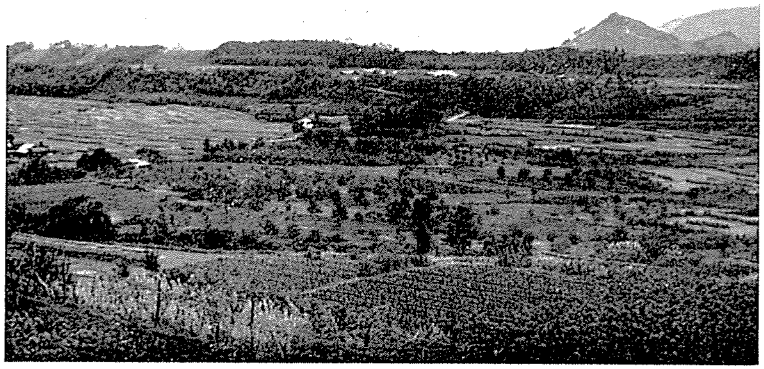

Fig. 10

Fig. 12

Fig. 13

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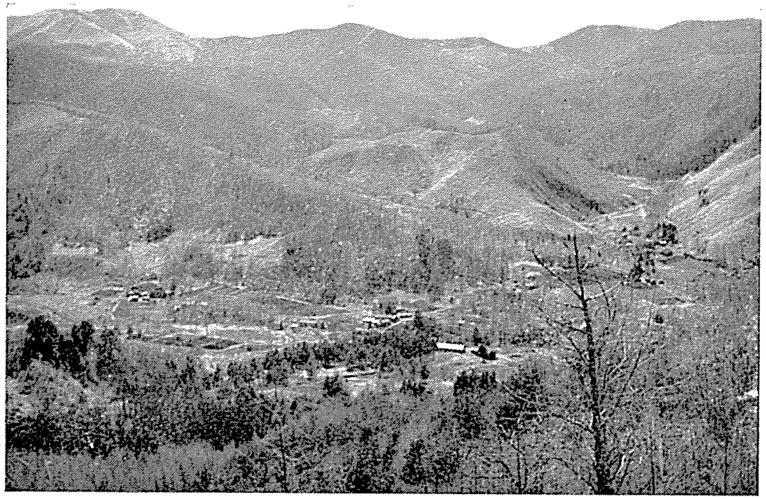

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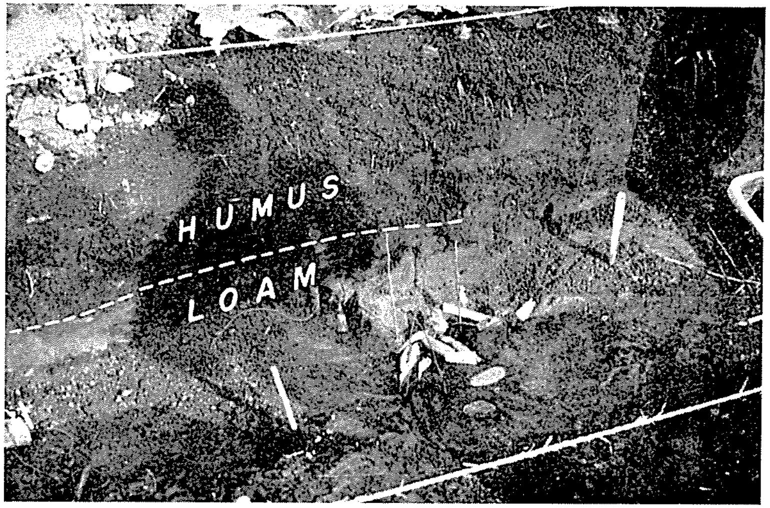


