Chapter 6
Human Adaptive Responses to Environmental Change During the Pleistocene-Holocene Transition in the Japanese Archipelago

Kazuki Morisaki, Masami Izuho, and Hiroyuki Sato

Introduction

In this chapter, we discuss human adaptive responses to environmental change during the Pleistocene-Holocene transition in the Japanese archipelago, focusing on correlations between lithic technological/human behavioral strategies and paleoenvironmental change. Our time period of focus is 19,000 ~ 10,000 cal BP (15,000 ~ 9000 ^{14}C BP), from the Final Paleolithic to the Initial Jomon period.

In Japan, past chronological studies established by Jomon pottery typology, lithic typology, and radiometric dates have isolated three stages that occurred equally over all regions of Japan: from (1) the initial stage characterized by a microblade industry; to (2) the Mikoshiba industrial stage composed by large foliate and lanceolate bifacial points, large ground axes, and small quantities of pottery; and finally, to (3) the Incipient Jomon stage characterized by stemmed points (Okamoto 1979; Inada 1986; Kurishima 1991; Okamura 1997). After the 1990s, however, accumulation of new archaeological data and radiocarbon dates has suggested a more complicated spatiotemporal mosaic of cultural complexes during this transitional period (Inada 1993; Imamura 1999; Odai-yamamoto I site excavation team 1999; Kodama 2001; Taniguchi and Kawaguchi 2001; Anzai 2002; Kudo 2005; Taniguchi 2011; Mitsuishi 2013), though lithic studies from this period are still few and only at a regional scale of analysis. Recent research has proposed a correlation

K. Morisaki (✉)
Monuments and Sites Division, Agency for Cultural Affairs-Japan, Tokyo, Japan
e-mail: morisaki@mext.go.jp

M. Izuho
Archaeology Laboratory, Faculty of Social Sciences and Humanities,
Tokyo Metropolitan University, Tokyo, Japan

H. Sato
Department of Archaeology, Faculty of Letters, The University of Tokyo, Tokyo, Japan

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between environmental change and lithic tools or assemblages (Kanomata 2007; Miyoshi 2013). These studies have made an important contribution, but there has been a lack of focus on questions of technological organizational and human behavioral change.

This paper embraces a technological organization perspective for analyzing lithic tools, in which technology, including lithic technology, is seen as a strategy for the manufacture, transportation, use, and discard of subsistence tools (Binford 1979). As Binford (1979, 1980) pointed out, since this strategy is systematically organized according to environmental conditions, a technological organizational perspective allows us to view lithic technology as a human behavioral strategy and better understand the dynamics of human adaptation. Therefore, the economic aspects of technology when dealing with environmental or ecological conditions are emphasized in studies of technological organization that sometimes reference to optimal foraging theory or risk management (Nelson 1991; Bamforth and Bleed 1997; Morisaki et al. 2015).

Accordingly, environmental change should be primarily considered as one of the most significant contexts for studying lithic technological and human behavioral change and diversity. Obviously, it is not the sole determinant of human behavior. Based on archaeological data, adaptive behavioral strategies must have been diverse, even in similar environments. From a technological organizational perspective, however, environmental conditions should be viewed as a constraint on lithic technology and human behavior.

It is well known that environmental conditions from the Late Pleniglacial to the Preboreal fluctuated abruptly. To explain lithic technological and human behavioral change for this period, the influence of environmental changes driven by climatic fluctuation should be addressed.

This paper first discusses the issue of chronology by compiling radiocarbon ages that have recently accumulated throughout the Japanese archipelago. We then analyze diachronic and interregional variability of lithic technology, its organizational characteristics, and its role in reflecting human responses to environmental change. Lastly, we consider human behavioral variation within the context of paleoenvironmental changes during this transitional period.

Paleoenvironments from Late MIS3 to the Beginning of MIS1

Climatic Fluctuation and Geological Setting

The Northern Europe chronozone of the Late Glacial (LG) has traditionally been divided into five stages: Oldest Dryas, Bølling, Older Dryas, Allerød, and Younger Dryas (Fig. 6.1a) (Stuiver et al. 1995). Although there are some studies which adapt these stages to Japanese archaeology, the stages are not always synchronized with the results of high-resolution pollen analyses in the Japanese archipelago (e.g., Lake Suigetsu). Recently, paleoclimate studies of cave stalagmites in China (e.g., Hulu

