(Original paper)

The Vegetation and Climate History during the Early and Mid Last Glacial Period in Kamiyoshi Basin, Kyoto, Japan

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(Received Sep. 30, 2000, Accepted Nov. 29, 2000)

The pollen record of a core from Kamiyoshi Basin in western Japan provided a continuous vegetation and climate history from 91 to 30 kyr BP. The chronology was based on widespread tephra, AMS ^{14}C dates and correlation of the core with SPECMAP marine oxygen isotope record. During isotope substage 5b, temperate conifer forests developed, composed of *Cryptomeria japonica* and *Sciadopitys verticillata*, associated mainly with Cupressaceae trees and cool-temperate deciduous broad-leaved trees, indicating a wet and temperate climate. Temperate conifer forests were composed primarily of *Cryptomeria japonica* during isotope substage 5a. Colder temperatures and decreasing precipitation are indicated by pinaceous conifer vegetation dominated by *Tsuga*, *Picea*, and *Pinus* subgenus *Haploxylon* between 70 and 60 kyr BP, corresponding to isotope stage 4. Around 60 kyr BP, this was followed by cool-temperate deciduous broad-leaved forests composed mainly of *Fagus crenata*, *Quercus* subgenus *Lepidobalanus* and *Ostrya / Carpinus*. Temperate conifer forests dominated by Cupressaceae trees with *Tsuga*, *Pinus*, *Sciadopitys verticillata*, *Cryptomeria japonica* and *Lepidobalanus* (deciduous oaks) occurred in the interstade (isotope stage 3). Especially, between 45 to 30 kyr BP, Cupressaceae trees were most dominant in forests. The correlation between this record and one from Kurota Lowland reveals differences in vegetation between the inland area and the coastal area of the Japan Sea during isotope stage 3. In the inland Kamiyoshi Basin, Cupressaceae trees were dominant, associated with *Sciadopitys verticillata* and deciduous oaks. Meanwhile in Kurota Lowland, adjacent to the Japan Sea, *Cryptomeria japonica* was dominant, associated with cool-temperate deciduous broad-leaved trees such as *Fagus crenata* and deciduous oaks. The difference in vegetation probably indicates a slightly drier climate in the inland area and a wet and heavy snow climate in the coastal Japan Sea area during isotope stage 3.

Key Words : Late Quaternary, vegetation and climate history, Pollen record, oxygen isotope stage, western Japan

Introduction

A great number of pollen records for the Holocene and the last full-glacial period have recently become available in Japan. Differences in vegetation among regions and for specified time periods, as well as patterns of species migration (e.g., *Cryptomeria japonica*), have been discussed by comparing pollen data [e.g., 1-4]. However, the pollen records prior to the full-glacial period during the latter part of the Quaternary are insufficient to discuss the regional response of vegetation to global climate changes. In a special issue of *Palaeogeography, Palaeoclimatology, Palaeoecology*, 'Palaeoecological Records of The Last Glacial / Interglacial Cycle : Patterns and Causes of Change', Kershaw and Whitlock (2000) [5] found that the Last Glacial Maximum (LGM) and Holocene stand out in the majority of records for the last 130,000 years as periods of anomalous vegetation and climate. More pollen data prior to the LGM are therefore needed to understand modern vegetation patterns.

It is often difficult to obtain a good chronology prior to the LGM because the sediments are beyond the limit of radiocarbon dating. However, in Japan there are several widespread tephra layers to indicate chronology. The Japanese Islands have never had any ice sheets aside from mountain glaciers, even during the LGM [6-7]; therefore, there are terrestrial sediments that record continuous vegetation histories since the last interglacial period. Fluctuation of the monsoon and of current flows in the Pacific Ocean and the Japan Sea during this period would have influenced vegetation changes in Japan. Palaeoecological data from Japan should therefore contribute significantly to clarifying climate dynamics in the Eurasian Continent.

In this paper, we present palynological data for between 91 and 30 kyr BP from an inland area in western Japan. These data are then compared with palynological data from Kurota Lowland [8] in the northern part of the Kinki region (Fig. 1), to investigate differences of vegetation and climate between the inland and the coastal Japan Sea areas.

Study area

Kamiyoshi Basin is situated in an inland area in the Kinki region, western Japan. Kamiyoshi is located in Funai-gun, Kyoto Prefecture, about 20 km northwest of Kyoto City. The basin is at an altitude of 335 m, in the southern region of the Tanba mountains, which extend inland from the Japan Sea. The diameter of the basin is 0.5 - 0.8 km. The coring location was at 35°06'08"N, 135°35'10"E (Fig. 1).

According to meteorological data [9] from Sonobe Climatological Station (10 km west of the study site, 130 m alt.), annual precipitation is 1618 mm and annual mean temperature is 14.2 ℃, with low and high monthly mean temperatures of −2.5 ℃ in January and 32.6 ℃ in August, respectively.

The site is situated in the warm-temperate zone. Almost all of the basin is covered by rice paddies. The climax vegetation of the hillslopes in the area is warm-temperate evergreen broad-leaved forest, composed mainly of evergreen oaks and *Castanopsis*. The climax vegetation above 600 m altitude is cool-temperate deciduous broad-leaved forest, composed mainly of beech (*Fagus crenata*) and deciduous oak (*Quercus crispula*). Most of the modern vegetation, however, is now secondary forests dominated by Japanese red pine (*Pinus densiflora*) and deciduous oaks (*Quercus serrata*), or plantations of Japanese cedar (*Cryptomeria japonica*) and Japanese cypress (*Chamaecyparis obtusa*).

