A Chronological Review of Pleistocene Human Remains from the Japanese Archipelago

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Abstract

This communication gives a brief review of relative and absolute dating studies, including our unpublished ones, of the Pleistocene human fossils from Japan, and a tentative chronological interpretation of these fossils. Some of the human remains have been frequently assigned to the Middle Pleistocene. We have, however, at present no clear chronological evidence for remains of this great antiquity. Preliminary palaeoanthropological implications concerning the population history of the Japanese Archipelago around the terminal Pleistocene are also addressed.

The purpose of the present report is to outline the chronology of the Pleistocene human remains from the Japanese Archipelago.

The Japanese Islands are widely overlaid with tephra (pyroclastic material including volcanic ash), which, when combined with heavy rains, has produced an acidic volcanic ash soil, that is not favourable for bone preservation. For this reason, almost all of the Pleistocene human remains so far discovered from Japan, are from calcareous caves and fissure sediments. Fig. 1 is a location map of sites of the Pleistocene human fossils, including a few tentative ones. As will be seen, the Ryukyu Islands of Okinawa Prefecture are the richest source of Pleistocene human remains, a situation which may simply reflect the presence in this region of many limestone caves and fissures, where bone mineral matter is well preserved. For the last thirty years, this region has been a center of discovery of Pleistocene hominids in Japan. Chronological research in this southern part of Japan is discussed first, particular attention being given to the Minatogawa site.

Minatogawa

Systematic excavations by Oyama Seiho and collaborators were carried out

from 1968 to 1974, at a fissure site of the Minatogawa limestone quarry near the southern coast of Okinawa Island (Fig. 2). Skeletons of more than five individuals (Suzuki, 1982a) were found in August 1970—January 1971. As is usually the case, there is no evidence of human occupation in the fissure deposits, but remains of numerous animals were identified.

The mammalian fauna from the site is of insular type, with few species being represented, the absence of large mammals, and high levels of endemicity (Kawamura, 1991). It should be remarked here that extinct cervid (*Cervus astylodon* and Muntjacinae, gen. et sp. indet.) fossils are confined to the lower levels of the fissure sediments, while wild boar (*Sus leucomystax taivanus*) fossils are less abundant in the lower levels, but increase in number in the upper levels.

The results of fluorine tests on the Minatogawa human and animal bones are given in Fig. 3. Buried bone substance takes up fluoride ions from surrounding soils and groundwater, and accumulates fluorine slowly with time. The analysis of this element hence provides relative dating information on bone remains from the same site or from similar sediments.

As seen in Fig. 3, the boar remains show varying fluorine content. On the other hand, the fluorine content of the cervid remains are in a range comparable to the upper half of the boar's dispersion. The boar bones from the upper levels (1-4) are, however, grouped around 0.8 %F, while those from the lower levels (5-8) appear to be in two separate groups. It is worth noting that the six boar specimens with high fluorine content from the lower levels have light-coloured surfaces, and the other boar specimens (either from the upper or the lower levels) are dark grey or brown in colour. These findings may indicate that three of the nine analysed boar bones from the lower levels are probably intrusions from an upper horizon.

These analytical results would introduce a provisional zonation of the mammalian fauna (Matsu'ura, 1982) as follows:

Phase a, the co-occurrence of wild boar and two cervid species;

Phase b, the occurrence of wild boar, and the absence of cervid species.

Comparison of the fluorine data (Fig. 3) suggests that Minatogawa human remains should be assigned to Phase a and possibly to the transitional phase from a to b.

Concerning the absolute age, radiocarbon measurements by Kobayashi et al. (see Suzuki & Hanihara, 1982) on charcoal fragments from the lower levels of the Minatogawa deposits have yielded two dates of 18,250±650 years BP (TK-99) and 16,600±300 years BP (TK-142), respectively. Future research is needed to relate these dates to the human remains at the site. Another chronometric age estimate is reported by Yokoyama (1992), who carried out non-destructive