Fig. 17

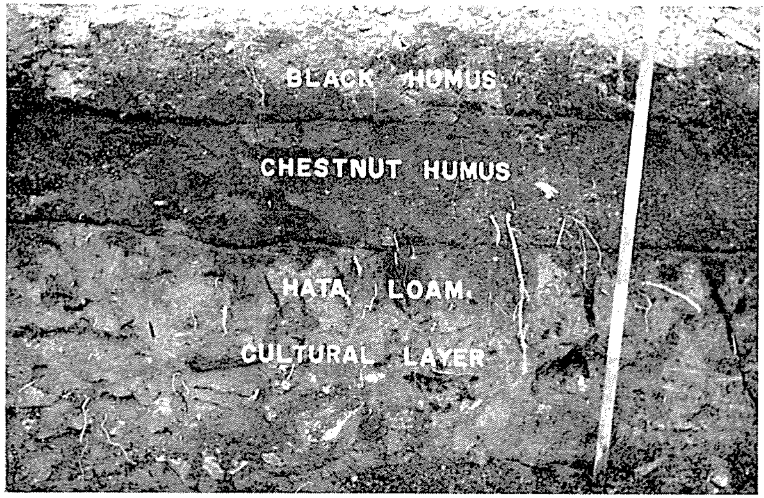
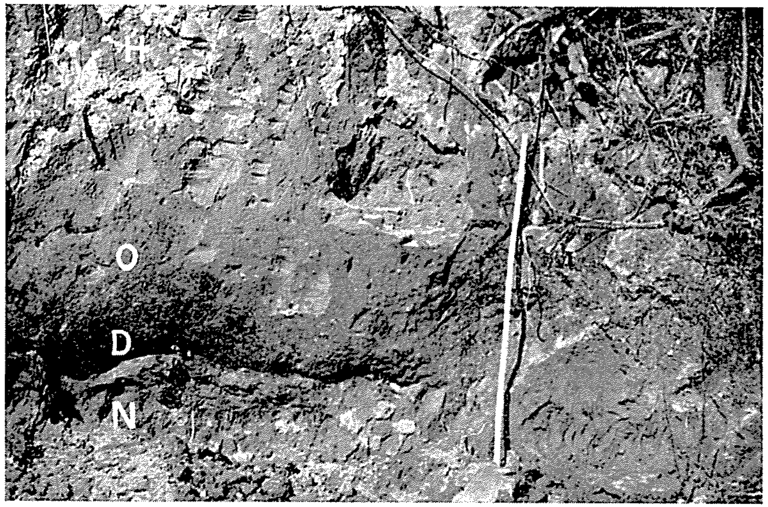


