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VOLCANIC ASH LAYERS AND STRATIGRAPHY OF THE PALAEOLITHIC IN THE KANTO DISTRICT, JAPAN

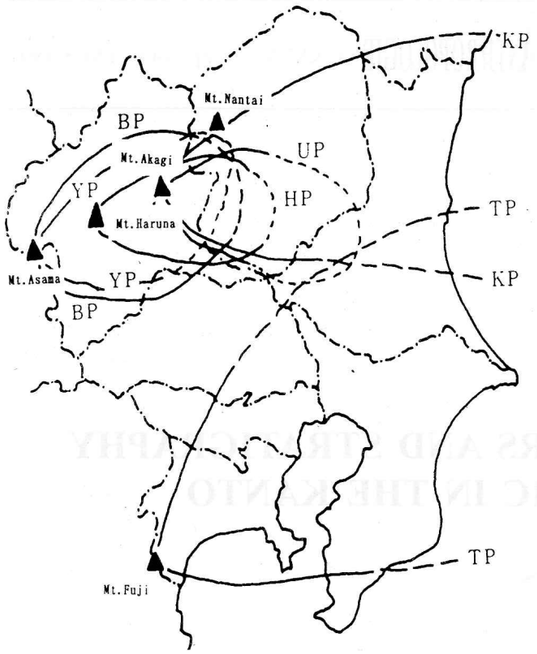
ABSTRACT: During the past 10 years, geoarchaeological investigations in Japan have provided a rich information on the Pleistocene occupation of the islands and the local cultural development. Except for the archaeological evidence, multidisciplinary investigations have assembled an immense database on the past volcanic activity which constitutes an integral and principal part of the Japanese Palaeolithic and Quaternary studies. The present research focuses on mapping and chronometric dating of single eruptions in terms of the provenience and geographical extent of individual ash layers which are used as stratigraphic markers for spatial and temporal correlation of individual palaeolithic sites. Tephrachronology plays a major role in the chronological assessment of the earliest cultural record. Further studies should focus on locating identical or closely comparable volcanic ashes resulting from one and the same eruption which could be used for establishment of a broader chronostratigraphic framework over a larger area, particularly for age determination of sites potentially older than 100 ka.

KEY WORDS: Pleistocene period – Quaternary stratigraphy – Japanese Palaeolithic – Tephra chronology – Pumice and volcanic ash layers – Lithic industry

INTRODUCTION

Excavation of Iwajyuku, the first palaeolithic site in Japan by Tadahiro Aizawa and Meiji University in 1949, was a starting point of palaeolithic studies on the Japanese Islansds (Sugihara 1956). This discovery provided an evidence of an earlier human occupation in this part of Eastern Asia, but also drew attention to volcanic ash layers called „loam layers" which are contextually associated with the archaeological records. Before the excavation at the Iwajyuku site, the Japanese prehistory was generally assumed to begin with the Neolithic Jomon culture dated to the Early Holocene. This scientific belief persisited for over 80 years following investigations of the Early Neolithic Omori shell mound. The former culture-historical model was governed by two principal ideas. First, it was believed that the Japan Islands were separated during most of the Pleistocene by sea from the Asian mainland, which prevented colonisation of the islands by other means than by boats. Secondly, the Pleistocene stratigraphy was almost non-existing. The widely distributed and locally rather thick volcanic ash layers were used as a proof for a very intensive past tectonic activity of the area that should have prevented establishment of a suitable natural environment for human occupation. This paradigm was definitely challenged by the discovery of the Iwajyuku site that showed the invalidity of the two principal assumptions.