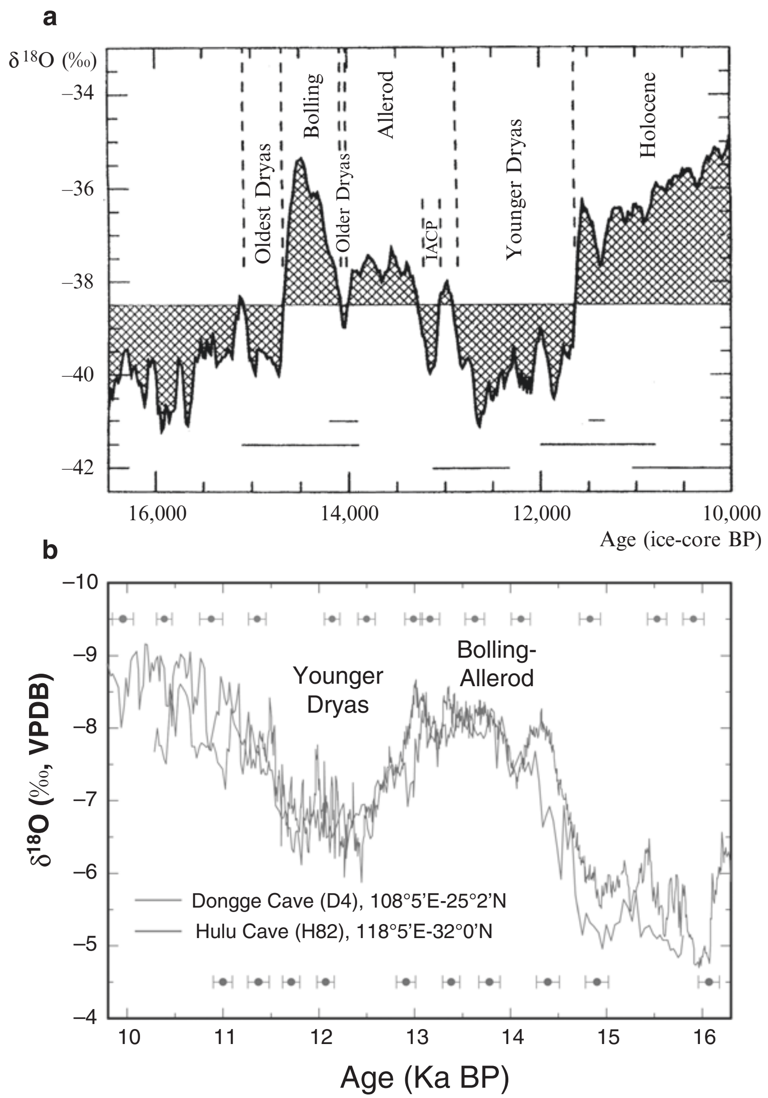

Fig. 6.1 Oxygen isotope record and chronozones in Northern Europe (**a**) (Stuiver et al. 1995) and in East Asia (China) (**b**) (Yuan et al. 2004)

Cave) have revealed millennium-scale fluctuations of Asian monsoon intensity, which correspond to the climatic fluctuations recorded in the Greenland ice cores (Fig. 6.1b) (Wang et al. 2001; Yuan et al. 2004). There are some differences between the oxygen isotope records of Northern Europe and China, but it should be noted that there seem to be at least three relatively distinct synchronic changes of oxygen isotope signatures between the two regions (Wang et al. 2001): the onset of the LG warm period, the Younger Dryas cold event, and the onset of the Holocene.

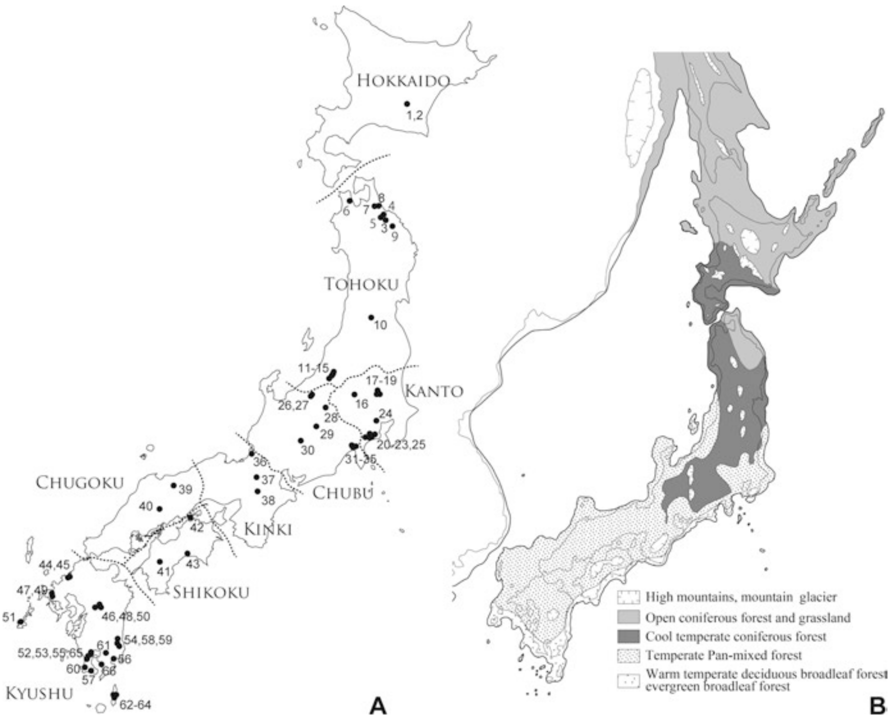

Fig. 6.2 Distribution of sites mentioned in this paper (**a**) and reconstructed paleogeography and vegetation of the Japanese archipelago and surrounding region during the Last Glacial Maximum (**b**) (After Sato et al. 2011a). Site numbers correspond to those in Table 6.2

