

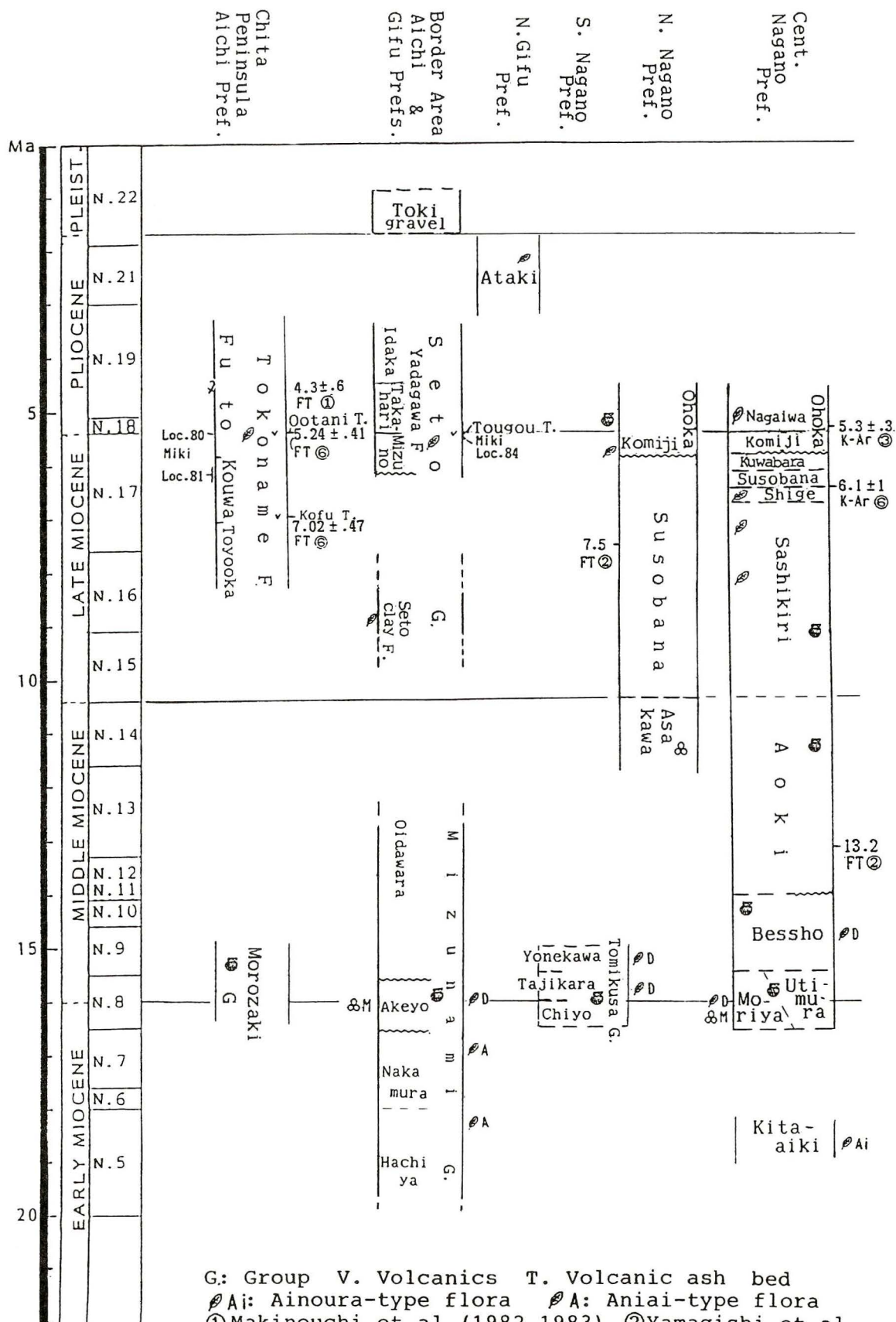
STRATIGRAPHIC CORRELATION OF THE PLANT-BEARING FORMATIONS AND CORRELATION OF THE FLORAS

Neogene biostratigraphy and chronology in Japan have been markedly progressing, and were compiled in the international scale, based on the inter-regional correlation by utilizing microfossils (Tsuchi et al., 1981; Ikebe and Tsuchi, 1984). However, their elaboration for Neogene correlation have been done principally for the marine sediments, but sparsely for the terrestrial sediments. Neogene formations of central Honshu which made up largely of marine sediments, are recently well dated, as in the case of Niigata, Toyama, Shizuoka and southern Kanto regions. In northern Kanto and central Nagano regions discussed here, the lacustrine sediments are prevailed in the Neogene, especially in the middle and upper parts. These lacustrine plant-bearing formations have been behind in their precise age-assignments and correlation. However, the recent accumulation of the radiometric ages of interbedding volcanic and pyroclastic rocks has made partly possible to date Neogene terrestrial sediments of Honshu including plant fossils.