Since that time, i.e. during the past 50 years, the number of Japanese palaeolithic sites has multiplied to the present 2,000 or even more. Former as well as current archaeological



YP Itahana Yellow Pumice layer (13,190 ± 235)
BP Itahana Brown Pumice layer (20,000 ~ 16,000 years old)
KP Kanuma Pumice layer
HP Hassaki Pumice layer
UP Yunokuchi Pumice layer (about 50,000 years old)
TP Tokyo Pumice layer (49,000 ± 5,000)

FIGURE 1. Distribution of the main pumice layers in the Kanto District.

investigations have provided rich information on the local Pleistocene settlement and cultural development. Except for the archaeological evidence, the multidisciplinary investigations have assembled an immense database on the past volcanic activity which constitutes an integral and principal part of the Japanese Palaeolithic and Quaternary studies. It is becoming evident how close was the lifestyle of early people influenced by the Pleistocene volcanic environments. The present research focuses on mapping and chronometric dating of single eruptions in terms of the provenience and geographical extent of individual ash layers. For example, Aira-Tanzawa pumice (AT) was carried at the distance of 2,000 km from the Kagoshima Bay to Aomori Prefecture sometime before 21,000 yr BP after explosion of the Aira volcano. The tephra is used as a chronostratigraphic marker for chronological correlation of the Japanese Upper Palaeolithic cultures. The AT layer formed a thick cover (Sirasu daichi) over several tens of kilometres in southern Kyushu near Aira caldera thus providing a possibility of a direct dating of palaeolithic sites between the Kyushu and Honshu Islands, central Japan.

Tephrachronology of the Palaeolithic in the Kanto District

Tephrachronology is used as a key tool for chronostratigraphy of the Japanese Palaeolithic. In Kanto District, there were several major volcanoes active in the Pleistocene (e.g. Mt. Fuji, Mt. Akagi, Mt. Asama, Mt. Nantai) which are applied as the principal stratigraphic markers at local palaeolithic sites. Products that result and are brought to the surface include lava rock, volcanic gas, volcanic ash (tephra), including larger pumice. The Pleistocene volcanic ashes in Kanto District include *(Figure1):*

1. *Yokokawa – 2 tephra (Yop-2)*
   The tephra, grey-white in color, is distributed in the north-eastern part of Gunma Prefecture. It is *ca* 20–30 cm thick at the palaeolithic Kashounishi Site. The location of the old volcano is not clear, but it is likely located near the boundary of Gunma and Nagano Prefectures. Dated to >130 ka.
2. *Ontake – 1 tephra (On-pm 1)*
   The tephra relates to explosion of the Ontake volcano, dated by fission track technique to 80 ka.
3. *Aso – 4 tephra (Aso-4)*
   This widespread tephra originates from explosion of the Aso volcano in Kyushu, dated by fission track to *ca* 70 ka.
4. *Hakone-Tokyo tephra (Hk-T)*
   The tephra, widely distributed in the southern Kanto District, relates to explosion of the Mt. Fuji around 49 ka (dated by fission track).
5. *Daisen Kurayoshi Pumice (DKP)*
   This widespread tephra was deposited after the explosion of the Daisen volcano in the Tottori Prefecture. Dated to >48 ka by stratigraphy.
6. *Akagi-Yunokuchi Pumice (Ag-Up)*
   A pumice from Mt. Akagi in Gunma Prefecture. Dated to >45 ka by stratigraphy; 4–5 m thick near the volcano.
7. *Haruna-Hatsusaki Pumice (Hr-Hp)*
   A pumice from Mt. Haruna in Gunma Prefecture. Dated to 40,000 yr BP by radiocarbon and to 42 ka by fission track.
8. *Akagi-Kanuma Pumioce (Ag-Kp)*
   A pumice from Mt. Akagi, dated to 32 ka by fission track.
9. *Aira-Tn Tephra (AT)*
   A widespread tephra from Mt. Aira of the gulf of Kagoshima. It is easily recognised and includes a great amount of volcanic grass. Dated by radiocarbon to *ca* 21,000 yr BP.
10. *Asama-Itahana Brown Pumice (As-Bp)*
    A pumice from Mt. Asama dated by radiocarbon to 20,000–18,000 yr BP and separated into three distinct units.
11. *Asama-Shiraito Scoria (As-Sr)*
    A scoria from Mt. Asama dated by radiocarbon to 15,000 yr BP.

12. *Asama-Itahana Yellow Pumice (As-Yp)*
    An orange-coloured pumice from Mt. Asama, dated by radiocarbon to *ca* 13,000 yr BP (Machida, Arai 1992).