At present, four reliable chronozones can be recognized within the time period considered in this chapter, based on Nakazawa et al. (2011), Kudo (2012), and Kudo et al. (2011): the Late Pleniglacial (LPG, GS-2: ca. 19000 ~ 14,700 cal BP), the Bølling/Allerød (B/A, GI-1), the Younger Dryas (YD, GS-1), and the Preboreal. Duration of the chronozones is ca. 14,700 ~ 12,800 cal BP for the B/A and ca. 12,800 ~ 11,500 cal BP for YD (Wang et al. 2001). The LG here means the time period from the Bølling/Allerød to the Younger Dryas.

Figure 6.2 shows the reconstructed paleogeography of the Japanese archipelago and surrounding region during the Last Glacial Maximum (LGM). Landmasses of this region during the LGM mainly consisted of two distinct parts: the Paleo-Sakhalin-Hokkaido-Kuril Peninsula and the Paleo-Honshu Island. Hokkaido was the southern part of the Paleo-Sakhalin-Hokkaido-Kuril (SHK) Peninsula, connected by a land bridge between the Sakhalin and the Kuril Islands (Kunashiri and Shikotan Islands). Honshu was attached to Shikoku and Kyushu, forming Paleo-Honshu Island. This island was not connected to the Paleo-SHK Peninsula during the Last Glacial, although distances across the straits were shortened from only a few up to a dozen kilometers (Matsui et al. 1998; Sato et al. 2011b). Hokkaido had long been under cold and dry continental-like climate, until inflow of warm current started and caused a precipitation increase around 15,000 cal BP. After the end of the Younger Dryas (ca. 11,500 cal BP), stable warm and wet climate dominated and changed the Japanese archipelago to the present form.

Flora

Table 6.1 is based on the latest data on vegetation history from the LGM to the Holocene (Takahara 2011). During the LGM, Hokkaido had long been covered by open *Larix* forest and grassland (Igarashi 2008), which never existed in Honshu. Honshu was divided into two vegetation zones: northeastern Honshu was covered by evergreen coniferous forest, and southwestern Honshu was covered by temperate coniferous forest. During the Late Glacial, flora changed as a consequence of the inflow of warm current into the Japan Sea and precipitation increase, which caused the vegetation of Honshu to change to temperate broadleaf forests. Hokkaido was gradually separated from the continent and started to be covered with forests similar to northeastern Honshu as well, though it occurred later than in Honshu.

This description is a little different from that of Fig. 6.2b, because the data source is not completely the same. The vegetation map in Fig. 6.2b tells us it is also possible to estimate higher proportion of broadleaf species in the southwestern Paleo-Honshu forest vegetation during the LGM than Table 6.1. Also, temperate broadleaf forests and broadleaf evergreen forests extended along the Pacific Ocean coastal area during the Terminal Pleistocene (Tsuji 2004). Here we confirm that the

Table 6.1 Vegetation history from the LGM to the Holocene

	Glacial period		Post-Glacial period	
ka BP	Stadial (30–15)	Late Glacial (15–10)	Early (10–7)	Middle (7–4)
Hokkaido	*Larix*	*Evergreen conifer* (Pinaceae)	*Pan mixed*	*Pan mixed*
Tohoku	*Evergreen conifer* (Pinaceae)	*Evergreen conifer* (Pinaceae)	*Temperate broadleaf*	*Temperate broadleaf*
Chubu	*Evergreen conifer* (Pinaceae)	*Temperate broadleaf*	*Temperate broadleaf*	*Temperate broadleaf*
Kanto	*Temperate conifer* (Pinaceae)	*Temperate broadleaf*	*Temperate broadleaf*	*Broadleaf evergreen*
Western Japan (Pacific Ocean side)	*Temperate conifer* (Pinaceae)	*Temperate broadleaf*	*Temperate broadleaf*	*Broadleaf evergreen*
Western Japan (Japan Sea side)	*Temperate conifer* (Pinaceae)	*Temperate broadleaf*	*Temperate broadleaf*	*Temperate conifer* (Pinaceae)

After Takahara (2011)

forest vegetation of southern Paleo-Honshu Island indicates a warmer climate than that of the northern part of the island and that only the Pacific Ocean coastal region of southern Honshu was covered with broadleaf evergreen forests.

Fauna

Recent studies of the formative history of terrestrial fauna on the Japanese archipelago during the terminal Pleistocene can be summarized as follows (Takahashi 2008; Takahashi and Izuho 2012). Before and during the LGM, several kinds of large mammals inhabited the Japanese archipelago. There were two faunal complexes: the Paleoloxodon-Sinomegaceroides complex with Nauman's elephant (*Palaeoloxodon naumanni*), which mainly inhabited Paleo-Honshu Island, and the Mammoth fauna complex with mammoths (*Mammuthus primigenius*), which mainly inhabited southern Paleo-SHK Peninsula, namely, Hokkaido, and areas further north. As a consequence of climatic fluctuations, some animals in each group are thought to have mixed complexes, migrating to the north or south according to species-specific habitat and temperature preferences.