Neogene sequences including fossil floras of central Honshu, which are described in the preceding chapters, are shown in Figure 18. The lowest-Middle Miocene or Uppermost Lower Miocene marine sediments are well defined by a datum level of planktonic foraminifer assemblage correlative with N. 8 of Blow's zone. The shallow-marine and lacustrine formations younger than this datum level, are placed mostly by their radiometric ages concerned.

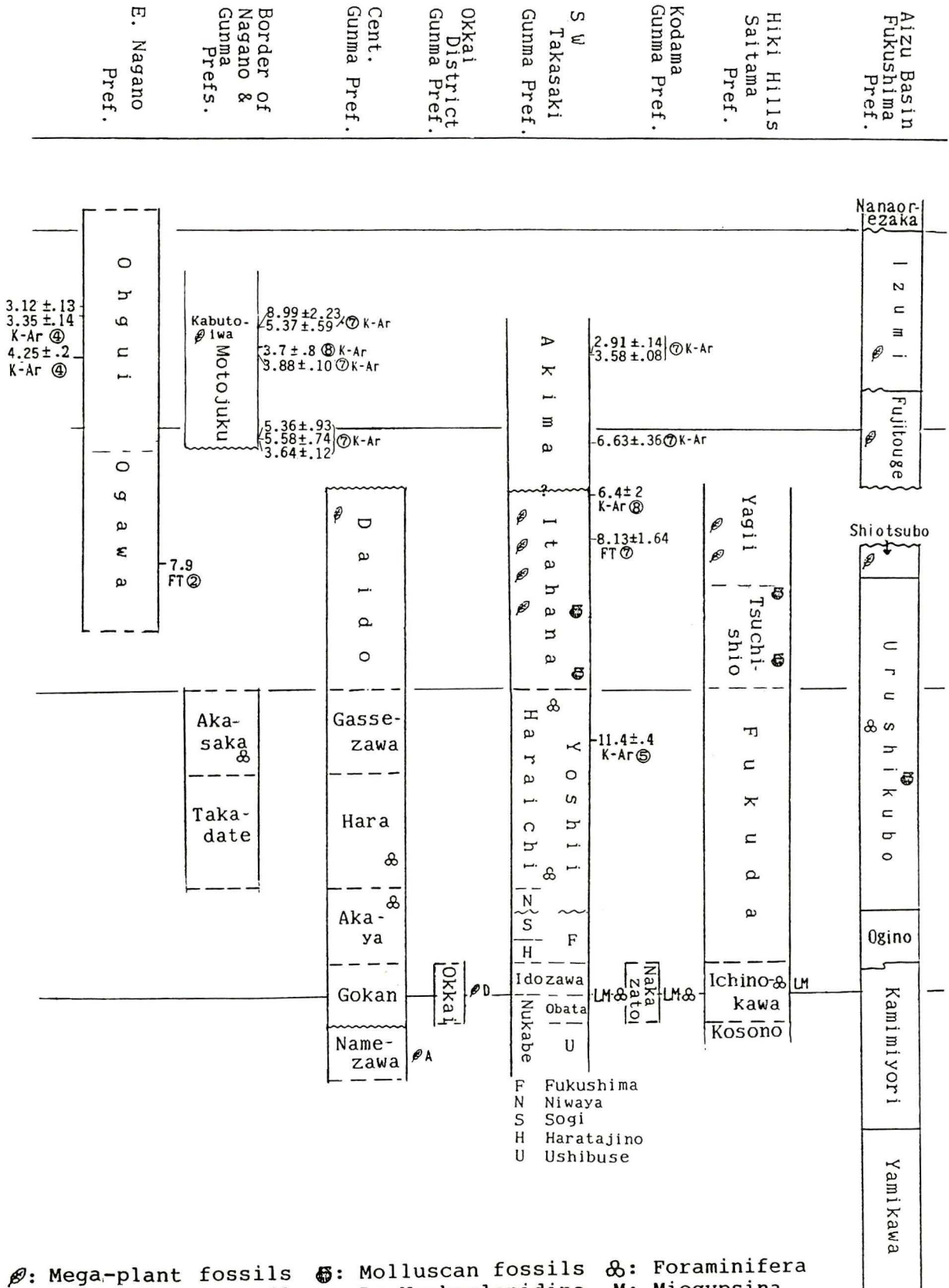
The Itahana Formation is considered to be the Late Miocene on the basis of the radiometric ages. The Hirakata tuff in the base of the Yagii Formation distributed along Arakawa River is correlated with the Tate tuff obtained in the middle of the Itahana Formation (Homma, 1987), and the upper part of the Yagii Formation may correspond to the middle part of the upper Itahana Formation, judging from a dominance of conglomerates. The Daido Formation is probably contemporaneous with the Itahana Formation on the basis of their lithology. Some radiometric ages on the Ogawa Formation and its correlatives in Nagano Prefecture indicate that the formations are Late Miocene in age, and that the Miocene-Pliocene boundary in north-central Nagano Prefecture is in the Ohgui Formation. The Miocene-Pliocene boundary in the Seto Group in Aichi Prefecture can be placed around the horizon of Tougou and the Ootani tuff (volcanic ash) beds. As the Seto porcelain clay Formation in Seto and southern area contains no tuff bed (Kuwahara, 1971), it is considered that the formation is older than the Tokoname Formation which contains many tuff beds. So, the Seto porcelain clay Formation is probably from 8 to 10 Ma in age. The Kabutoiwa (Upper Motojuku) Formation is of the Lower Pliocene, considering from the radiometric ages.