Palaeolithic archaeology

1. Kirihara Site

Stratigraphy (Figure 2):

Stratum 1. A dark brown humus, 20–50 cm thick. The upper part (1-a) is grey-coloured (cultivated soil), the lower part (1-b) is dark brown and separated into two distinct layers.

Stratum 2. A yellow-brown loamy layer, 45–50 cm thick. The upper transitional part (2-a) follows a lower, Asama (AS-BP) brown pumice-rich layer (2-b).

Stratum 3. A dark brown loamy layer, 30 cm thick.

Stratum 4. A dark grey-brown loamy layer („black band"), 30 cm thick, with a fine volcanic ash (AT) in the upper part.

Stratum 5. A grey-brown loamy layer, 30 cm thick.

Stratum 6. A brown loamy layer, 5 cm thick.

Stratum 7. A grey-coloured volcanic ash (AG-KLP), 2–3 cm thin.

Stratum 8. A brown loamy layer, 45 cm thick.

Stratum 9. Rock fragments in the upper part of the stratum, including chert and grey-blue volcanic ash (AG-KP-

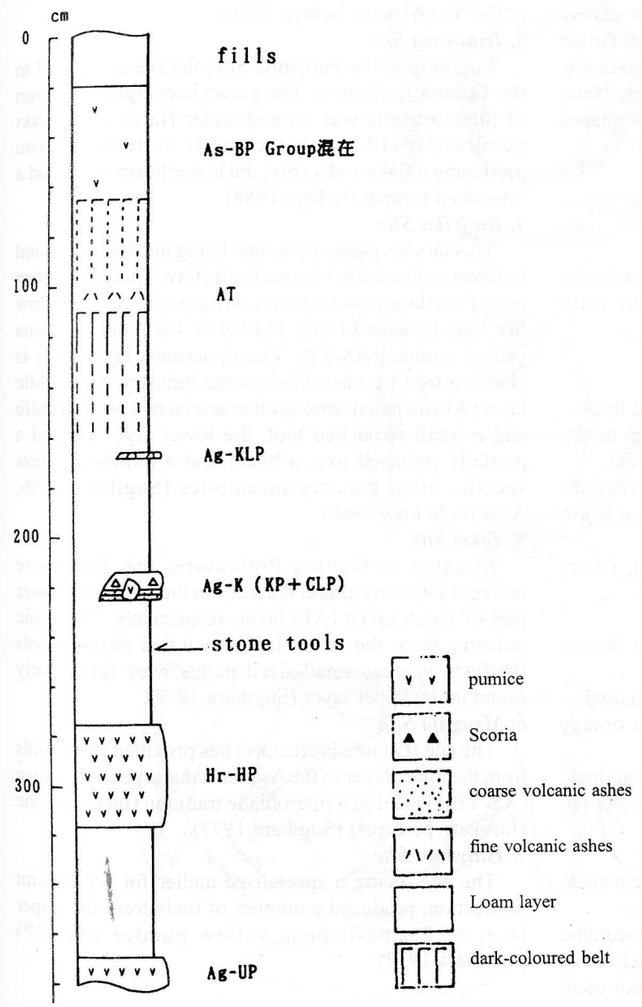


FIGURE 2. Stratigraphy of the Kirihara Site with position of stone tools.