Large mammals of the Paleoloxodon-Sinomegaceroides complex became almost extinct at the onset of LGM due to the climatic deterioration. Terrestrial fauna in Paleo-Honshu Island seemed to be composed of middle and small species like the present time since this period. On the other hand, the mammoth complex lived through the LGM in Hokkaido. However, large mammals of this complex seem to have become extinct or moved to northern regions gradually, having faced the climatic amelioration of the Late Glacial (Kuzmin and Orlova 2004). Terrestrial fauna in Hokkaido seems to have approximated to the present complexes since this period.

Materials and Methods

Data

The study includes a total of 74 assemblages from 66 archaeological sites across the Japanese archipelago, except the Ryukyu Islands which are located in the southernmost Japanese archipelago. We selected the materials which have both radiocarbon ages or firm tephrochronology or pottery typology and a lithic assemblage to establish a reliable archaeological chronology (about the distribution of the sites, see Fig. 6.2a). All data were gleaned from published excavation reports of Paleolithic sites (in Japanese). Most published excavation reports we consulted contained information on lithic tool kit assemblage structure and reduction strategies reconstructed through refit analyses. Unfortunately, organic remains are usually absent at the sites discussed here. However, rich lithic materials are preserved. All these data are summarized in Table 6.2.

Table 6.2 List of archaeological sites from 19,000 to 10,000 cal BP in the Japanese archipelago, with region, pottery association, stone weaponry, reduction technique, occupation intensity, radiocarbon dates of related archaeological assemblages, and references

No.	Region	Site	Pottery	Stone hunting weapon[a]	Primary reduction	Score of occupation intensity	Lab. no.	Method	Material	^{14}C Age (BP)	±1σ	Calendar age (cal BP; 68.2%)[b]		Chronozone	References
1.	Hokkaido	Taisho 3	Yes	Bf	Biface, flake	0	Beta-194631	AMS	Charred residues on pottery	12100	40	14050	13850	B/A	Obihiro City Board of Education (2006)
							Beta-194629	AMS	Charred residues on pottery	12420	40	14680	14320		
2.	Hokkaido	Taisho 6	Yes	Ah, Bf	Flake, blade, biface?	0	Beta-194635	AMS	Charred residues on pottery	9250	40	10510	10300	PB	Obihiro City Board of Education (2005, 2006)
							Beta-194636	AMS	Charred residues on pottery	9480	40	11050	10600		
3.	Tohoku	Takihata	Yes	(GAx)	——	2	Beta-138898	AMS	Charcoal	10260	40	12110	11840	YD	Hashikami Town Board of Education (1999)
4.	Tohoku	Kushibiki	Yes	Ah	Flake	2	Beta-113349	AMS	Charcoal	10030	50	11700	11390	YD~PB	Aomori Prefecture Buried Cultural Property Center (1999)
5.	Tohoku	Kiwada	Yes	n/a	n/a	0?	Unreported	AMS	Charcoal	12360	50	14520	14170	B/A	Aomori Prefecture Nango Village Board of Education (2001)
6.	Tohoku	Odai-yamamoto I	Yes	Ah, Bf	Blade, biface?	0	NUTA-6510	AMS	Charred residues on pottery	12680	140	15310	14760	LPG	Odai-yamamoto I site excavation team (1999)
							NUTA-6506	AMS	Charred residues on pottery	~13780	170	16940	16390		
7.	Tohoku	Akahira I	Yes	Bf	Blade, biface	0	IAAA-61926	AMS	Charcoal	13740	60	16740	16450	LPG	Aomori Prefecture Buried Cultural Property Center (2008)
							IAAA-61927	AMS	Charcoal	13800	70	16850	16540		

(continued)

Table 6.2 (continued)

No.	Region	Site	Pottery	Stone hunting weapon[a]	Primary reduction	Score of occupation intensity	Lab. no.	Method	Material	^{14}C Age (BP)	±1σ	Calendar age (cal BP; 68.2%)[b]		Chronozone	References
8.	Tohoku	Itsukawame	No	Mc (prism)	Microblade	0	IAAA-92228	AMS	Charcoal	13600	30	16470	16280	LPG	Aomori Prefecture Buried Cultural Property Center (2011)
							IAAA-92231	AMS	Charcoal	~15930	40	19300	19100		
9.	Tohoku	Hayasakatai, CL2	No	Mc (wedge)	Microblade	0	Beta-176021	AMS	Charcoal	13450	100	16330	16030	LPG	Iwate Prefecture Buried Cultural Property Center (2004)
10.	Tohoku	Hinata Cave western terrace	Yes	Bf, Ah	Biface, flake	0	n/a	n/a						(B/A[c])	Sagawa and Suzuki (2006)
11.	Tohoku	Kurohime cave	Yes	Ah	Flake	2	IAAA-40495	AMS	Charred residues on pottery	9050	50	10240	10190	PB	Irihirose Village Board of Education, Cave Excavaton Team of Uonuma Region (2004)
							Beta-194820	AMS	Charred residues on pottery	~9850	40	11270	11220		
12.	Tohoku	Unoki-minami	Yes	Bf, Ah	Flake, biface	0	Tka-14593	AMS	Charred residues on pottery	10660	170	12750	12380	B/A~YD	Yoshida et al. (2008)
							Tka-14583	AMS	Charred residues on pottery	~11670	130	13700	13350		
13.	Tohoku	Jin	Yes	Bf, Ah	Biface, flake	2		AMS	Charred residues on pottery	11700	90	13700	13420	B/A	Yoshida et al. (2008), Kobayashi (1981)
							Tka-14552	AMS	Charred residues on pottery	11800	60	13720	13560		
14.	Tohoku	Kubodera-minami	Yes	Bf	Biface, blade	0	Tka-14598	AMS	Charred residues on pottery	12460	90	14850	14320	B/A	Nakazato Village Board of Education (2001)
							Tka-14586	AMS	Charred residues on pottery	~12690	110	15290	14880		