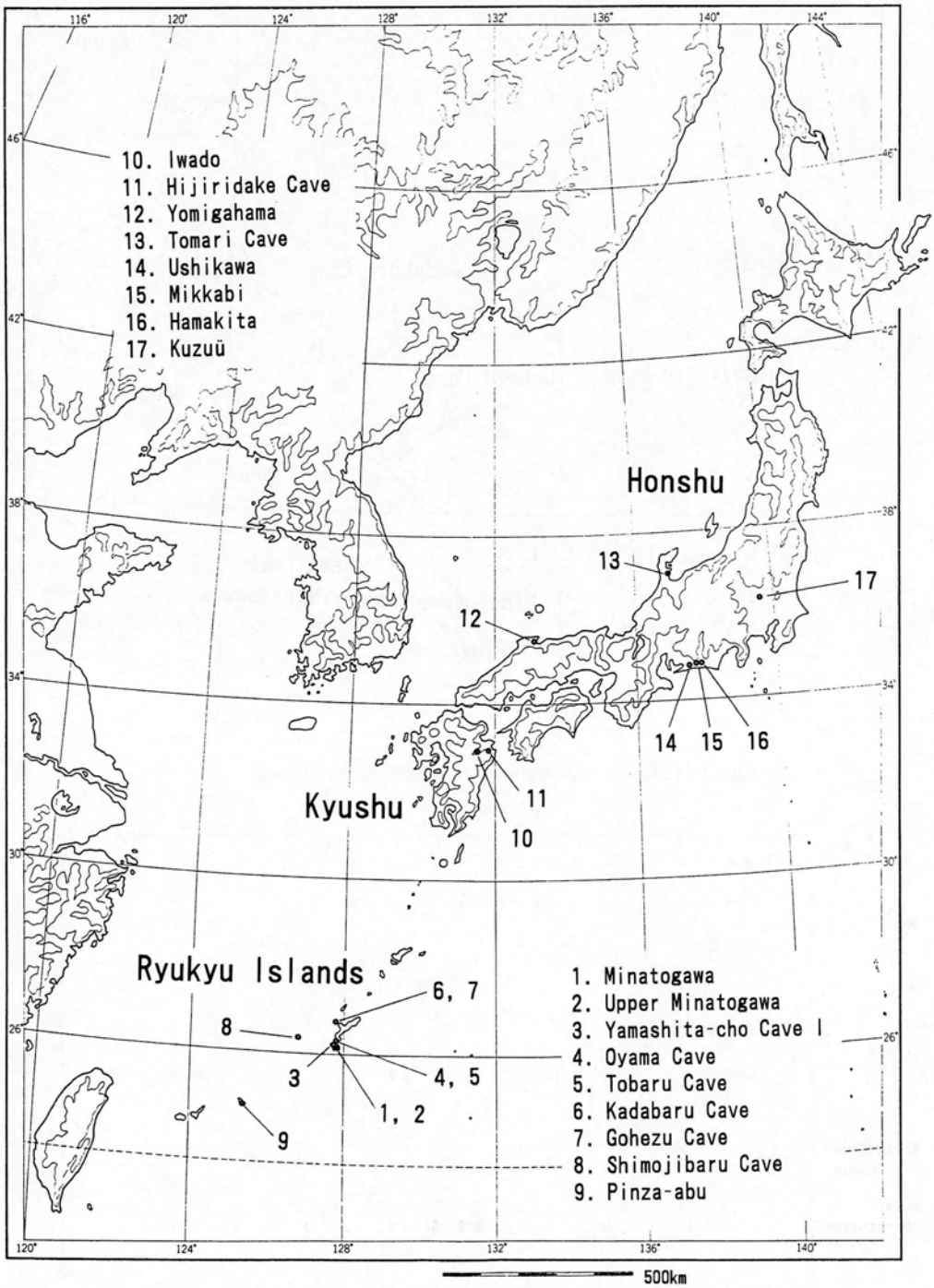

Fig. 1 Pleistocene hominid sites in the Japanese Archipelago. For the Ryukyu Islands, see also Fig. 2.