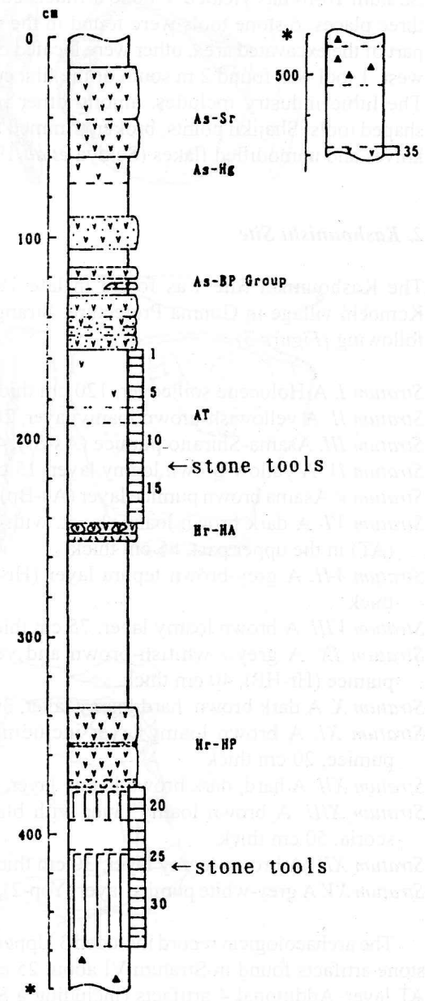


FIGURE 3. Stratigraphy of the Kashounishi Site with position of stone tools.

CLP); the lower part consists of a yellow-brown pumice and up to 10 cm large fragments of andesite. 10–15 cm thick in total.

Stratum 10. A brown, loamy layer, 50 cm thick, separated into two horizons by consistency and colour. The lower (10-b) horizon is harder and dark-coloured, and includes stone artifacts in the upper part.

Stratum 11. A yellow-white-brown pumice layer (Hr-HP), 40 cm thick.

Stratum 12. A brown loamy layer, 50 cm thick.

Stratum 13. A grey-brown pumice (AG-UP). The excavation was stopped at 30 cm below the contact with the stratum 12.

The only artifact-bearing stratum (the upper part of Stratum 10-b) has yielded 9 stone artifacts concentrated at three places; 6 stone tools were found in the north-eastern part of the excavated area, other were located *ca* 2 m farther west, 1 tool was found 2 m south of the first concentration. The lithic industry includes, among other pieces, Hera-shaped tools, Shajiku points, broken trimmed tools, shaped knives and unmodified flakes (Sekiya *et al.* 1992).

2. Kashounishi Site

The Kashounishi Site was found in late 1996 near the Komochi village in Gunma Prefecture. Stratigraphy is the following *(Figure 3)*:

Stratum I. A Holocene soil cover, 120 cm thick.
Stratum II. A yellowish-brown loamy layer, 20 cm thick.
Stratum III. Asama-Shiraito pumice (As-Sr), 45 cm thick.
Stratum IV. A yellow-brown loamy layer, 15 cm thick.
Stratum V. Asama brown pumice layer (As-Bp), 70 cm thick
Stratum VI. A dark brown loamy layer, with volcanic ash (AT) in the upper part, 85 cm thick.
Stratum VII. A grey-brown tephra layer (Hr-HA), 10 cm thick.
Stratum VIII. A brown loamy layer, 75 cm thick.
Stratum IX. A grey / whitish-brown and yellow-brown pumice (Hr-HP), 40 cm thick.
Stratum X. A dark brown, hard loamy layer, 30 cm thick.
Stratum XI. A brown loamy layer including an orange pumice, 20 cm thick.
Stratum XII. A hard, dark brown loamy layer, 40 cm thick.
Stratum XIII. A brown loamy layer with black-coloured scoria, 50 cm thick.
Stratum XIV. A brown loamy layer, 30 cm thick.
Stratum XV. A grey-white pumice layer (Yop-2), 30 cm thick.

The archaeological record included 3 Upper Palaeolithic stone artifacts found in Stratum VI about 25 cm below the AT layer. Additional 4 artifacts (including a Shajiku point and 3 scrapers), all assigned to Middle Palaeolithic, were yielded by Stratum XII within a narrow 3 cm thick cultural horizon (Machida, Arai 1992, Fujimura, Seiya 1996).

Principal palaeolithic sites in the Kanto District (Summary)

1. Tama New Town 471-b Site

The site is located at the Inagi city near Tokyo. Palaeolithic remains (a lithic industry) were distributed in the upper and lower layers of the Hakone-Tokyo tephra (HK-T). The upper cultural horizon yielded 10 artifacts, including points, scrapers, a hammerstone, a core and flakes; the lower cultural horizon incorporated 3 artifacts (a hare-shaped tool and two flakes) (Preliminary Report of Tama Newtown 471-b Site).