15.	Tohoku	Araya	No	Mc (wedge, boat)	Microblade, biface	1	GrA-5715	AMS	Charcoal	13690	80	16660	16340	LPG	Department of Archaeology Graduate School of Arts and Letters Tohoku University (1990, 2003)
							GrA-5713	AMS	Charcoal	~14250	110	17520	17180		
16.	Kanto	Saishikada Nakajima	Yes	Ah	Flake	1	Beta-128025	AMS	Charcoal	10070	70	11770	11400	YD~PB	Kasakake Town Board of Education (2003)
17.	Kanto	Tako-minamihara	No	n/a	n/a	1	GaK-17981	β	Charcoal	10650	150	12720	12420	YD	Tochigi Archaeological Research Center (1999)
							GaK-17982	β	Charcoal	10240	130	12380	11710		
18.	Kanto	Yakushiji-inaridai	Yes	Ah	Flake	0	Unreported	AMS	Charred residues on pottery	11170	50	13100	13000	B/A~YD	Kobayashi et al. (2009)
							Unreported	AMS	Charred residues on pottery	10750	50	12730	12660		
19.	Kanto	Nozawa	Yes	Ah	Flake	1	IAAA-10051	AMS	Charred residues on pottery	11390	50	13290	13160	B/A	Tochigi Archaeological Research Center (2003)
							IAAA-10050	AMS	Charcoal	~11860	50	13740	13610		
20.	Kanto	Shonan Fujisawa Campus	Yes	Sp, Bf, Ah	Flake	1	Gak-15904	AMS	Charcoal	11350	160	13370	13060	B/A	Keio-gijuku University Department of Archaeology (1993)
21.	Kanto	Manpukuji	Yes	Sp, Bf, Ah	Flake	0	Beta-191840	AMS	Charred residues on pottery	12330	40	14400	14140	B/A	Ariake Cultural Property Research Institute, Manpukuji Sites Excavation Team (2005)
22.	Kanto	Tsukimino-kamino, loc.2	Yes	Sp, Ah	Flake	0	Beta-158196	AMS	Charred residues on pottery	12480	50	14900	14460	B/A	Yamato City Board of Education (1986)
23.	Kanto	Miyagase-kitahara	Yes	Sp? Bf	Flake, biface?	1	Beta-105402	AMS	Charcoal	13020	80	15740	15420	LPG	Kanagawa Archaeology Foundation (1998)
							Beta-105398	AMS	Charcoal	~13060	80	15810	15480		
24.	Kanto	Gotenyama 2N	Yes	Bf	Flake, biface?	1	Beta-196087	AMS	Charred residues on pottery	13560	40	16420	16230	LPG	Kato Construction Company Research Department of Buried Property (2004)
							MTC-05108	AMS	Charcoal	13200	70	15990	15740		

(continued)

Table 6.2 (continued)