Methods

A sediment core, 15.75 m in length, was taken from a rice paddy in Kamiyoshi Basin. The whole core was obtained with a Thomas-type hand borer. The upper part between 0 and 5.5 m was also recovered with a

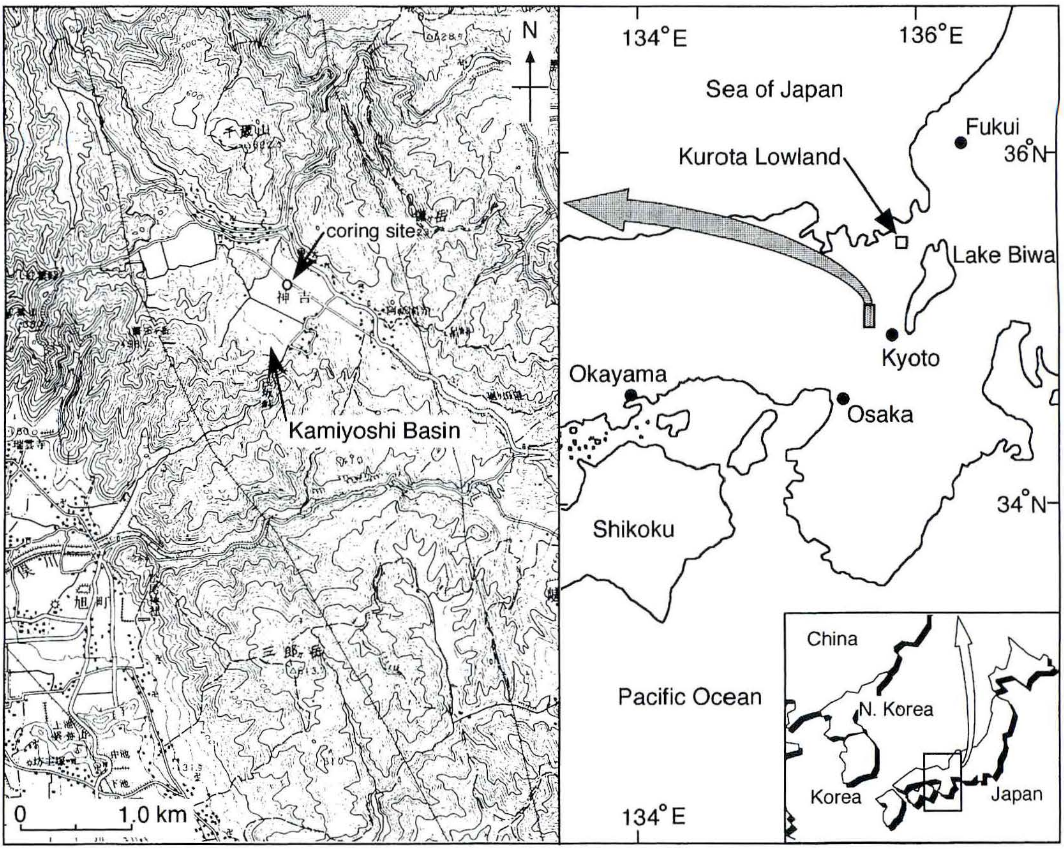


Fig. 1. Map showing the location of Kamiyoshi Basin and Kurota Lowland [8]. The left-hand map is a part of the 1 : 50,000 topographical map of Kyoto-seihokubu (northwestern part of Kyoto City) issued by the Geographical Survey Institute of Japan.

6.0-cm-diameter thin wall sampler.

Between 2.1 and 15.7 m depth, one-cubic-centimeter samples were taken every 30-50 cm from peat and peaty clay layers for pollen analysis. Thirty-three samples were prepared by standard KOH, acetlysis and HF procedures [10]. Also, to determine pollen concentration, a known concentration (20.2×10^4 grains / ml) of 25-micrometer plastic microspheres in suspension [11] was added to each sample before chemical procedures. All fossil pollen grains and spores extracted from samples were preserved in sample tubes with silicon oil. At least 500 tree pollen grains were counted for each level, except where pollen concentrations were too low. The percentages of each taxon in the pollen diagram (Fig. 3) were calculated based on the sum of the tree pollen. *Alnus* was excluded from the tree pollen sum because of its high frequency, considered derived from *Alnus* thickets, which are abundant in Japanese bogs.

Results and interpretation

Lithology and chronology

The lowermost part between 15.75 and 12.80 m depth was a woody peat layer. Within this layer, a tephra was recognized from 15.37 to 15.38 m and a peaty clay from 12.80 to 11.75 m. The layer from 11.75 to 8.90 m was a decomposed peat. From 8.90 to 8.15 m was a peaty clay. A decomposed peat was recognized again from 8.15 to 7.60 m. The layer from 7.60 to 3.15 m was a peaty clay with seeds and plant fragments. From 3.15 to 2.00 m was a peat with seeds of *Trapa*. A white clay layer ranged from 2.00 to 1.35 m, and a tephra layer from 1.35 to 1.16 m. The layer from 1.16 to 0.80 m was a peat. Finally, the uppermost part from 0.80 to 0 m was disturbed soil due to agricultural activities in the rice paddy.

The upper tephra layer from 1.35 to 1.16 m was identified as Aira-Tn (AT), based on the refractive index of volcanic glass shards (Table 1) and the thickness of the layer (19 cm). The tephra layer from 15.37 to 15.38 m was characterized by beta-quartz in the bubble-walled glass shards. This feature, and the refractive index of the volcanic glass shards (Table 1), indicated that this was Kikai-Tozurahara (K-Tz) ash. The AT ash deposited at 25,000 yr BP [(12)]. Yoshikawa and Inouchi (1993) [(13)] estimated the ages of AT and K-Tz at 25,000 and 91,000 yr BP. Two ^{14}C dates were obtained from samples of the bulk peat and from a piece of *Trapa* seed (Table 2).

The age-depth relationship of the core is shown in Fig. 2. Linear age-depth relationship represented by a broken line in Fig. 2 is tentative until further dating conducted. The average sedimentation rate from 15.37 m to 1.35 m was 0.02124 cm / year. Almost all Holocene sediments were missing, judging from the date above the AT ash layer.