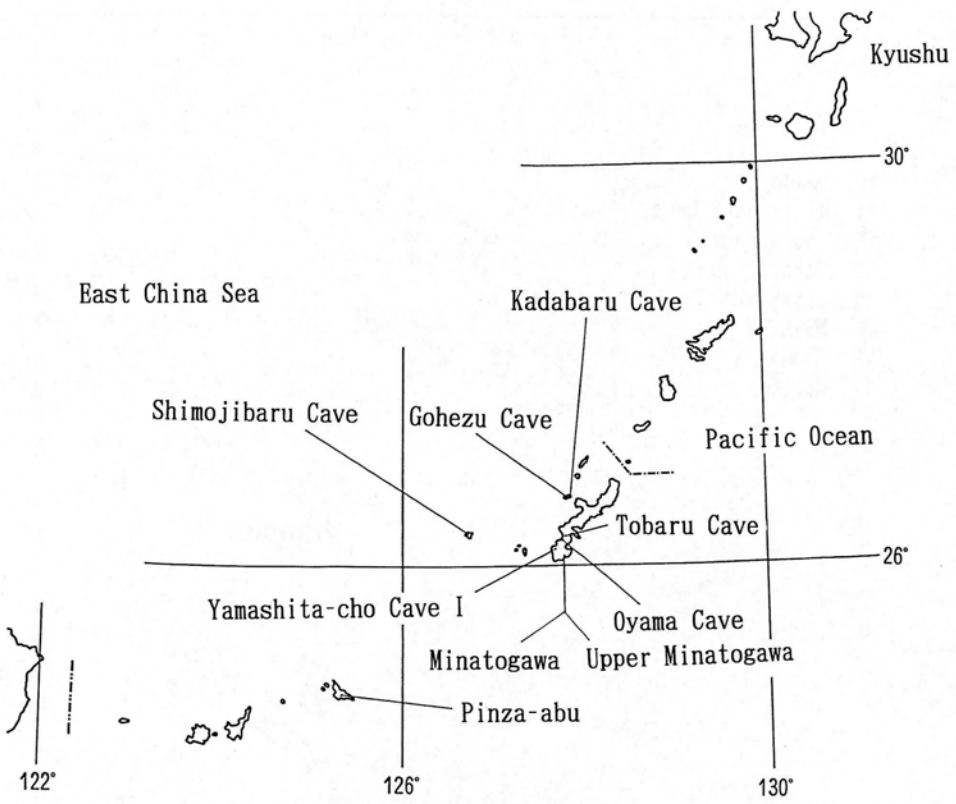

Fig. 2 Pleistocene hominid sites in the Ryukyu Islands.

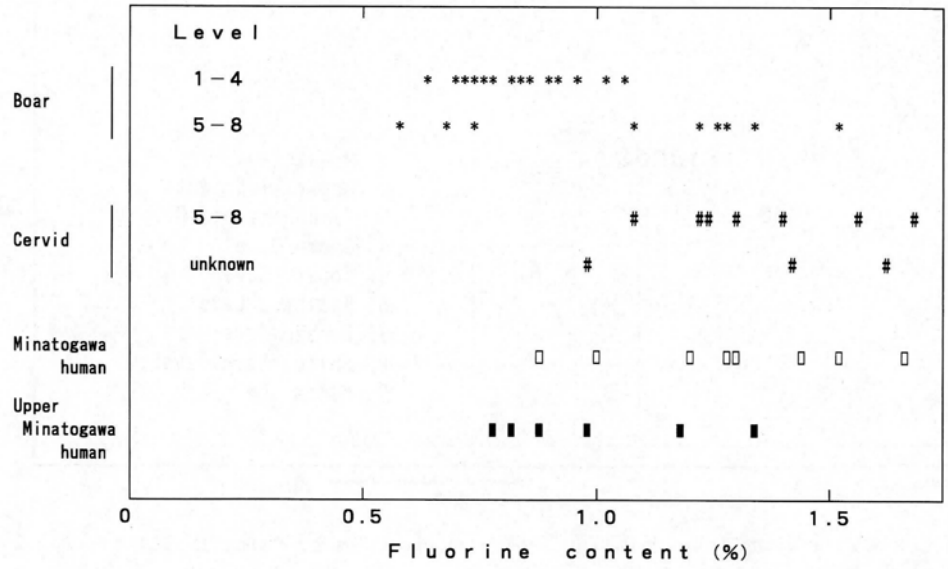

Fig. 3 Fluorine content of fossil bones from the Minatogawa Fissure (based on Matsu'ura, 1982 and Matsu'ura, unpublished).

gamma-ray spectrometric uranium-series dating of one of the Minatogawa skulls, which gave a U-Pa date of 19,200±1,800 years ago. The result is consistent with the above radiocarbon age determinations, although there are many uncertainties in the uranium-series dating of fossil bone since uranium can be either taken up into or leached out from bone during burial.