No.	Region	Site	Pottery	Stone hunting weapon[a]	Primary reduction	Score of occupation intensity	Lab. no.	Method	Material	^{14}C Age (BP)	±1σ	Calendar age (cal BP; 68.2%)[b]		Chronozone	References
25.	Kanto	Yoshioka B	No	Mc (prism), Bf?	Microblade, flake	0	Tka-11613	AMS	Charcoal	16490	250	20200	19580	LPG	Kanagawa Archaeology Foundation (1999)
							Tka-11599	AMS	Charcoal	16860	160	20540	20130		
26.	Chubu	Nakamachi, loc. BP5a, SQ03	Yes	Sp, Bf, Ah	Flake, biface	0	NUTA2-7388	AMS	Charred residues on pottery	11420	45	13320	13200	B/A	Archaeological Research Center of Nagano Prefecture (2004)
							PLD-1843	AMS	Charred residues on pottery	~12280	110	14520	14030		
27.	Chubu	Seiko-sanso B	Yes	Sp, Bf, Ah	Flake, biface	1	Beta-133847	AMS	Charred residues on pottery	12000	40	13940	13760	B/A	Archaeological Research Center of Nagano Prefecture (2000)
							Beta-133848	AMS	Charred residues on pottery	~12340	50	14470	14150		
28.	Chubu	Tenjin-one	No	Mc (boat)	Microblade, blade	0	Beta-150648	AMS	Charcoal	13290	80	16110	15840	LPG	Saku City Board of Education (2006)
							Beta-150647	AMS	Charcoal	14780	80	18100	17870		
29.	Chubu	Mikoshiba	No	Bf, blade tool	Blade, biface	0	n/a							(LPG)[d]	Hayashi et al. (2008).
30.	Chubu	Hananoko	Yes	Ah	Flake	0	MTC-09201	AMS	Charred residues on pottery	9775	50	11240	11180	PB	Hara et al. (2010)
31.	Chubu	Ikeda B	Yes	Ah	Flake	2	Beta-127648	AMS	Charcoal	9480	50	11060	10600	PB	Shizuoka Prefecture Archaeological Center (2000)
							Beta-127647	AMS	Charcoal	~9590	50	11100	10780		
32.	Chubu	Maruokita	Yes	Ah	Flake	0	Beta-127648	AMS	Charcoal	9480	50	11060	10600	YD~PB	Shizuoka Prefecture Archaeological Center (2009)
							IAAA-80894	AMS	Charred residues on pottery	~10090	40	11810	11410		
33.	Chubu	Kuzuharazawa IV	Yes	Ah	Flake	2	IAAA-71618	AMS	Charcoal	10860	60	12780	12700	YD	Kobayashi (2008)
							IAAA-71620	AMS	Charcoal	10960	60	12890	12730		
34.	Chubu	Yasumiba	No	Mc (boat)	Microblade	1	Gak-604	Beta	Charcoal	14300	700	18260	16450	LPG	Sugihara and Ono (1965)

35.	Chubu	Oshikakubo loc.3	Yes	Ah, Bf?	Flake	3	Beta-167428	AMS	Charcoal	10850	40	12750	12700	YD	Shibakawacho Board of Education (2006)
36.	Kinki	Torihama, 84 trench layer 52–61	Yes	Ah	Flake	0	KSU-1016	Beta	Wood	10070	45	11760	11400	YD~PB	Torihama shell midden research group (1987), Keally et al. (2003), Murakami and Onbe (2008)
							KSU-404	Beta	Wood	10320	45	12380	12010		
		Torihama, 83 trench layer 85	Yes	Ah, Bf?	Flake	0	KSU-1017	Beta	Wood	10290	45	12160	11960	YD	
							KSU-1027	Beta	Wood	10770	160	12850	12530		
37.	Kinki	Aitani-kumahara	Yes	Ah	Flake	1	IAAA-100028	AMS	Charcoal	10870	50	12780	12700	B/A~YD	Matsumuro and Shigeta (2010)
							IAAA-100022	AMS	Charcoal	~11210	50	13130	13040		
38.	Kinki	Kiriyama-wada	Yes	Ah, Sp, Bf	Flake	0	n/a							(B/A)[c]	Archaeological Institute of Kashihara (2002)
39.	Chugoku	Higashi	No	Mc, Bf	Microblade, flake	1	n/a							(LPG)[d]	Hiruzen Educational Association Board of Education (2003)
40.	Shikoku	Taishakukyo-mawatari, layer 4	Yes	Ah, Sp, Bf	Flake	0	HR-330	Beta	Shell	12080	100	14050	13790	B/A	Kawagoe (1995), Takehiro (2008)
41.	Shikoku	Kamikuroiwa, layer 9	Yes	Sp, Ah	Flake	0	Beta-201260	AMS	Charcoal	12530	40	15010	14700	LPG~B/A	Onbe and Kobayashi (2009), Watanabe (1966)
42.	Shikoku	Wasajima	No	Mc (wedge,boat)	Microblade, flake?	0	n/a							(LPG)[d]	Kagawa Prefecture Board of Education (1984)
43.	Shikoku	Okutani-minami	No	Mc (boat), Bf?	Microblade, flake?	0	n/a							(LPG)[d]	Kochi Prefecture Cultural Foundation Buried Cultural Property Center (2001)
44.	N.Kyushu	Obaru D, grid15-3	Yes	Ah	Flake	0	Beta-139873	AMS	Carbonized wood	9170	110	10490	10230	PB	Fukuoka City Board of Education (2002)
							Beta-139874	AMS	Carbonized wood	9210	80	10400	10210		
		Obaru D, grid14	Yes	Ah, Gah	Flake	2	Gak-20568	AMS	Charcoal	10480	30	12530	12400	YD	
							PLD-6288	AMS	Charred residues on pottery	~10880	110	12890	12690		

(continued)

Table 6.2 (continued)