Pollen records and reconstruction of vegetation

A pollen diagram is shown in Fig. 3. Cupressaceae-type pollen in the diagram includes Cephalotaxaceae, Taxaceae and Cupressaceae pollen. Also, the Japanese Cupressaceae consist of *Thuja*, *Thujopsis*, *Chamaecyparis* and *Juniperus* whose pollen are difficult to separate morphologically. The pollen stratigraphy was divided, using stratigraphically constrained incremental sum of squares cluster analysis (CONISS in Tilia 2.05b) [(14-15)], into seven local pollen assemblage zones on the basis of the tree pollen frequencies (Fig. 3).

The lower zones (KMY-1, KMY-2 and KMY-3) were characterized by the dominance of *Cryptomeria japonica* pollen. Relatively high percentages of pinaceous conifer (KMY-4) and deciduous broad-leaved tree (KNY-5) pollen occurred in the middle zones. In the upper zones (KMY-6 and KMY-7), Cupressaceae-type pollen was predominant. In terms of shrub and herbaceous pollen, the percentages of *Myrica* pollen were high in zone KMY-4, *Alnus* pollen levels were generally high in zones KMY-1, KMY-2, KMY-5 and KMY-6, Gramineae and Cyperaceae pollen had significant but variable representation in zones KMY-1, KMY-2, KMY-4, KMY-5 and KMY-6, and there was a high percentage of *Lysichiton* pollen in zones KMY-1 and KMY-3.

Table 1. Refractive index of volcanic glass shards in the sediment from Kamiyoshi Basin

Depth (cm)	Minimun	Maximum	Mean	St. dev	Count*
116 - 135	1.4977	1.5008	1.4992	0.0007	28
1537 - 1538	1.4978	1.5007	1.4992	0.0007	30

*Count of glass shards

Table 2. Radiocarbon dates for the samples from Kamiyoshi Basin

Depth (cm)	Material	Age (^{14}C yr BP)*	Method	Lab. number
90 - 96	peat	2210 ± 60	radiometric	Beta- 83409
542	*Trapa* seed	44970 ± 1600	AMS	Beta-125950

*the result after applying ^{13}C / ^{12}C corrections to the measured age

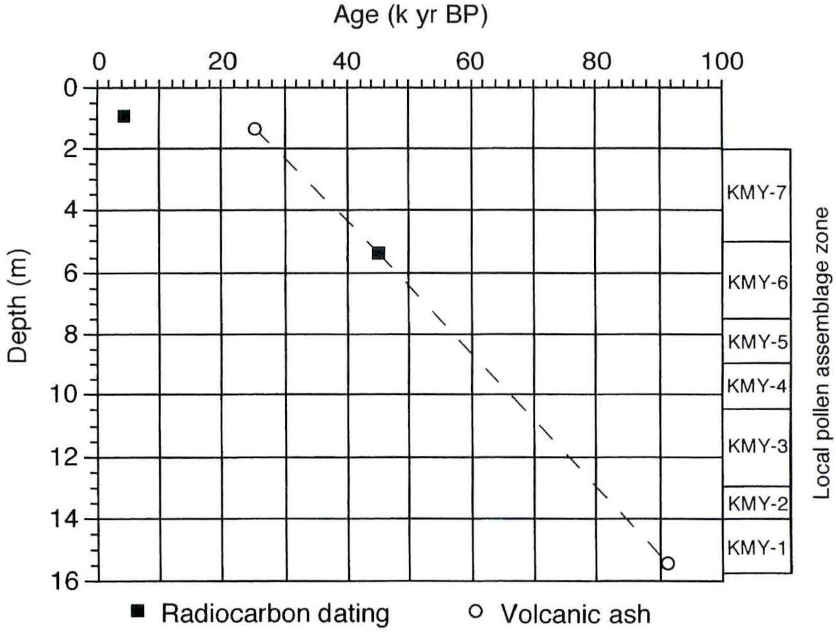


Fig. 2. Age-depth relationship of the core from Kamiyoshi Basin. Radiocarbon dates are shown in Table 2. Ages of volcanic ash layers are based on Matsumoto et al. (1987) [12] and Yoshikawa and Inouchi (1993) [13]. A broken line represents tentative linear age-depth relationship until further dating conducted. Local pollen assemblage zone on the right-hand is indicated in Fig. 3.

Zones KMY-1 and KMY-2

These zones show high percentages of *Cryptomeria japonica* pollen (25 – 69%) and relatively high percentages of *Sciadopitys verticillata* pollen (8 – 31%), except at a depth of 14.2 m. In the uppermost part of zone KMY-1, there is a prominent increase of Cupressaceae-type pollen, while frequencies of *Cryptomeria japonica* and *S. verticillata* pollen decline. Percentages of *Ostrya / Carpinus* and *Lepidobalanus* pollen are 2 – 6 % and 2 – 7 %, respectively, through zones KMY-1 and KMY-2. In zone KMY-1, 2 – 5% is *Betula* pollen. In zone KMY-2, 13% and 8 % is *Fagus crenata* and *Fagus japonica* pollen, respectively.

During the period of zones KMY-1 and KMY-2, *Cryptomeria japonica* was the main component of forests, associated with *Sciadopitys verticillata* and probably with Cupressaceae trees. *C. japonica* was especially dominant in the early stage of this period. However, around the end of zone KMY-2, Cupressaceae trees became dominant within a relatively short period. During the period of zone KMY-2, *Fagus crenata*, which is a cool-temperate element, increased in the temperate conifer forests.

Zone KMY-3

In zone KMY-3, values of *Cryptomeria japonica* pollen are generally higher than in zones KMY-1 and KMY-2, while *Sciadopitys verticillata* percentages decreased to 2 – 9 % and Cupressaceae-type percentages remaine at 4 – 19 %. Also, frequencies of pinaceous pollen, including *Tsuga*, *Picea* and *Pinus*, increase slightly in the lower part of the zone, while the percentages of temperate deciduous trees pollen show reductions.