Upper Minatogawa

The Upper Minatogawa remains are from the same fissure site as the Minatogawa specimens just described. Human remains, consisting of nine postcranial bones of at least three individuals, were found from the Minatogawa quarry in March 1968 by Oyama. These initial discoveries led to systematic excavations of the site (Watanabe, 1980), resulting in the so-called Minatogawa man material unearthed in 1970-1971 that was reported in 1982 (Suzuki & Hanihara, 1982). However, the 1968 finds, which were assumed to derive from the upper horizons, have received little attention. Morphological and chronological studies on these 'Upper Minatogawa' remains have been only briefly reported by Baba (1984) and Matsu'ura (1984a), respectively.

The results of fluorine analysis of the Upper Minatogawa bones are also shown in Fig. 3. Although the ranges of fluorine content of the Minatogawa human remains and the Upper Minatogawa human remains overlap, the difference on average between the two groups is significant ($P<0.05$). If two separate series of human bones from Minatogawa are recognized, the Upper Minatogawa series is assignable to late Phase a to early Phase b of the mammalian fauna of this site (see above).

Matsu'ura (1988, unpublished) has attempted aspartic acid racemization dating of bones from the Minatogawa site. Using bones from the lower deposits (ca. 17-18 kyr BP; see above) as 'calibration' samples, a date of about 12 kyr (=thousand years) ago is obtained for late Phase b. This value should give a minimum age estimate for the Upper Minatogawa human remains. However, it must be acknowledged that the racemization method requires several assumptions be satisfied as an absolute dating method and thus the reported age calculation is preliminary.

It should be noted here that unlike the Minatogawa postcranial remains (see Baba & Narasaki, 1991) the Upper Minatogawa postcranial remains show similar morphological characteristics to those of the Mesolithic–Neolithic Jomon–age skeletons of Japan, as communicated by Baba (1984). This topic will be addressed further later.

Yamashita-cho Cave I

The Yamashita-cho Cave I is located in a residential suburb of Naha City, Okinawa Island. In 1968 human remains, a juvenile (ca. 6 year old) femur and tibia were recovered in association with abundant extinct cervid fossils from the uppermost part of Layer VI of the excavated cave deposits (Takamiya et al., 1975). The human lower-limb bones were lying just under the charcoal lens intercalations of Layer III and V, and the two charcoal levels are considered to actually belong to the same layer which is estimated to be related to human occupation (Takamiya et al., 1975). The radiocarbon date of 32,100±1,000 years BP (TK-78) obtained from the charcoal sample may, therefore, be regarded as the probable age estimate of the Yamashita-cho child. Very recently, Trinkaus & Ruff (1996) have reported comparative morphological data on the Yamashita-cho remains which demonstrate a mosaic pattern of features seen in archaic *Homo* and in early modern humans.

Oyama Cave, Tobaru Cave, Kadabaru Cave, Gohezu Cave

Other human fossils from Okinawa Island include a right mandible fragment found in 1964 from the Oyama Cave, Ginowan City, by the family of American Officer; and a skullcap fragment found in 1966 from the Tobaru Cave, Chatan Village, by Tawada Sinjun and collaborators. Added to these, I will mention the fossilized human remains from two sites on Ie Island, about 5 km offshore of Okinawa Island: parietal bone fragments found from the Kadabaru Cave in 1962 by Tawada (see Takamiya, 1991); and a left mandible fragment found from Hall 3 of the lower branch of the Gohezu Cave in 1976 by Kato Shinpei and collaborators (Ie Village Board of Education, 1977).