Fig. 16



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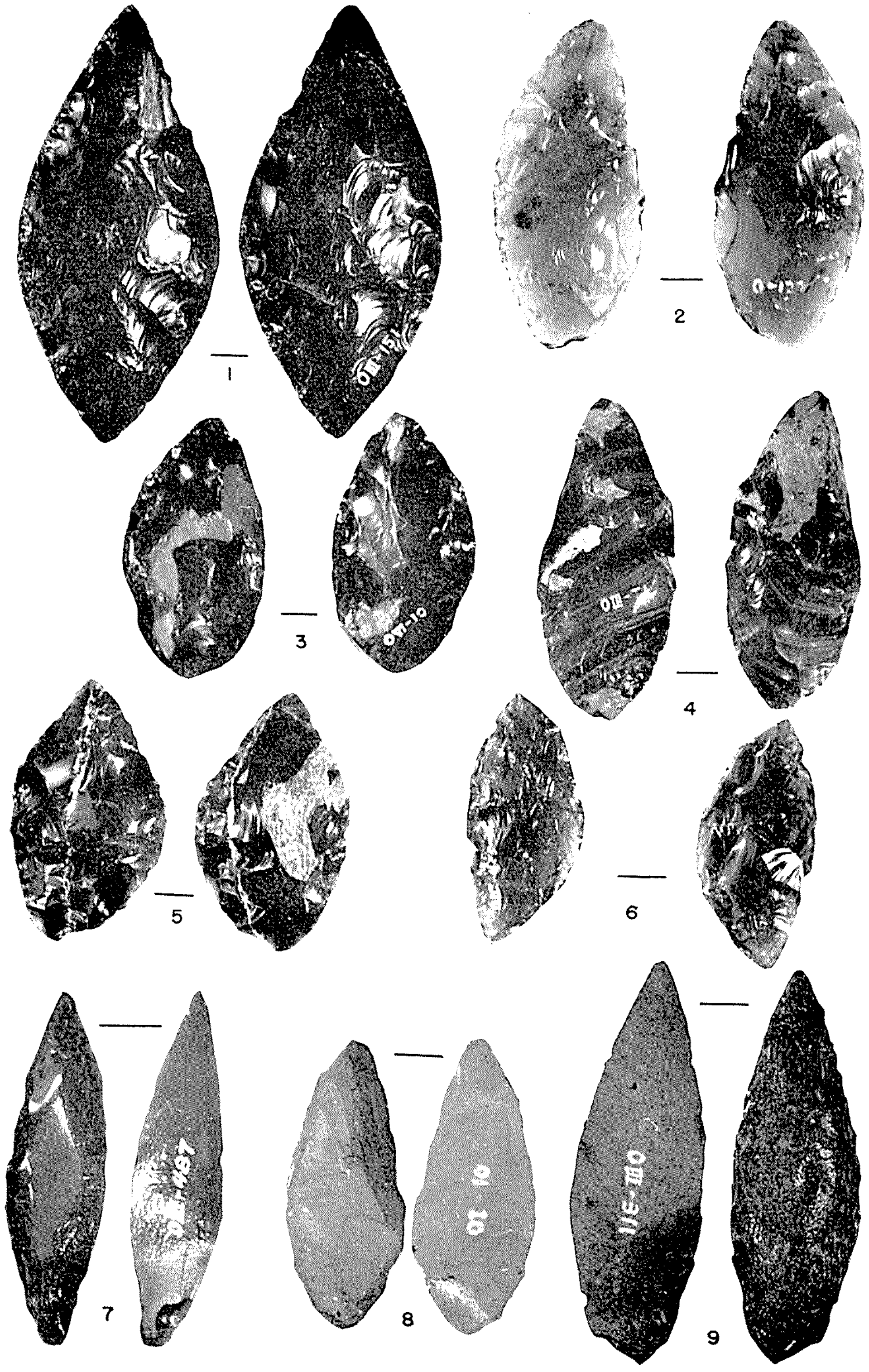
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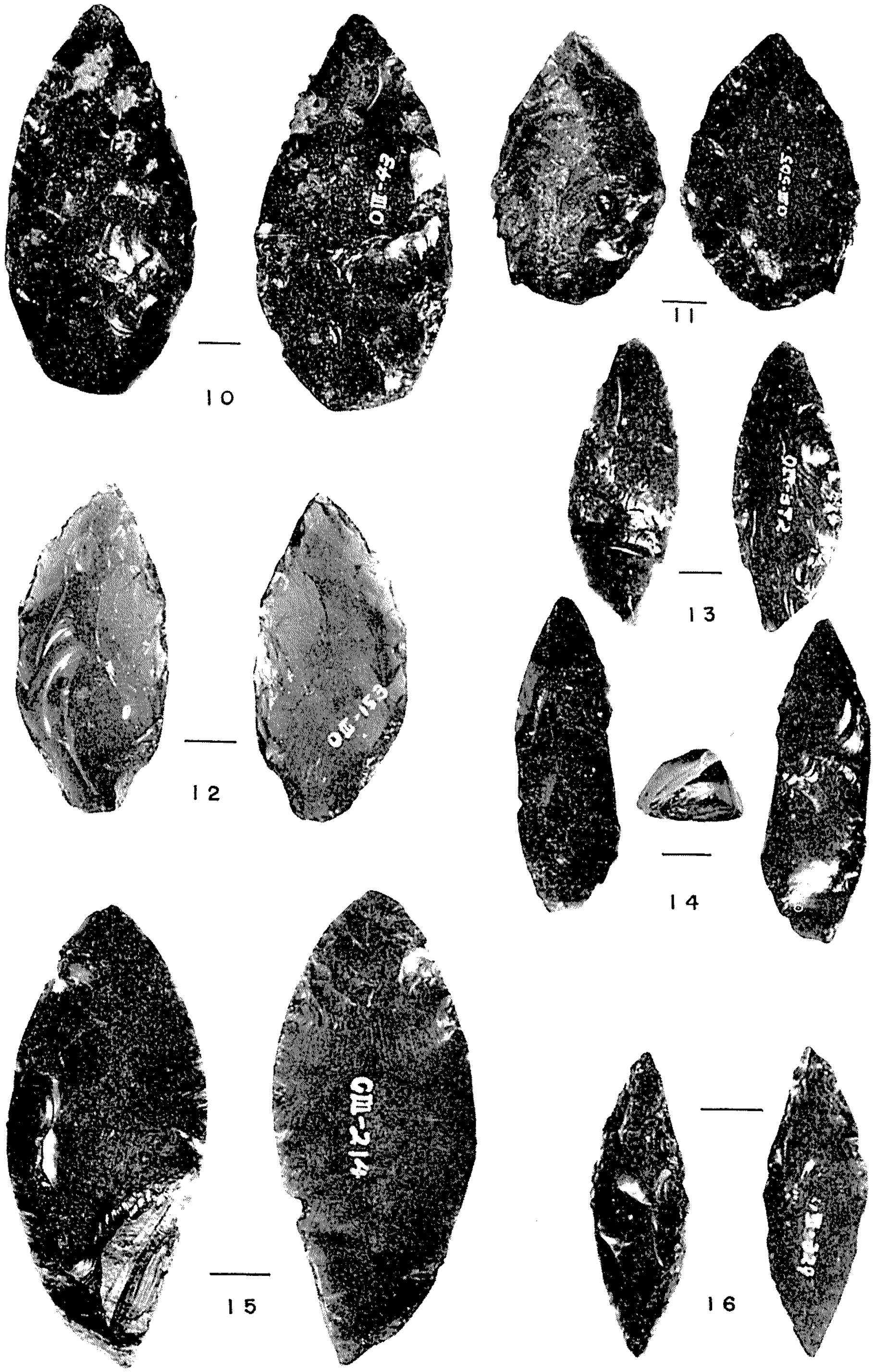
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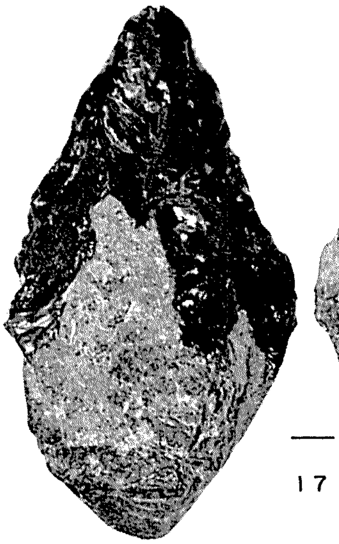