The pollen assemblage of zone KMY-3 indicates that *C. japonica* was still the main component of the forests but that pinaceous conifer trees such as *Tsuga*, *Picea* and *Haploxylon* pine increased in the first half of the

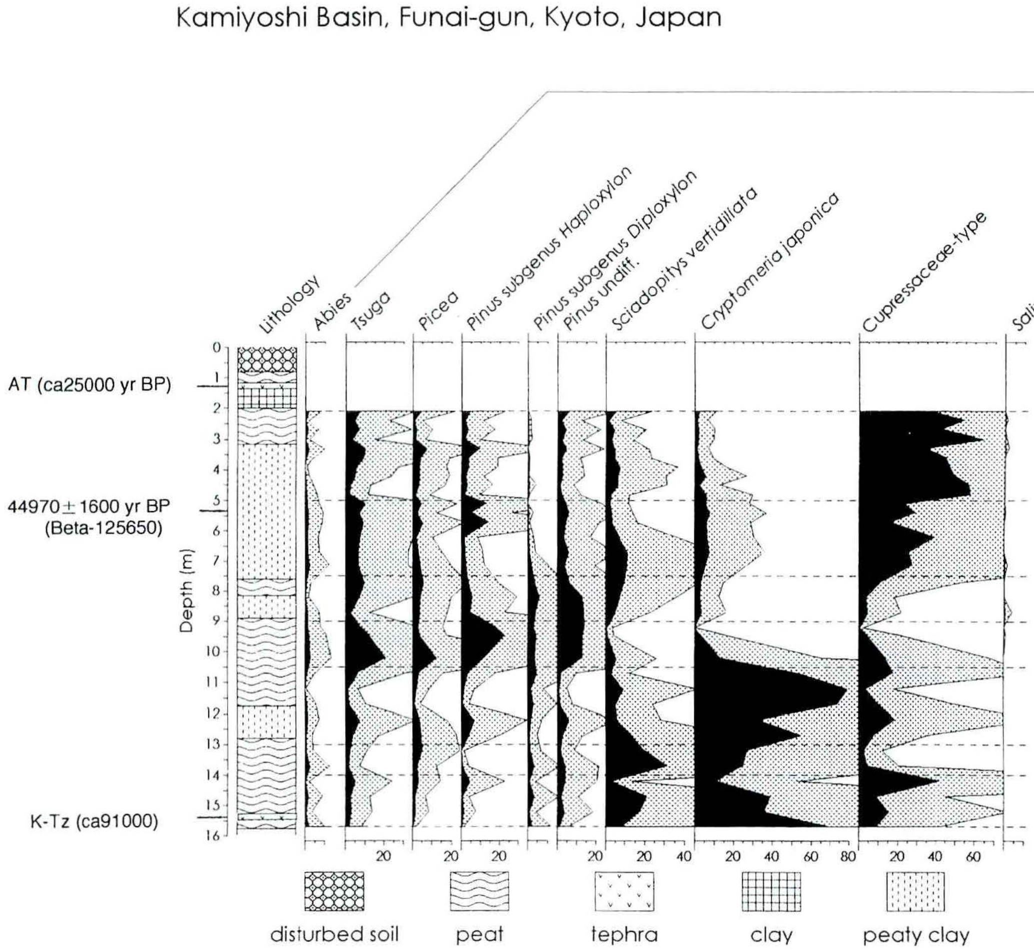


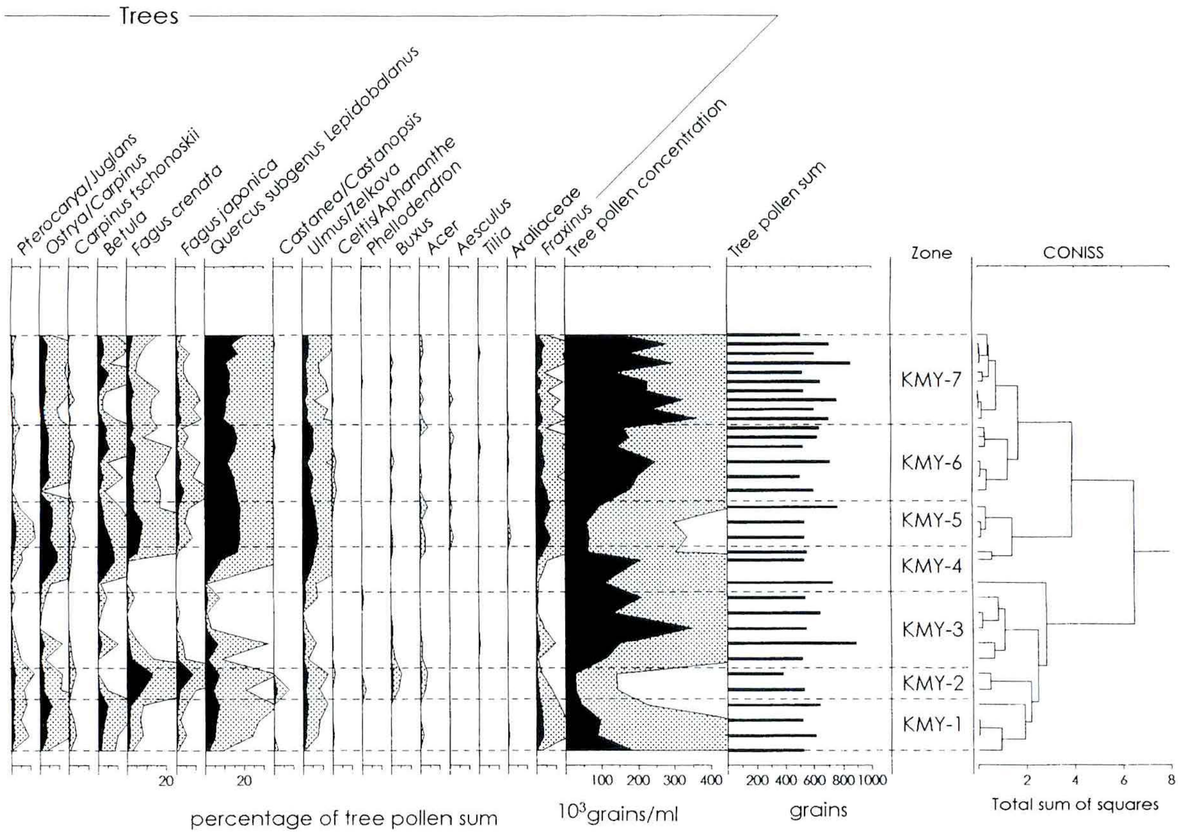
Fig. 3. Pollen percentage and concentration diagram from Kamiyoshi Basin. Cupressaceae-type pollen includes Cephalotaxaceae, Taxaceae and Cupressaceae pollen. Shaded pattern shows 5 × exaggeration.