For analysis of the paleoenvironments and paleovegetation indicated by the fossil flora is used the distribution of the extant equivalent of fossil species. To compare 8 floras described in preceding pages, the floristic feature of each flora is diagrammed by the proportion of cumulative numbers of the most related extant species distributed in 1 to 7 forest zones which were designated in chapter 3 (Figure 19). The relative abundance of the living species in each forest zone is shown by bar graphs. The ordinate represents the percentage of number of species against the total number in each forest zone, and the numerals on the abscissa indicate the forest zones. The original values are given in Table 49. To facilitate the comparison floristic composition, the top of the upper warm temperate forest zone (3) and the top of the lower cool temperate forest zone (4) are tied. The tie line slants rightward when the warm



G: Group V. Volcanics T. Volcanic ash bed
 Ai: Ainoura-type flora A: Aniai-type flora
 ① Makinouchi et al. (1982, 1983) ② Yamagishi et al.
 ⑤ Shibata et al. (1979) ⑥ Hayashi and Fujii (1985)

Fig. 18. Stratigraphic Correlation in Central Honshu



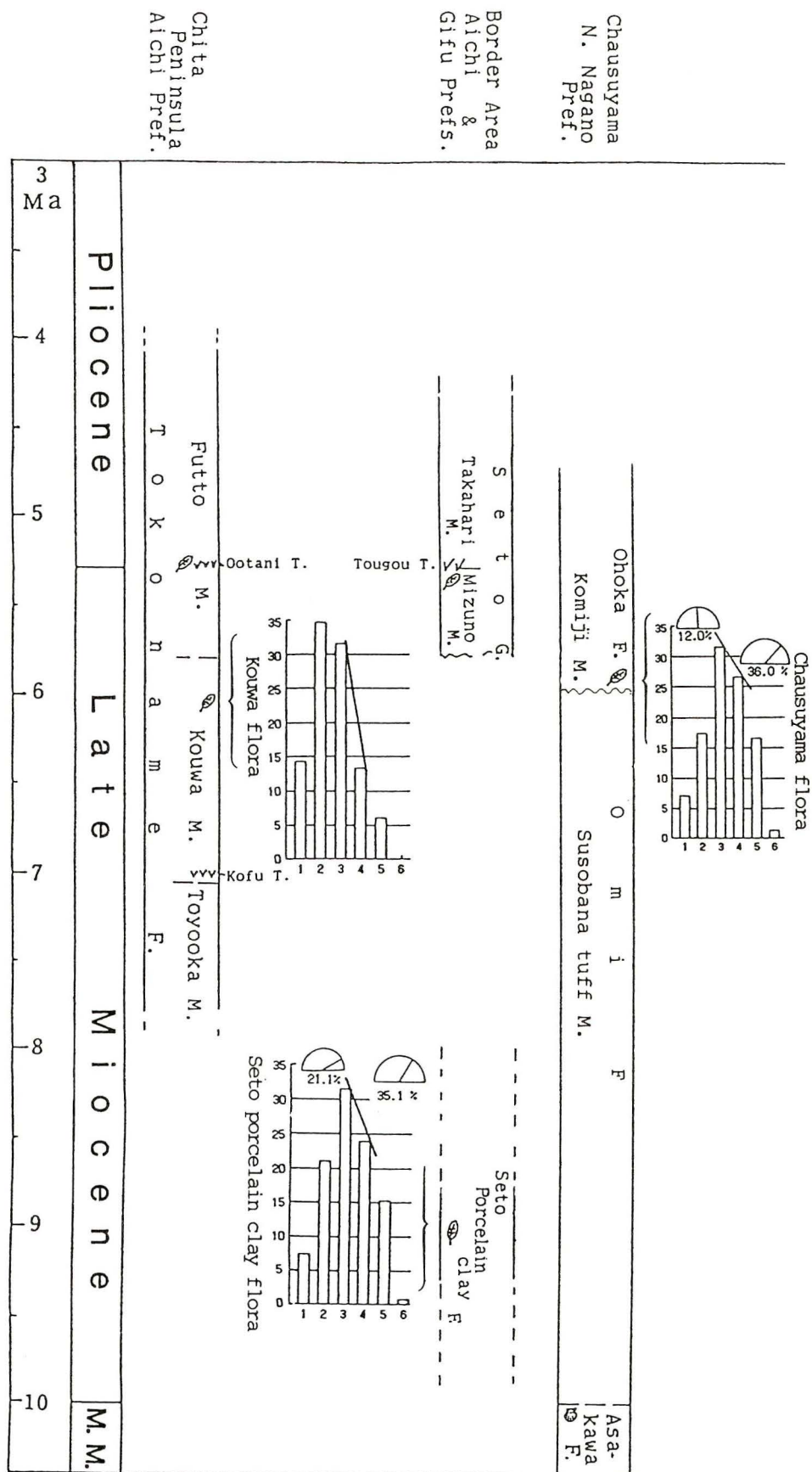


Fig. 19. Relative abundance of the distribution of living species most allied to the fossil ones (bar graph), ratio of the evergreen broad-leaved species (left semicircle graph), and ratio of the entire-margined broad-leaved species (right semicircle graph) in each flora.