2. Fujiyama Site

The site is located in Gunma Prefecture. The archaeological horizon, producing a shajiku point and a pebble tool, is located under the Akagi-Yunokuchi pumice (AG-UP) (Aizawa, Sekiya 1988).

3. Irinosava Site

Similarly to the Fujiyama Site, the site is situated in the Gunma Prefecture. The geoarchaeological position of lithic artifacts was on and under Haruna-Hatsusaki pumice (Hr-HP), with the upper cultural horizon producing a flake and a core; the lower horizon yielded a retouched scraper (Sekiya 1988).

4. Iwajyiku Site

This famous palaeolithic site, being the first one found in Japan, is located in Gunma Prefecture. There have been more than three cultural layers recognized – on and below the Aira-Tn tephra (AT), and below the Asama-Itahana yellow pumice (AS-YP). The uppermost layer (AT) is characterized by microblade stone industry, the middle layer (AT) included, among other artefacts, a point, a knife and a small retouched tool; the lower layer yielded a partially polished axe, a blade and a number of less specific lithic industry inventories (Sugihara 1956, Aizawa, Sekiya 1988).

5. Takei Site

Situated in Gunma Prefecture, the Takei site incorporates two cultural horizons in the upper and lower part of the Aira-Tn (AT) layer, respectively. The lithic industry from the lower layer included shaped tools (knifes), whereas small-sized points were dominantly found in the upper layer (Sugihara 1977).

6. Msugata Site

The site (Gunma Prefecture) has provided stone tools from the lower layer of the Asama-Itahana yellow pumice (AS-YP) typical of a microblade tradition (including the Horoka type cores) (Sugihara 1977).

7. Ishiyama Site

The site, being a specialised atelier for lithic point production, produced a number of tools from the upper layer of Ssama-Itahana yellow pumice (AS-YP) (Sugihara 1977).