zone, and deciduous broad-leaved trees showed a decline around the middle of the zone.

Zone KMY-4

In zone KMY-4, 47 – 64 % of the pollen is pinaceous, including *Abies*, *Tsuga*, *Picea* and *Pinus*, while percentages of *C. japonica* pollen decreased abruptly to 2 – 3 %. In the upper part of zone KMY-4, pollen from deciduous broad-leaved trees increase (38%), including *Ostrya / Carpinus*, *Betula*, *Lepidobalanus* and *Ulmus / Zelkova* and *Fraxinus*. The lowest percentages of *Sciadopitys verticillata*, *Cryptomeria japonica* and Cupressaceae-type pollen are recorded in zone KMY-4.

The period of this zone is characterized by the development of pinaceous conifer forests. In the latter half of the zone, these forests were associated with temperate deciduous broad-leaved trees such as *Lepidobalanus*, *Ostrya / Carpinus* and *Betula*.



Zone KMY-5

Pollen of deciduous broad-leaved trees (45 – 51%), which include *Ostrya / Carpinus*, *Betula*, *Fagus crenata*, *F. japonica*, *Lepidobalanus*, *Ulmus / Zelkova* and *Fraxinus*, become dominant in zone KMY-5. Cupressaceae-type pollen also shows a gradual increase in this zone.

This pollen assemblage represents the development of cool-temperate, deciduous, broad-leaved forests composed mainly of *Fagus crenata*, *Lepidobalanus*, *Ostrya / Carpinus*, *Ulmus / Zelkova* and *Fraxinus*. Pinaceous conifer forests also existed near the site.

Zones KMY-6 and KMY-7

Zones KMY-6 and KMY-7 are characterized by a predominance of Cupressaceae-type pollen (16 – 64%), with relatively high percentages of *Lepidobalanus* pollen (9 – 21%). The percentages of Cupressaceae-type

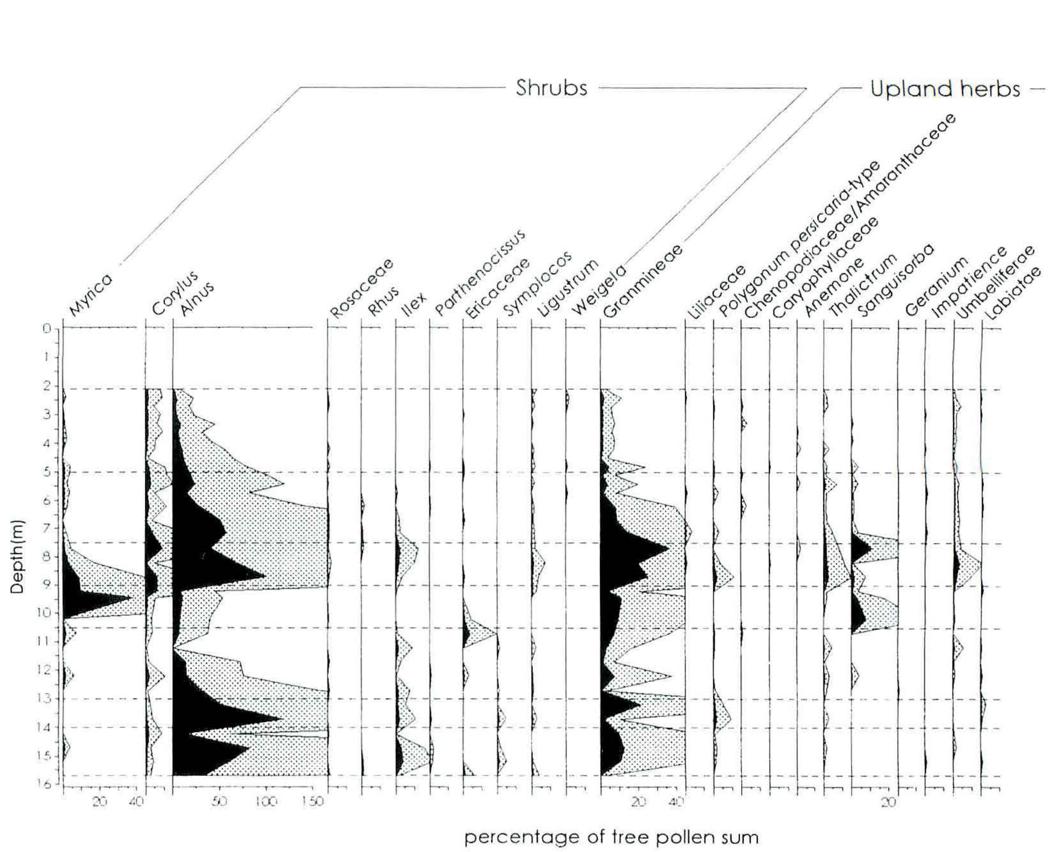


Fig. 3. (continued).

pollen are much higher in zone KMY-6 than in zone KMY-7.