G.: Group F.: Formation M.: Member V.: Volcanics T.: tuff bed

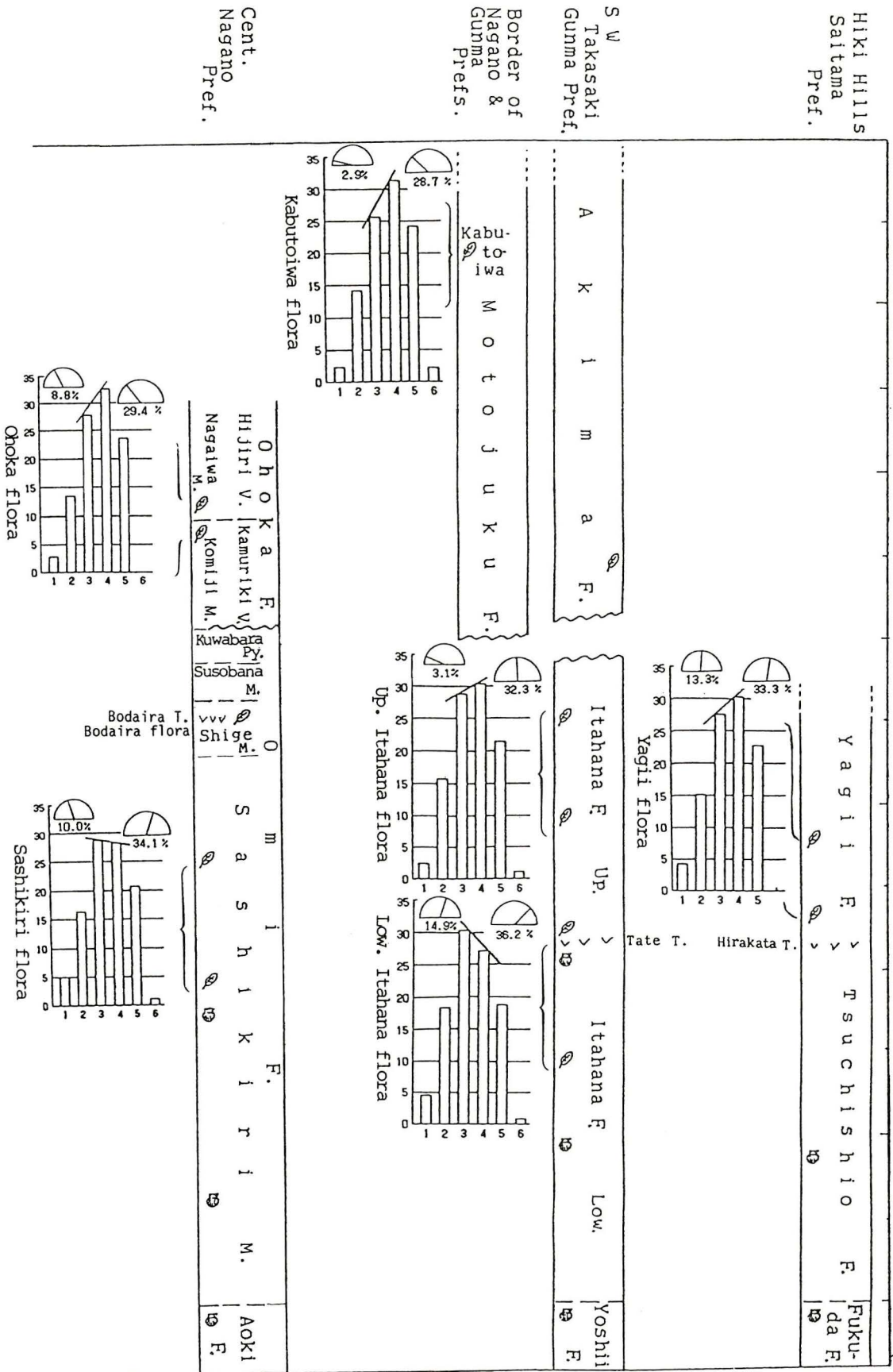


Table 49. Integrating Numbers and Percentages of the Each Zone.

	Seto		Yagii		L. Itahana		U. Itahana		Sashikiri		Chausuyama		Ohoka		Kabutoiwa	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
7	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	1.0	0.54	0.0	0.00	0.0	0.00	7.0	0.80
6	0.0	0.00	1.0	0.87	1.0	0.88	1.0	0.74	1.0	0.54	1.0	1.37	0.0	0.00	3.5	1.41
5	18.5	14.23	27.5	23.81	22.5	19.74	31.0	22.79	37.5	20.44	12.0	16.44	18.0	23.84	58.5	23.49
4	31.0	23.85	34.5	29.87	35.5	31.14	41.5	30.51	53.0	28.88	19.5	26.71	24.5	32.45	78.5	31.53
3	41.0	31.54	31.0	26.84	33.5	29.38	36.0	26.47	52.5	28.61	23.0	31.51	21.0	27.81	64.0	25.70
2	29.5	22.69	16.5	14.29	17.5	15.35	22.5	16.54	29.5	16.08	12.5	17.12	10.0	13.25	37.5	15.06
1	10.0	7.69	5.0	4.33	4.0	3.51	4.0	2.94	9.0	4.90	5.0	6.85	2.0	2.65	5.0	2.00
	129.0	100.00	115.5	100.01	114.0	100.00	136.0	99.99	183.5	99.99	73.0	100.00	75.5	100.00	249.0	99.99