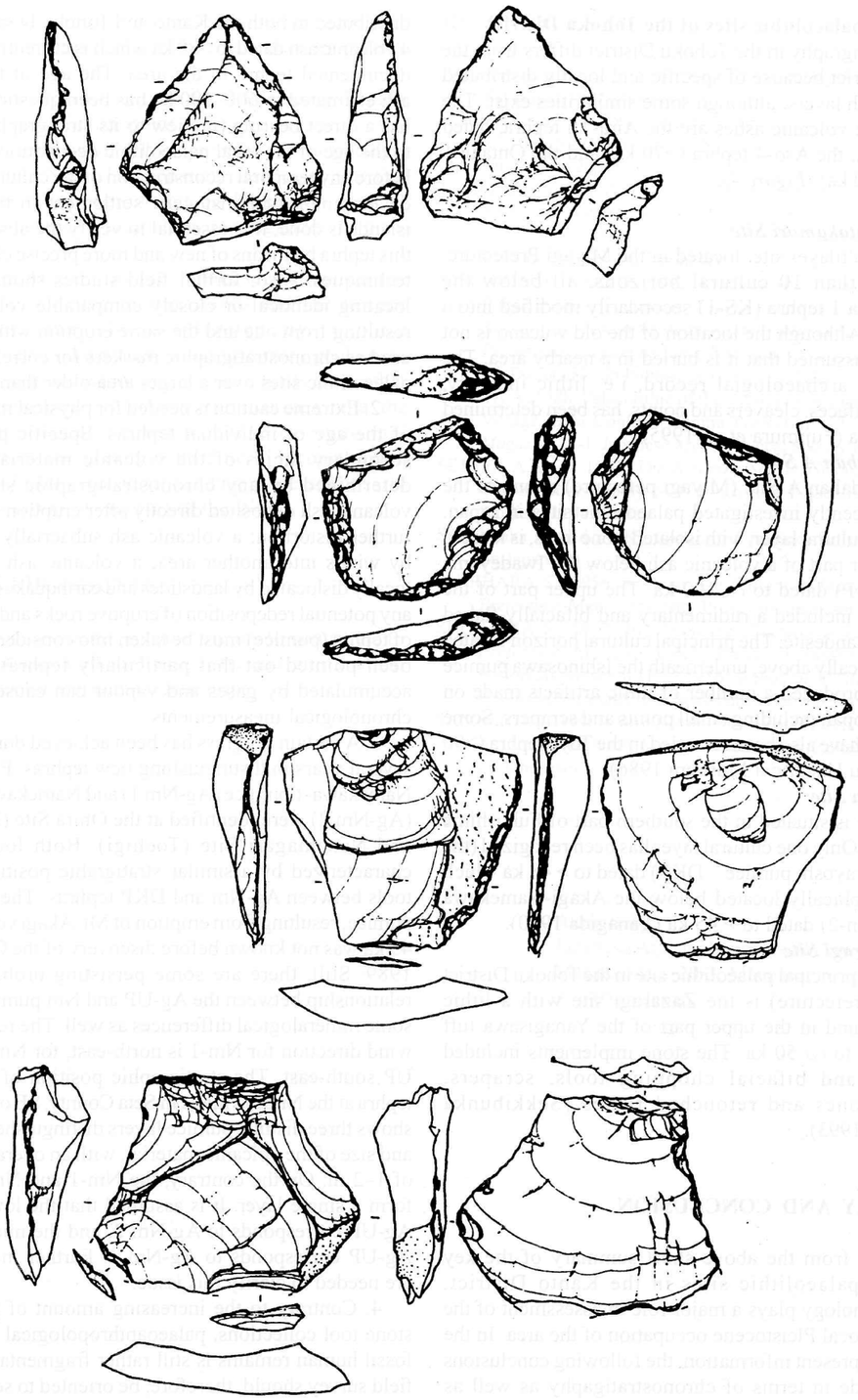


FIGURE 4. Lithic industry of the Kashounishi Site (lower layer).

Principal palaeolithic sites of the Tohoku District

Tephrastratigraphy in the Tohoku District differs from the Kanto District because of specific and locally distributed volcanic ash layers, although some similarities exist. The comparable volcanic ashes are the Aira-Tn tephra, dated to *ca* 21 ka, the Aso-4 tephra (>70 ka) and the Ontake-1 tephra (>80 ka) *(Figure 4)*.

1. Kamitakamori Site

This multilayer site, located in the Miyagi Prefecture, has more than 10 cultural horizons, all below the Kuranosawa 1 tephra (KS-1) secondarily modified into a fossil soil. Although the location of the old volcano is not clear, it is assumed that it is buried in a nearby area. The age of the archaeologial record, i.e. lithic industry, including bifaces, cleavers and points, has been determined to *ca* 500 ka (Fujimura *et al.* 1995).

2. Badaban A Site

The Badaban A Site (Miyagi pefecture) is one of the key and recently investigated palaeolithic sites in Japan. An earlier cultural layer, with isolated stone tools, is located in the upper part of a volcanic ash below the Iwadeyama pumice (IwP) dated to *ca* 100 ka. The upper part of the IwP tephra included a rudimentary and bifacially flaked industry on andesite. The principal cultural horizon located stratigraphically above, underneath the Ishinosawa pumice (IcP), has produced a number of lithic artifacts made on jasper and opal, including small points and scrapers. Some stone tools have also been recorded in the Toya tephra (>90 ka) (Tohoku Historical Museum 1986).

3. Ohira Site

The site is situated in the southern part of Fukushima Prefecture. Only one cultural layer has been recogized (the Daisen-Kurayoshi pumice – DKP) dated to > 48 ka which is stratigraphically located below the Akagi-Namekawa pumice (Nm-2) dated to > 45 ka (Yanagida 1990).

4. Zazaragi Site

The last principal palaeolithic site in the Tohoku District (Miyagi Prefecture) is the Zazaragi site with a lithic industry found in the upper part of the Yanagisawa tuff layer dated to *ca* 50 ka. The stone implements included unifacial and bifacial chopping tools, scrapers, hammerstones and retouched flakes (Sekkibunka Danwakai 1993).