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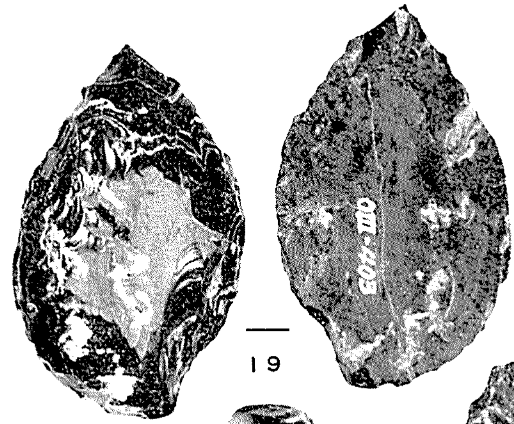

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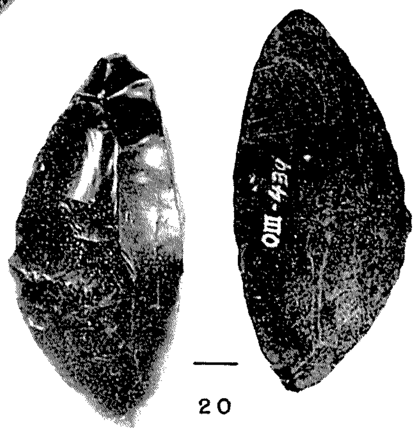

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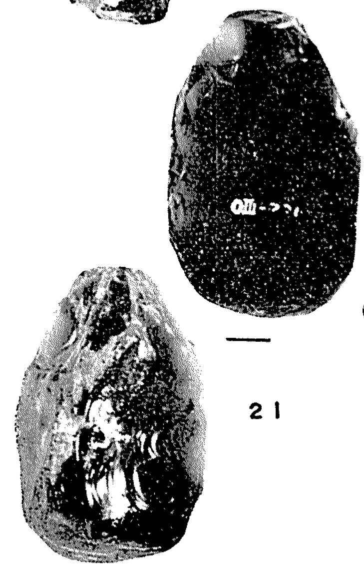

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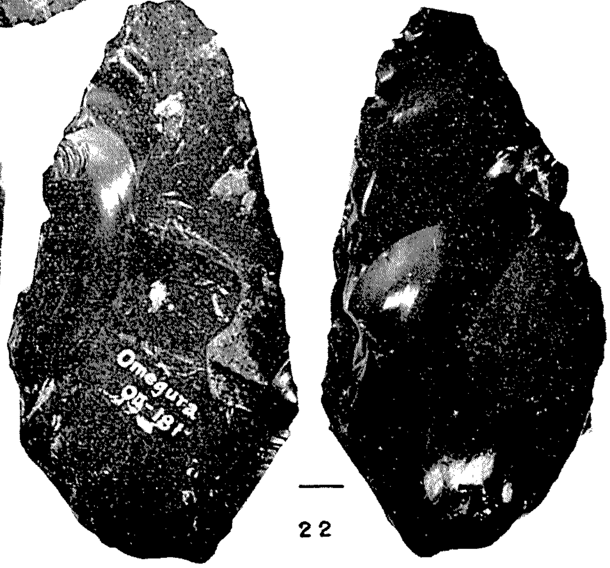