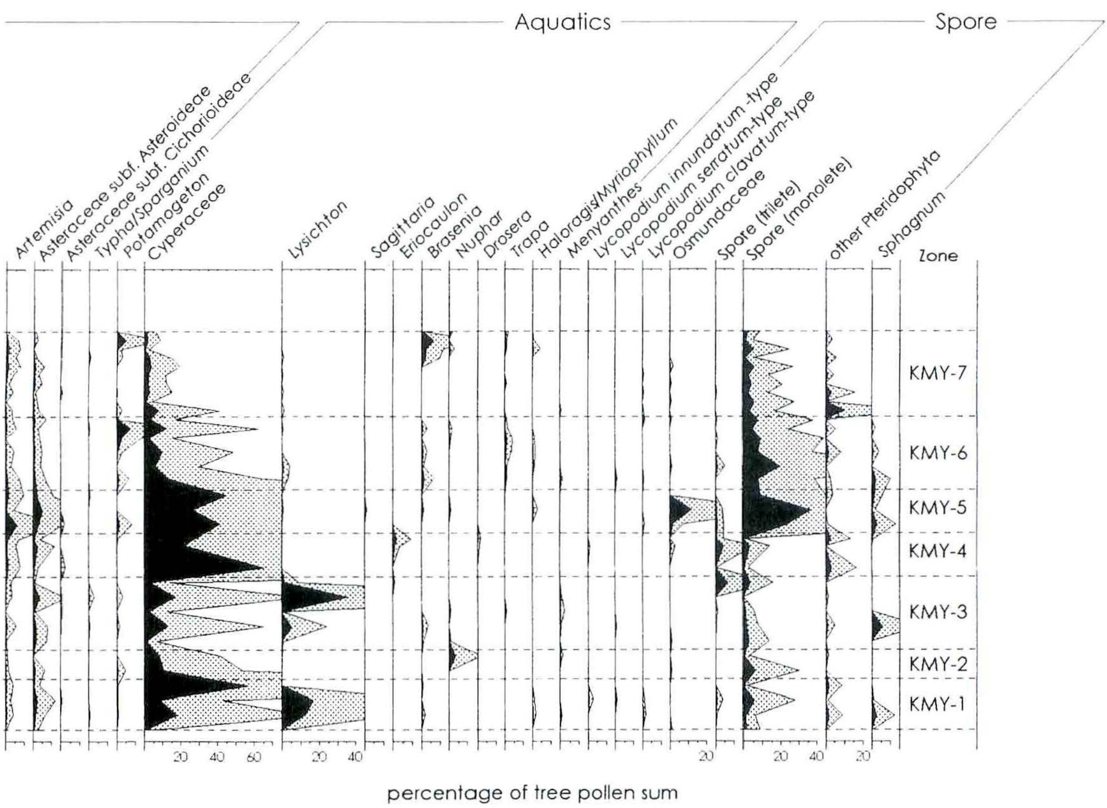
Temperate conifer forests dominated by Cupressaceae trees with *Tsuga*, *Pinus*, *Sciadopitys verticillata*, *Cryptomeria japonica* and *Lepidobalanus* occurred in the period of zones KMY-6 and KMY-7. The major pollen taxa of zone KMY-6 are typical of modern spectra from the temperate conifer zone (~ 700 m altitude) in western Japan. Between 45 and 30 kyr BP (zone KMY-7), Cupressaceae trees became dominant in these forests.

Discussion

Temporal resolution of the pollen record was about 2000 years. Shorter sampling intervals would be desirable for detailed vegetation reconstruction. This temporal resolution is, however, appropriate to correlate the pollen data with the SPECMAP marine oxygen isotope stages, representing the major climate changes at ca. 10−30 kyr intervals before the LGM. The pollen diagram will first be used to reconstruct environment in Kamiyoshi Basin, and will then be correlated with the oxygen isotope stages for bioclimatic interpretation.

Environment reconstruction

The pollen spectra of the core revealed that pinaceous conifers, temperate conifers and temperate deciduous broad-leaved trees were common and in the period from 91 to 30 kyr BP. Also, none of the warm-temperate



evergreen trees such as the *Quercus* subgenus *Cyclobalanopsis* and *Castanopsis* that are components of modern vegetation around the study site, were recongnized in the pollen spectra of this period, indicating a cooler-than-present conditions.

The modern habitats of main pollen taxa from Kamiyoshi Basin are as follows. *Abies*, *Tsuga*, and *Pinus* includes both boreal (subalpine) and temperate (montane) species. A range of *Picea* is the upper cool-temperate and the boreal zones. These pinaceous genera usually can grow in relatively dry condition. *Cryptomeria japonica*, Cupressaceae trees (*Thuja*, *Thujopsis*, *Chamaecyparis* and *Juniperus*) and *Sciadopitys verticillata* prefer a temperate climate from the warm-temperate to the cool-temperate. Today, *Cryptomeria japonica* is densely distributed in areas where the annual precipitation is above 2,000 mm, and it requires a minimum annual precipitation 1,600 mm [16]. On the other hand, genera of Cupressaceae and *Sciadopitys verticillata* can grow in areas with less precipitation from 1,000 to 1,500 mm (Hayashi, 1960). Also, *Cryptomeria japonica* is distributed in both heavy snow and little snow areas, whereas *Sciadopitys verticillata* are difficult to grow in heavy snow areas. As regards broad-leaved taxa, *Fagus crenata* is found in cool and wet conditions and requires a minimum of 900 mm precipitation during the growing season [17]. *Lepidobalanus* (deciduous oak) includes both warm-temperate and cool-temperate species. *Fagus crenata* and *Quercus crispula* (belong to *Lepidobalanus*) are main components of the coo-temperate deciduous broad-leaved forests. On the basis of the composition of taxa in each pollen zone, the environmental conditions can be inferred using the feature for taxa mentioned above.