As for the remains of Oyama, Tobaru and Kadabaru, from the results of fluorine analysis (Tanabe in Suzuki, 1975), the degree of fossilization and other aspects of geological context, as well as morphological characteristics, Suzuki (1975) has estimated that the Oyama specimen is the oldest, being probably from the Pleistocene, followed by the specimens from Kadabaru and then Tobaru.

The Gohezu Cave mandible, which is well-fossilized and likely associated with extinct cervid fossils but not with wild boar bones (Ie Village Board of Education, 1977, 1978), is provisionally assigned to late Late Pleistocene.

The detailed chronologies of these human remains, however, have not been resolved.

Shimojibaru Cave

An infant's (8-10 months) partial skeleton was unearthed in 1982-1983 and

1986 by Hasegawa Yoshikazu and collaborators from the Shimojibaru Cave on Kume Island. The human remains were derived from a clay layer under a calcareous layer, so-called travertine floor, measuring 10-20 cm in thickness. The associated mammalian remains include a number of extinct cervid fossils.

A radiocarbon date of 15,200±100 years BP (Hasegawa, personal communication) has been obtained on crab fossils from the clay layer. The racemization analysis of a deer bone from the same layer (Matsu'ura, unpublished; results briefly referred to by Sakura 1988), has given a D/L aspartic acid ratio slightly lower but roughly comparable to those found for bones from the lower deposits (ca. 17-18 kyr BP; see above) of the Minatogawa site. These data suggest a tentative age estimate of approximately 15-16 kyr BP for the Shimojibaru infant.

Pinza-abu

From 1979 to 1983 at Pinza-abu (Goat Cave) in Miyako Island, human and animal fossils were collected from a gravel-bearing clay layer that is covered in some places with calcareous flowstone (see Cultural Section, Education Agency of Okinawa Prefecture, 1985). The mammalian fauna includes roe-deer (*Capreolus miyakoensis*), wild cat, wild boar, and rats; all of which are currently extinct on this island. The human fossils consist of cranial bones, teeth and some postcranial fragments. These human remains have been described as having a morphological resemblance to the Minatogawa remains (Sakura, 1981, 1985).

Although just slightly lower, the fluorine content of the human skull is comparable to that of the roe-deer bones (Matsu'ura, 1985a). Two consistent radiocarbon dates, 25,800±900 years BP (TK-535) and 26,800±1,300 years BP (TK-605), respectively, have been reported on charcoal fragments collected from the bone-bearing clay layer during the 1983 and 1984 season's fieldwork (Hamada, 1985). Aspartic acid racemization analysis of bone, however, yielded on trial calculation a date of ~20 kyr ago for the roe-deer bones (Matsu'ura, 1985, unpublished). This latter approach also suggests that the mammalian faunas from the Minatogawa lower levels, Shimojibaru Cave and Pinza-abu appear to belong to the same aminozone (Matsu'ura, 1988, unpublished).

Iwado

Human remains were recovered in 1979 from a Shusekibo (grave with stone assemblage) in Layer 7 (Iwado D Culture) of the Iwado site in Ono-gun, Oita Prefecture (Sakata, 1980). Layer 7 consists of Aira-Tn tephra (Yanagida, 1985), a well-known widespread volcanic ash, the eruption age of which is radiocarbon-dated at about 24 kyr BP. Unfortunately, the remains comprise very small fragments, probably of human teeth and skulls.

Hijiridake Cave

Excavation in 1962 at the Hijiridake Cave in Minami-amabe-gun, Oita Prefecture, yielded a human parieto-occipital fragment possessing a thick cranial vault from the upper part of Layer III of the cave sediments (Goto, 1964; Kogawa, 1967). The horizon containing the skull bone (Layer III Man 1) also contained micro-blade stone tools. The micro-blade phase of the latest Upper Palaeolithic in Japan is estimated to be of about 13-14 kyr BP. Ogata (1981) has reported some additional skull fragments from Layer III, designated as Layer III Man 2, possibly belonging to Layer III Man 1. Evidence to support their antiquity comes from the fluorine content of these remains (Layer III Man 1=0.56%F; Layer III Man 2= 0.55%F) which seems to contrast with that of the mediaeval human bone (0.20% F) from Layer I of the same site (Tanabe in Ogata, 1981). Further research is yet necessary to clarify the temporal relationship of the Layer III remains and the microliths for determining their absolute chronology.