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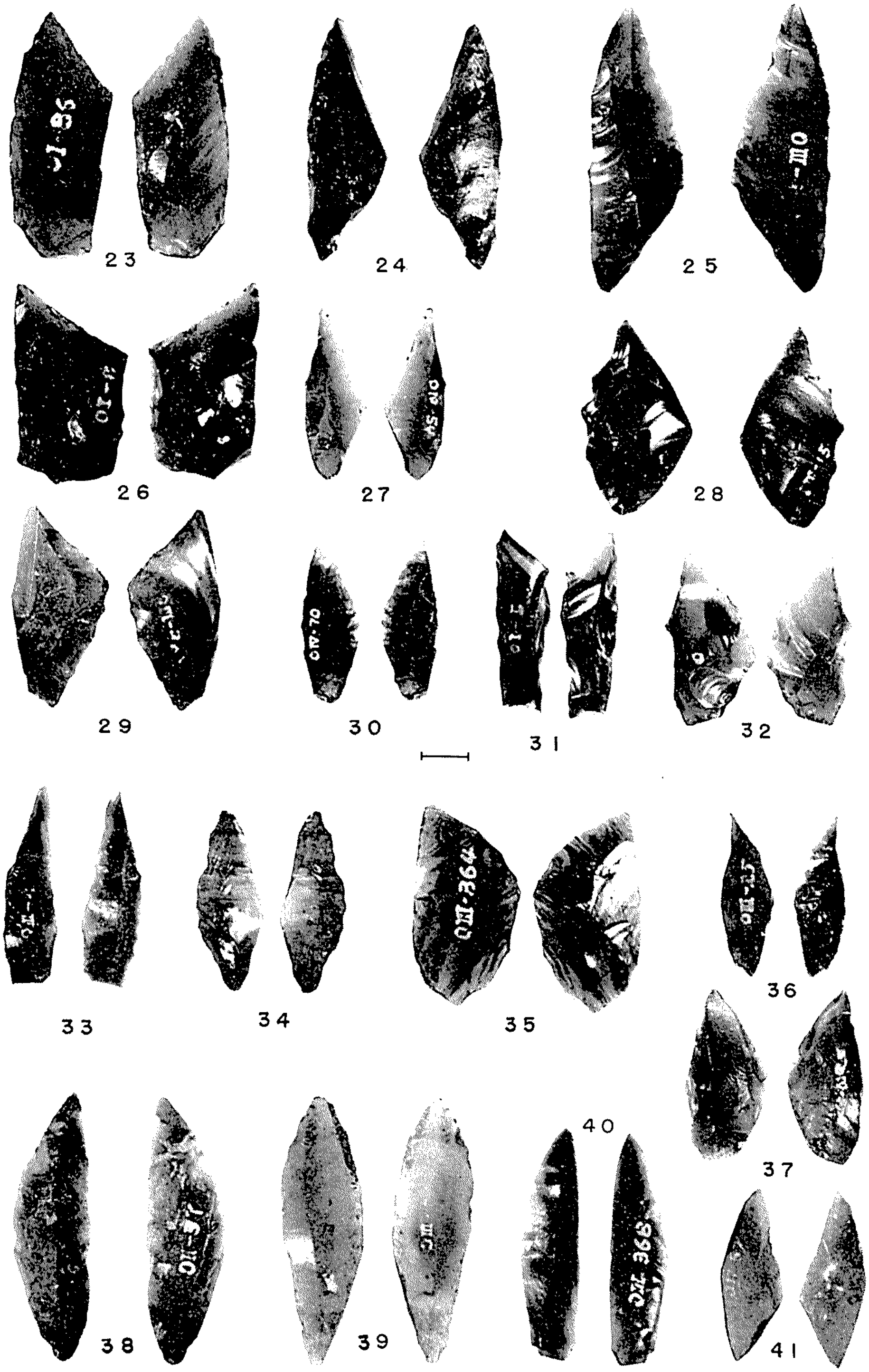
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