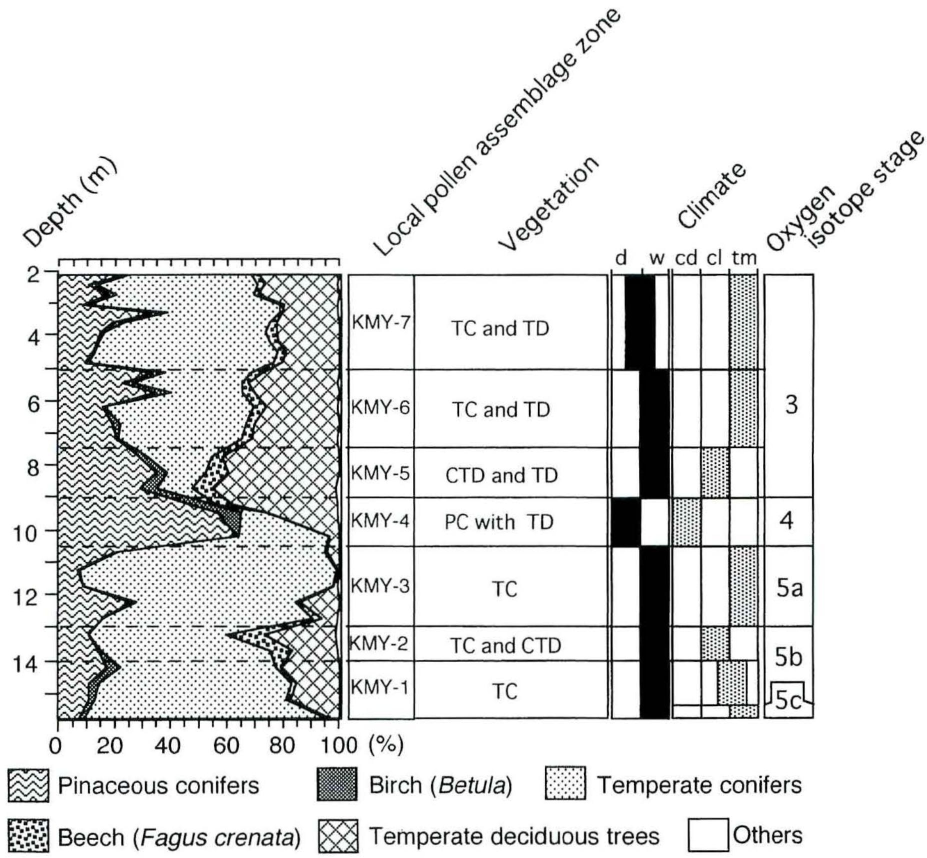


Fig. 4. Summary of tree pollen diagram, reconstructed vegetation and inferred climate and correlation of the local pollen assemblage zones in Kamiyoshi Basin with marine oxygen isotope stages.

*1 Temperate conifers : *Sciadopitys verticillata*, *Cryptomeria japonica* and Cupressaceae-type.

*2 Temperate deciduous trees : *Pterocarya/Juglans*, *Ostrya / Carpinus*, *Carpinus tschonoskii*, *Fagus japonica*, *Quercus* subgenus *Lepidobalanus*, *Castanea / Castanopsis*, *Ulmus / Zelkova*, *Celtis / Aphananthe*, *Phellodendron*, *Acer*, *Aesculus*, *Tilia*, Araliaceae, *Fraxinus*.

Abbreviations. Vegetation : TC = temperate conifers ; TD = temperate deciduous trees ; CTD = cool-temperate deciduous trees ; PC = pinaceous conifers ; Climate : d = dry ; w = wet ; cd = cold ; cl = cool ; tm = temperate. Solid column indicating moisture, shaded column indicating temperature.

The high incidence of *Cryptomeria japonica* pollen in zones KMY-1, KMY-2 and KMY-3, indicates a wet climate with high precipitation, judging from the modern habitat of *C. japonica* mentioned above. The lower part of zone KMY-1 and the middle part of zone KMY-3 showed that *C. japonica* forests spread extensively. An increase of *Fagus crenata* during the period of zone KMY-2 implies a cooler climate than today.

Temperate conifer forests composed mainly of *C. japonica* declined in the period of zone KMY-4, and pinaceous conifer forests including *Abies*, *Picea*, *Tsuga* and *Haploxylon* pine developed. Similar modern vegetation composed of *Abies*, *Tsuga*, *Picea*, and *Haploxylon* pine occures in the upper cool-temperate or the subalpine zones above 1200 m altitude in western Japan. Therefore, pinaceous conifer forests were distributed at lower altitudes than they are today, indicating colder temperatures. Also, the reduction of *C. japonica* and predominance of pinaceous conifers imply decreasing precipitation.

During the period zone KMY-5, the climate is considered to have been wetter than the previous period, since *Fagus crenata*, which prefer a wet climate, increased in forests. The vegetation changes from pinaceous conifer forests to cool-temperate deciduous broad-leaved forests is the same as seen in the late-glacial [e.g. 18].

The development of temperate conifer forests dominated by Cupressaceae trees, associated with *Tsuga*, *Pinus*, *Sciadopitys verticillata*, *Lepidobalanus* during the period of zones KMY-6 and KMY-7 indicates a temperate climate that is cooler than today. It is considered that the decline in *Cryptomeria japonica* which prefer wet conditions indicates that the period was dryer than those of zones KMY-1, KMY-2, KMY-3 and KMY-5.

Correlation between the pollen record and the marine oxygen isotope stages

A summarised pollen daigram for Kamiyoshi Basin and its correlation with the SPECMAP marine oxygen isotope record [19] are shown in Fig. 4. The lowest part of zone KMY-1, which is below the K-Tz layer (91,000 yr BP) and is characterized by the predominance of *Cryptomeria japonica* pollen, indicating wet and temperate conditions, probably corresponds to isotope substage 5c. The reminder of zone KMY-1 and zone KMY-2 correspond to substage 5b, zone KMY-3 to substage 5a, zone KMY-4 to isotope stage 4, and zones KMY-5, KMY-6 and KMY-7 to isotope stage 3.