From Hijiridake, there is another human bone (left talus) likely assignable to the Pleistocene (Matsu'ura, 1984b), though it is a surface find.

Yomigahama

A right mandible was discovered by Nishikoori in 1969 at Yomigahama (or Yumigahama) Beach in Sakaiminato City, Tottori Prefecture, from a marine sand layer about 6 m deep from the ground surface. Naora (1972) reported that the specimen, given the designation as 'Yomigahama man', presumably belongs to Late Pleistocene *Homo sapiens*. Recently Hanihara (1995) has reported that the mandible is fossilized and possesses some archaic features which imply an antiquity of at least an earlier phase of the Jomon Period. The question of the precise age of this specimen is open to further inquiry.

Tomari Cave

A human cranium came to light in 1967 at the Tomari Cave in Himi City, Toyama Prefecture, in the course of construction of a road, without any cultural associate; and a rib fragment was found at the same location in 1972 (Minato, 1980). Relative dating by the fluorine method was attempted by Tanabe (1973 personal communication to Ogata T.; see Matsu'ura, 1985) and by Matsu'ura (1985), using bone remains from neighbouring sites as reference specimens. From the results of fluorine analysis, Matsu'ura (1985) has provisionally attributed the Tomari remains to the early Holocene, or to the late Late Pleistocene. Further chronometric datimg of these remains is now in preparation.

Meanwhile, morphological comparisons have shown that the Tomari cranium

best resembles the Initial to Early Jomon-age skulls (Ogata et al., 1989).

Ushikawa, Mikkabi, Hamakita

Limestone fissure deposits at the Ushikawa site in Toyohashi City, Aichi Prefecture, the Tadaki site in Mikkabi-cho, Shizuoka Prefecture, and the Negata site in Hamakita City, Shizuoka Prefecture, all located near Lake Hamana in central Japan, have yielded the following well-known Pleistocene human fossils (year of discovery shown in parentheses):

Ushikawa (Suzuki, 1959, 1982b)

left humerus shaft fragment (1957), left femoral head (1959)

Mikkabi (Suzuki et al., 1962)

five cranial fragments (1959), partial right pelvis (1959), right femur shaft (1961)

Hamakita (Suzuki et al., 1966)

Upper Layer

cranial fragments (1960), right LM3 (1961), right clavicle fragment (1961), partial right humerus (1961), right ulna fragment (1962), right ilium fragment (1960)

Lower Layer

right tibia fragment (1962)

Of these bones, the human status of the Ushikawa humerus has been repeatedly questioned. Matsumura & Mizoguchi (1996), for example, have announced that a recent examination has proved that the humerus is non-human.

Setting aside the morphological problem, the Ushikawa remains have been very often cited as dating back to the late Middle Pleistocene, while the Mikkabi and Hamakita remains have been placed in the Late Pleistocene (Hamakita Lower Layer remains particularly are considered to belong to the main part of the Last Glaciation according to Chinzei, 1966)

The age assignment of the Ushikawa remains is based primarily on work by Takai (1959a, b), who used extinct species of shrew (*Anourosorex japonicus*) and elephant (*Palaeoloxodon naumanni*) as the main guide fossils to geological correlation, and presumed that the Ushikawa fauna is comparable in age to the Upper Kuzuü fauna of Tochigi Prefecture (see Kuzuü section below). He further described the fissure fillings at Ushikawa, Nagara, Tadaki, Shiraiwa, Yage and Gansuiji as assignable to the Upper Middle Pleistocene (Takai, 1959a). Note here that 'Tadaki' is identical to the Mikkabi human site and 'Gansuiji' is identical to the Hamakita human site.

However, in a later paper (Takai, 1962) in the "Mikkabi Man Report" (Suzuki et al., 1962), Takai concluded that the fossil mammalian fauna of Tadaki is as-

signable to the Upper Kuzuü fauna of *Late Pleistocene*, and the fissure fillings at Ushikawa, Nagara, Tadaki, Shiraiwa, Yage and Gansuiji are to be contemporaneous. Again in the "Hamakita Man Report" (Suzuki et al., 1966), Takai & Hasegawa (1966, p.176) summarized that the "fossil fauna in the Gansuiji formation resembles in composition that of the Upper Kuzuüan formation and the Tadaki formation of the late Pleistocene."