No.	Region	Site	Pottery	Stone hunting weapon[a]	Primary reduction	Score of occupation intensity	Lab. no.	Method	Material	^{14}C Age (BP)	±1σ	Calendar age (cal BP; 68.2%)[b]		Chronozone	References
45.	N.Kyushu	Matsukida	Yes	Gah,Ah	Flake	2	PLD-6290	AMS	Charred residues on pottery	9400	30	10670	10580	PB	Fukuoka City Board of Education (1998), Nishimoto (2009)
							PLD-6289	AMS	Charred residues on pottery	~9630	25	11140	10870		
46.	N.Kyushu	Kawayo F	Yes	Mc (wedge), Ah	Microblade, flake	0	Beta-154841	AMS	Charcoal	12140	50	14120	13940	B/A	Kumamoto Prefecture Board of Education (2003)
							Beta-154931	AMS	Charcoal	~12360	50	14520	14170		
47.	N.Kyushu	Sempukuji, layer 8	Yes	Mc (wedge)	Microblade (bifacial blank)	3	MTC-11296	AMS	Charred residues on pottery	12220	80	14250	13980	B/A	Aso (1985)
48.	N.Kyushu	Takahata-otonohara	Yes	Mc (wedge), Ah	Microblade, flake	0	Beta-213635	AMS	Charred residues on pottery	12470	50	14860	14430	LPG~B/A	Yamato Town Board of Education (2007)
							Beta-213636	AMS	Charred residues on pottery	12570	60	15080	14760		
49.	N.Kyushu	Fukui cave, layer 2–3	Yes	Mc (wedge)	Microblade	0	Unreported	AMS	Charcoal	13180	50	15940	15740	LPG	Sasebo City Board of Education (2013)
							Unreported	AMS	Charcoal	~13410	50	16240	16050		
		Fukui cave, layer 4	No	Mc (boat)	Microblade	0	Unreported	AMS	Charcoal	13580	40	16450	16250		
		Fukui cave, layer 7–9	No	Small flake tool	Flake	1	Unreported	AMS	Charcoal	14230	50	17450	17220		
		Fukui cave, layer 12	No	Mc (prism)	Microblade	1	Unreported	AMS	Charcoal	14670	50	17960	17770		
		Fukui cave, layer 13	No	Flake tool	Flake	2	Unreported	AMS	Charcoal	14600	50	17880	17680		
							Unreported	AMS	Charcoal	~15290	60	18650	18480		
50.	N.Kyushu	Kawahara 3, CL6	No	Mc (prism)	Microblade	0	Beta-135259	AMS	Charcoal	14660	70	17950	17730	LPG	Shiba and Obata (2007)

51.	N.Kyushu	Chaen, layer 5	No	Mc (prism)	Microblade	1	Beta-107730	AMS	Charcoal	15450	190	18910	18510	LPG	Kishiku Town Board of Education (1998)
52.	S.Kyushu	Kakuriyama	Yes	Ah	Flake	2	N-3928	Beta	Carbonized wood	8630	125	9890	9480	PB	Kagoshima Prefecture Board of Education (1981), Taniguchi (2002)
							N-3927	Beta	Carbonized wood	~9110	125	10500	10170		
53.	S.Kyushu	Nagasakobira	Yes	Ah	Flake	2	IAAA-40272	AMS	Charcoal	9280	50	10570	10400	PB	Kagoshima Prefectural Buried Cultural Property Center (2005b)
							IAAA-40273	AMS	Charcoal	~9400	50	10700	10570	PB	
54.	S.Kyushu	Kiwaki	Yes	Ah	Flake	1	MTC-10292	AMS	Charred residues on pottery	9505	25	11060	10700	PB	Miyazaki Prefecture Archaeological Center (2001a), Onbe (2009)
							MTC-10293	AMS	Charred residues on pottery	9430	55	10720	10580		
55.	S.Kyushu	Kenshojo	Yes	Ah, Bf, Mc (prism)	Flake, microblade	4	Beta-163810	β	Charcoal	11220	120	13240	12970	B/A	Kagoshima Prefecture Aira Town Board of Education (2005)
							Beta-163812	AMS	Charcoal	~10920	50	12810	12720		
56.	S.Kyushu	Higashi-kurotsuchida	Yes	n/a	n/a	2	PLD-15892	AMS	Carbonized cotyledon	11530	35	13420	13320	B/A	Setoguchi (1981), Kudo (2012)
							PLD-15893	AMS	Carbonized cotyledon	11555	35	13440	13340		
57.	S.Kyushu	Mizusako, layer 7	Yes	Ah	Flake	3	n/a (layer 7 containing Sz-S <ca. 12800 cal BP>)							(B/A~YD)	Ibusuki Board of Education (2002)
		Mizusako, layer 9	No	Bp, Tr, Mc?	Flake, microblade?	0	n/a (layer 9 containing Ata-Iw <ca. 19000–15000 cal BP>)							(LPG)	
58.	S.Kyushu	Kiyotake Kamiinoharu, loc.5	Yes	Ah, Bf	Flake	3	Unreported	AMS	Charcoal	11380	60	13280	13150	B/A	Kiyotake Town Board of Education (2009)
							Unreported	AMS	Charcoal	~11720	40	13570	13480		

(continued)

Table 6.2 (continued)