Ages for intrastages boundaries are interpolated [20] from the SPECMAP marine isotope event ages [19]. Ages for boundaries of 5c / 5b, 5b / 5a, 5a / 4, 4 / 3 and 3 / 2 are 94, 85, 74, 59, and 28 kyr BP, respectively. The radiocarbon date (Fig. 2 and Table 2) and the age of tephra of the core from Kamiyoshi Basin (Fig. 2) match with the ages of the isotope stages.

Differences of vegetation and climate between the inland and the coastal Japan Sea area

The vegetation and climate history since isotope stage 6 is available for Kurota Lowland [8, 18], which is located in the coastal area near the Japan Sea in the same region as the study site (Fig. 1). Differences between the pollen records of Kamiyoshi Basin and Kurota Lowland reveal differences in the vegetation history between the inland and the coastal Japan Sea areas.

In the period from approximately 91 to 60 kyr BP (substage 5b, 5a and stage 4) vegetation histories of the two areas are very similar. Temperate conifer forests, composed primarily of *Cryptomeria japonica*, were predominant in 91 to 70 kyr BP (substage 5b and 5a), conifer forests composed of pinaceous trees dominated from 70 to 60 kyr BP (stage 4), and cool-temperate deciduous broad-leaved forests dominated around 60 kyr BP. However, during the interstade (isotope stage 3) from 60 to 30 kyr BP, Cupressaceae trees became dominant in Kamiyoshi Basin whereas *Cryptomeria japonica* were dominant in Kurota Lowland. The difference in vegetation between the two sites became more distinct between 45 and 30 kyr BP (in the latter half of isotope stage 3). That is, Cupressaceae trees were predominant in Kamiyoshi Basin, associated with *Sciadopitys verticillata* and deciduous oaks, while *Cryptomeria japonica* was dominant in Kurota Lowland, associated with cool-temperate deciduous broad-leaved trees such as *Fagus crenata* and deciduous oaks. The dominance of *Cryptomeria japonica* in the interstade has been recognized in Oofuke moor [21], Lake Mikata [22] and Yamakado Moor [23], which are located in the coastal area of the Japan Sea. The difference in vegetation between two areas suggests that the climate in the inland area differed from that in the coastal area of the Japan Sea during the period from 60 to 30 kyr BP (especially between 45 and 30 kyr BP). Judging from habitats of temperate conifers mentioned above, during isotope stage 3, slightly dry and little snow conditions in the inland area are inferred from the predominance of Cupressaceae trees and *Sciadopitys verticillata*. On the other hand, a wet and heavy snow climate in the coastal area of the Japan Sea would have led to the dominance of *Cryptomeria japonica* and the decline of *Sciadopitys verticillata*.

Acknowledgment

We thank Manabu Taniguchi for permission to take the core from his paddy field, Kazuhiro Mori and Kyoko Tanida for their help with laboratory work, and Shinya Sugita for valuable comments. Part of this study was supported by a Grant-in-Aid for Basic Scientific Research (09660170, to H. Takahara) by the Ministry of Education, Science and Culture, Japan.

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神吉盆地周辺における最終氷期初期・中期の植生および気候変遷

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京都府船井郡神吉の標高 335m に位置する小規模な山間盆地からえられた 15.75m の堆積物の花粉分析学的研究によって，約 91 ～ 30 kyr BP に相当する最終氷期初期から中期にかけて（酸素同位体ステージ 5 b，5 a，4，3 に対比された）の植生変遷が明らかになった．堆積物の編年は，放射性炭素年代と広域火山灰である姶良 Tn 火山灰（AT）および鬼界葛原（K-Tz）および SPECMAP 酸素同位体ステージに基づいた．この期間における植生変遷と気候変動は以下のとおりである．酸素同位体ステージ 5 b では，スギとコウヤマキが優勢で，ヒノキ科および冷温帯性落葉広葉樹が伴う森林が広がった．この期間は湿潤で冷涼な気候であった．酸素同位体ステージ 5 a においては，スギ林は最も発達し，落葉広葉樹が極めて低率となり，気候は湿潤でやや温暖であった．酸素同位体ステージ 4 に対比される 70 ～ 60 kyr BP には，ツガ属，トウヒ属，マツ属単維管亜属からなるマツ科針葉樹林が発達し，寒冷で乾燥した気候であった．この時代に続いて，ブナ，コナラ亜属，アサダ属あるいはクマシデ属などの冷温帯性落葉広葉樹林が 60 kyr BP に形成された．この期間には，再び冷涼で湿潤な気候へと変化した．60 から 30 kyr BP の亜間氷期には，ヒノキ科樹木が増加し，ツガ属，マツ属，コウヤマキ，スギ，コナラ亜属を伴う温帯性針葉樹林が発達した．特に 45 から 30 kyr BP には特にヒノキ科樹木が最も優勢となった．内陸部に位置する神吉盆地の本研究結果と日本海側地域に位置する黒田低地における植生変遷を比較した結果，酸素同位体ステージ 5 b，5 a，4 に相当する時代における植生変遷はお互いに類似していた．しかし，酸素同位体ステージ 3 の約 60 ～ 30 kyr BP については，植生が異なっていた．すなわち，内陸の神吉盆地では，コウヤマキやコナラ亜属を伴ってヒノキ科が優勢であったが、日本海側の黒田低地では，ブナ，コナラ亜属などの冷温帯性落葉広葉樹を伴いスギが最も優勢であった．この植生の違いは，この期間には，日本海側では湿潤で多雪な気候で，内陸部ではやや乾燥して寡雪な気候という気候の地域差の形成を示唆している．