Recent studies on the Quaternary mammals of Japan (e.g. Kamei et al., 1988; Kawamura, 1988, 1989, 1991) attribute the faunas from Ushikawa, Tadaki, Gansuiji and the Upper Kuzuü Formation to the Late Pleistocene. Therefore, for the present, there is little or no support for regarding the Ushikawa remains as old as the Middle Pleistocene.

The human remains from the area around Lake Hamana have been dated relatively using fluorine analysis (Tanabe, 1962, 1966). Toward developing their chronological framework, we are currently undertaking investigations that involve reconsideration of both the reported (Tanabe, 1962, 1966) and additional fluorine data along with discussions (see e.g. Kawamura et al., 1990) of the faunal succession in the related region. Radiocarbon dating of bones is also being undertaken. Preliminary findings (partly presented by Kondo & Matsu'ura at the 50th Joint Meeting of the Anthropological Society of Nippon and the Japanese Society of Ethnology, held in October 1996; and by Matsu'ura at the 51st Meeting of the Anthropological Society of Nippon, held in November 1997) include:

1) The faunal remains from the Tadaki (Mikkabi) site have a wide age range;
2) The Mikkabi human remains are estimated to be no older than 18 kyr BP, and some of the specimens might be even as late as 8 kyr BP;
3) The Hamakita Lower Layer tibia is estimated to be around 18 kyr BP, and the Hamakita Upper Layer remains are to be younger than 18 kyr BP;
4) The Ushikawa 'human remains' are likely to be older than 16 kyr BP.

Details and further discussion of these results will appear elsewhere.

Yokoyama (1992) has reported non-destructive gamma-ray spectrometric U-Pa dates of 15,600±2,200 years ago and 17,300±1,500 years ago for the Hamakita (Upper Layer or Lower Layer?) remains and the Mikkabi remains, respectively. Unfortunately, information on which specific bone specimens were dated has not been released. Given the many uncertainties of uranium-series dating of fossil bone, as mentioned above, the significance of these U-Pa dates is hard to assess at this point.

I should remark here that both the Mikkabi remains and the Hamakita Upper Layer remains have some morphological characteristics close to the Jomon-age human remains, while the Hamakita Lower Layer tibia lacks such characteristics (Suzuki, 1962, 1966)

Kuzuü

'Hominid' finds from the town of Kuzuü in Aso-gun, Tochigi Prefecture, are listed below.

1. Distal end of right humerus, found in June 1950 from the No. 10 Quarry of Yoshizawa Limestone Mining Co. (Naora, 1952a).
2. Distal end of left femur, found in July 1950 from the No. 10 Quarry of Yoshizawa Limestone Mining Co.: Holotype of *Homo? tokunagai*, "Kuzuü Man" (Naora, 1952a).
3. Mid-shaft fragment of left humerus, found in August 1950 from the No. 10 Quarry of Yoshizawa Limestone Mining Co. (Naora, 1952a).
4. Shaft of left femur, found in May 1951 from the Maegawara Lower Cave (Naora, 1952b).
5. Shaft fragment of right femur, found in May 1951 near the Maegawara Lower and Upper Caves (briefly referred to by Naora, 1952b).
6. Right mandible fragment, found in July 1951 from the Maegawara Upper Cave (Naora, 1952b).
7. Distal shaft fragment of left humerus, found in July 1951 from the Maegawara Upper Cave (Naora, 1952b).
8. Proximal end to shaft of right fifth metacarpal, found in December 1984, near the Maegawara Lower and Upper Caves (Sakura, 1990).
9. Proximal part of right ulna, found amongst the Naora collection by Harunari Hideji.

Of these nine specimens, only four (No. 4 femur, No. 5 femur, No. 8 metacarpal and No. 9 ulna) have been recognized to be undoubtedly human (Harunari, 1985; Hanihara, 1995; Yamaguchi, B., Sakura, H & Baba, H., 1989 verbal communication), whereas the others including the holotype of "Kuzuü Man", have not. In particular, Nishimoto and Harunari (Harunari, 1985) have concluded that No. 1 specimen (humerus) is that of a young bear, and No. 6 specimen (mandible) likely belongs to a large monkey.