SUMMARY AND CONCLUSION

As evident from the above short summary of the key Japanese palaeolithic sites in the Kanto District, tephrachronology plays a major role in assessment of the age of the local Pleistocene occupation of the area. In the light of the present information, the following conclusions can be made in terms of chronostratigaphy as well as methodology of the current geoarchaeological investigations:

1. The only broadly comparable volcanic ash deposit distributed in both the Kanto and Tohoku Districts is Aso-4 volcanic ash dated to >80 ka which is currently the earliest documented tephra in the area. The age of the volcanic ash estimated to 600–100 ka has been questioned since it has a direct bearing (in view to its stratigraphic position) to the age of the local palaeolithic occupation. Therefore, before any temporal reconstruction of the cultural-historical development of Pleistocene settlement in the Japanese islands is done, it is essential to verify the absolute age of this tephra by means of new and more precise chronometric techniques. Also, further field studies should focus on locating identical or closely comparable volcanic ashes resulting from one and the same eruption which could be used as chronostratigraphic markers for correlation of the palaeolithic sites over a larger area older than 100 ka.

2. Extreme caution is needed for physical measurement of the age of individual tephras. Specific primary and secondary facies of the volcanic materials must be determined by any chronostratigraphic study (i.e. a volcanic ash deposited directly after eruption without any further distortion; a volcanic ash subaerially transported by winds into another area; a volcanic ash repiled and locally dislocated by landslides and earthquakes). Similarly, any potential redeposition of eruptive rocks and other forms of tephra (pumice) must be taken into consideration. It has been pointed out that particularly tephras and rocks accumulated by gases and vapour can cause inaccurate chronological measurements.

3. A certain progress has been achieved during the past several years in distinguishing new tephras. For example, Namekawa-1 pumice (Ag-Nm 1) and Namekawa-2 pumice (Ag-Nm 2) were identified at the Ohira Site (Fukushima) and Nanamagari Site (Tochigi). Both localities are characterized by a similar stratigrahic position of stone tools between Ag-Nm and DKP tephras. The Namekawa pumice, resulting from eruption of Mt. Akagi volcano about 45 ka was not known before discovery of the Ohira Site in 1989. Still, there are some persisting problems in the relationship between the Ag-UP and Nm pumice showing some mineralogical differences as well. The reconstructed wind direction for Nm-1 is north-east, for Nm-2 east and UP south-east. The stratigraphic position of the Ag-UP tephra at the Nisato village in Seta County, SE of Mt. Akagi, shows three distinct pumice layers distinguished by colour and size of the volcanic material, with an overall thickness of 1–2 m. On the contrary, the Nm-1 and Nm-2 pumice form a single layer. It is assumed that the lowest part of Ag-UP corresponds to Ag-Nm 2, and the middle part of Ag-UP corresponds to Ag-Nm 1. Further investigations are needed to clarify this issue.

4. Contrary to the increasing amount of palaeolithic stone tool collections, palaeoanthropological database of fossil human remains is still rather fragmentary. A future field survey should, therefore, be oriented to searching for sites (particularly caves) which may potentially incorporate skeletal records. A long term investigation started in Hyotanana Cave (Iwate Prefecture) in 1996 with the

specific aim of finding palaeolithic anthropological remains. Similar efforts should be made in other parts of the country.

5. The main fossil tool type for the Japanese Middle Palaeolithic – the Shajiku point – shows a broader area of distribution from Iwate (Hyotanana Cave) to northern Kyushu (Tsujita Site). The apparent absence of this tool type in the Chubu region and on Hokkaido may be explained by lack of palaeolithic investigations in these areas.

6. Future progress in the Japanese studies on the palaeolithic occupation of the islands and Pleistocene environments may be accelerated by a close multidisciplinary collaboration with Quaternary geologists, Earth scientists and palaeolithic archaeologists from other East Asian countries, particularly from Korea, China, the Russian Far East and Siberia. Close international collaboration should greatly contribute to reconstruction of the earliest history and understanding processes of early human colonisation of this part of the World.

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