1 : Subtropical forest zone 2 : Lower warm temperate forest zone 3 : Upper warm temperate forest zone 4 : Lower cool temperate forest zone
5 : Upper cool temperate forest zone 6 : Subalpine forest zone 7 : Alpine forest zone

temperate forest zone species are abundant, and leftward when the cool temperate forest zone species are abundant. The Kouwa flora reported by Miki from the Kouwa Member in Chita Peninsula is presented for reference, though the number of species is small. The semicircle on the right shoulder of the bar graph indicates the proportion of the entire-margined broad-leaved species in the flora. Its left end corresponds to 25% and the right end to 40%. The semicircle on the left shoulder of the bar graph indicates the proportion of the evergreen broad-leaved species in the flora. Its left end corresponds to 0% and the right end to 25%.

The Seto porcelain clay flora from the Seto porcelain clay Formation and the Lower Itahana florule from the lower Itahana Formation are close in the stratigraphic horizon and have similar composition and component. The similarity is indicated in the bar and semicircle graphs, though the ratio of the evergreen broad-leaves species is higher in the Seto flora than in the Lower Itahana florule. These two floras have largest number of the most allied living species in the zone 3 (upper warm temperate forest zone) and abound in the entire-margined and evergreen broad-leaved species. The difference between the above two floras may partly reflect the paleogeographic difference ; the lower Itahana Formation was deposited at the sea, and the Seto porcelain clay Formation was deposited in inland lakes.

In the Upper Itahana florule the tie line of the bar graph slants leftward in contrast to the Lower Itahana florule in which the tie line slants rightward. Corresponding to this trend, the proportion of the entire-margined species and those of the evergreen broad-leaved species decrease also in the Upper Itahana florule.

The Yagii flora resembles the Upper Itahana florule in both the bar and semicircle entire-margined species graph, but is different in the ratio of evergreen broad-leaved species. It is well consistent with stratigraphic correlation that the Yagii Formation is correlated with the middle part of the Itahana Formation. The evergreen broad-leaved species occurs only in the lower part of the upper Itahana Formation, whereas they are found throughout the Yagii Formation.

In the Sashikiri flora from the Sashikiri Member of the lower Ogawa Formation, the tie line of the bar graph merely slants rightward. This trend along with the semicircle graphs indicates an aspect intermediate between the Lower and the Upper Itahana florules.

The Chausuyama flora from the base of the Ohoka Formation is rather different in both graphs from the Sashikiri flora. The Chausuyama flora is closely similar in the bar graph to the Seto porcelain clay flora, and it represents the semicircle graphs during about 6 Ma when the evergreen broad-leaved forest developed widely in the central Honshu.

In the Ohoka flora from the Latest Miocene showing the maximum value in the forest zone 4, the tie line declines steeply leftward. This flora has rather small proportion in both the semicircle graphs. It is suggested the climate indicated by the Ohoka flora became fairly cold in comparison with the Chausuyama flora. The minor floras from the Ootani and Tougou volcanic ash beds of the Seto Group in Aichi Prefecture are also lacking in evergreen broad-leaved species. The Akima flora lacking evergreen broad-leaved species is composed mostly

of beech leaves, although meagre in the number of species. It is considered that the Ohoka, the upper Seto and the lower Akima floras represent cool climate during latest Miocene to early Pliocene time.

The Kabutoiwa flora in the middle Pliocene has the leftward-slanted tie line in the bar graph, and small proportion in both the entire-margined and evergreen broad-leaved graphs. These features show a similar aspect to the Ohoka flora. But it is considered that temperature on lowland indicated by the Kabutoiwa flora was warmer than those of the Ohoka flora, because the Kabutoiwa Formation is supposedly the upland deposits.

We can easily understand the changes of floristic composition during Late Miocene to Pliocene in Central Hoshu in the illustrations of Fig. 19. Early Late Miocene forests (8–9 Ma) represented by the Seto porcelain and Lower Itahana floras, were predominant in the elements of the warm forest zone. Toward the middle Late Miocene (8–7Ma) the forests were dominated by the elements of the cool temperate forest zone, as represented by the Yagii, Sashikiri and Upper Itahana floras. Late- Late Miocene (About 6 Ma) forest appears to have been predominant again in the elements of the warm forest zone, as shown in the Bodaira and Chausuyama floras. Pliocene forests represented by the Ohoka and Kabutoiwa floras, show cool temperate aspect.