As yet few investigations have been undertaken regarding the chronology of the Kuzuü human remains. The fossiliferous fissure sediments of the Upper Kuzuü Formation of Shikama (1949), a possible source of Kuzuü remains, are overlain by a breccia bed with a thickness of 10 m. This breccia bed is covered by the Kanuma Pumice Bed (Shikama, 1949; Kawamura, 1988), for which Suzuki (1976) reported two fission track dates of 32,000±4,000 and 31,000±8,000 years ago, respectively, on hornblende separated from pumice. Given that a somewhat long period of time separates the deposition of the Kanuma Pumice Bed and the Upper Kuzuü Formation, the latter can be estimated to date back to the early phase of the Late Pleistocene (Kawamura, 1988). Because there are many prob-

lems regarding fission track dating on hornblende, these dates should be viewed with caution. The clarification of the antiquity of the Kuzuü remains awaits further study.

Concluding Remarks

Some general conclusions regarding the chronologies of Pleistocene human remains from the Japanese Archipelago and their palaeoanthropological implica-

Table 1 An inventory of Pleistocene hominids of Japan.

Name	Fossils	Age Estimation
Ryukyu Islands		
Minatogawa	skeletons of 5 to 9 individuals	late Late Pleistocene (about 17−18kyr BP*?)
Upper Minatogawa	postcranial remains	late Late Pleistocene
Yamashita-cho Cave I	child femur, tibia	late Late Pleistocene (about 32kyr BP)
Oyama Cave	mandible	late Late Pleistocene
Tobaru Cave	calotte	late Late Pleistocene?
Kadabaru Cave	cranial fragments	late Late Pleistocene?
Gohezu Cave	mandible, other fragments?	late Late Pleistocene?
Shimajibaru Cave	infant skeleton	late Late Pleistocene (about 15−16kyr BP?)
Pinza-abu	parietal, occipital, teeth, postcranial fragments	late Late Pleistocene (about 26kyr BP?)
Kyushu		
Iwado	cranial fragments, UI, UC	Aira-Tn tephra horizon (about 24kyr BP)
Hijiridake Cave	cranial fragments, talus	late Late Pleistocene (about 13−14kyr BP?)
Honshu		
Yomigahama	mandible	late Late Pleistocene?
Tomari Cave	cranium, rib	late Late Pleistocene? or early Holocene?
Ushikawa	humerus, femur	Late Pleistocene
Mikkabi	cranial fragments, postcranial bones	late Late Pleistocene (maybe no older than 18kyr BP**)
Hamakita	Upper Layer: cranial fragments, LM3, postcranial bones	late Late Pleistocene (younger than 18kyr BP)
	Lower Layer: tibia	main part of Last Glaciation (about 18kyr BP)
Kuzuii	ulna, metacarpus, femora	early Late Pleistocene?

* BP means 'radiocarbon years before AD1950', and kyr is used for thousand years.

** Some specimens are possibly younger due to intrusion, even as late as 8kyr BP.

tions can be made:

1. Almost all of the Pleistocene hominid fossils of Japan can be assigned to the late phase of the Late Pleistocene (see Table 1).
2. At present, there are no human skeletal remains from Japan which can be assigned, with certainty, to the Middle Pleistocene or older.
3. For the present, all Pleistocene human remains, such as Upper Minatogawa, Mikkabi, and Hamakita Upper Layer specimens, having a close morphological resemblance to the Mesolithic-Neolithic Jomon-age (from ca. 12 kyr BP to ca. 2.5 kyr BP) human remains especially in postcranial characteristics, are tentatively assigned to a period no older or younger than 18 kyr BP. This finding may possibly suggest: i) new human arrivals from the Asian continent or some other region after 18 kyr BP, or ii) *in situ* micro-evolution within the Japanese Archipelago due to environmental changes after 18 kyr BP to the terminal Pleistocene. The possibility of regional continuity, or its alternatives, to explain the emergence of Jomon people and culture, is the subject of future interdisciplinary research.

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