No.	Region	Site	Pottery	Stone hunting weapon[a]	Primary reduction	Score of occupation intensity	Lab. no.	Method	Material	^{14}C Age (BP)	±1σ	Calendar age (cal BP; 68.2%)[b]		Chronozone	References
59.	S.Kyushu	Tsukabaru C	Yes	Ah, Mc	Flake, microblade	1	MTC-10288	AMS	Charred residues on pottery	11850	60	13740	13590	B/A	Miyazaki Prefecture Archaeological Center (2001b)
							MTC-10289	AMS	Charred residues on pottery	11750	60	13700	13470		
60.	S.Kyushu	Shikazegashira	Yes	Ah, Mc (prism)	Flake, microblade	3	Beta-118964	AMS	Charred residues on pottery	11780	50	13720	13550	B/A	Kagoshima Prefecture Kaseda City Board of Education (1999)
							Beta-118963	AMS	Charred residues on pottery	11860	50	13740	13610		
61.	S.Kyushu	Kiriki-mimitori, CL3	Yes	Ah, Mc?	Flake, microblade?	2	Beta-139159	AMS	Charcoal	11800	110	13750	13490	B/A	Kagoshima Prefectural Buried Cultural Property Center (2005a)
							Beta-139160	AMS	Charcoal	11690	110	13710	13400		
		Kiriki-mimitori, CL2	No	Bp, Tr	Flake	0	n/a (CL2 containing Tkn-bs <ca. 19100 cal BP>)							(LPG)	
62.	S.Kyushu	Okunonita	Yes	Ah, GAh	Flake	1	MTC-09141	AMS	Charred residue on pottery	11740	60	13700	13460	B/A	Kagoshima Prefecture Nishino-omote City Board of Education (1995)
63.	S.Kyushu	Sankakuyama I	Yes	Ah, GAh	Flake	3	MTC-05834	AMS	Charred residues on pottery	12080	70	14030	13810	B/A	Kagoshima Prefecture Buried Cultural Property Center (2006)
							IAAA-31697	AMS	Charred residues on pottery	~11050	70	13010	12820		

64.	S.Kyushu	Onigano	Yes	Ah, GAh	Flake	3	Beta-177289	AMS	Charred residues on pottery	11880	60	13760	13600	B/A	Kagoshima Prefecture Nishino-omote City Board of Education (2004)
							Beta-177290	AMS	Charred residues on pottery	~12180	40	14140	14000		
65.	S.Kyushu	Yokoi-takenoyama	Yes	Ah, Mc (boat, prism)	Microblade, flake	0	n/a (archaeological assemblage contained below Sz-S<ca. 12800 cal BP>)							LPG~B/A	Kagoshima City Board of Education (1990)
66.	S.Kyushu	Nishimaruo, layer 7b	No	Mc (boat, prism)	Microblade	1	n/a (archaeological assemblage contained below Sz-S<ca. 12801 cal BP>)							LPG~B/A	Kagoshima Prefecture Board of Education (1992)

Ah arrowhead, *GAh* ground arrowhead, *Bf* bifacial point, *Sp* bifacial stemmed point, *Mc* microblade, *Bp* backed point, *Tr* trapezoid, *PD* pit dwelling, *PC* pebble cluster, *H* hearth, *CH* hearth with chimney, *SH* stone-lined hearth, *SP* storage pit, *TP* trap pit, *LPG* Late Pleniglacial, *B/A* Bølling/Allerød, *YD* Younger Dryas, *PB* Preboreal

[a]Microblade core is classified intro three types: wedge-shaped, boat-shaped, and prism

[b]The IntCal 13 calibration curve is used

[c]Chronologically positioned by pottery typology

[d]Chronologically positioned by lithic typology

As past studies reported, there are at least five regions where different pottery types and lithic assemblages developed (Okamura 1997). These regional differences seem to have derived from those formed during the LGM which reflect lithic technological and human behavioral differences (Morisaki 2010). Accordingly, we divided the Japanese archipelago into five regions, namely, Hokkaido, Tohoku, Kanto/Chubu, Kinki/Chugoku/Shikoku, and Kyushu, in this paper (Fig. 6.2a). Only the Kyushu region has been subdivided into northern and southern areas.

Chronology

Most of the assemblages are dated by radiocarbon dates. In collecting the dates, the latest data sources (Nakazawa et al. 2011; Kudo 2012) are referenced. According to the sample evaluation criteria of Graf (2009), almost all samples were collected from clear contexts, and, therefore, the dates are also reliable because samples from bad contexts were already excluded from the data source in advance. All dates were calibrated using the OxCal v.4.2 (Bronk Ramsey 2009, 2013), adopting the IntCal13 radiocarbon age calibration curve (Reimer et al. 2013). When a site has multiple ^{14}C dates, the oldest and youngest dates were listed in Table 6.2. All sites were assigned to the possible chronozone, indicated by the calibrated dates.

Detailed lithic technological and human behavioral study in Hokkaido was recently published (Yamada 2006, 2008), so we therefore relied on this data and only compiled data for sites that were not focused on in that study.

Lithic Technological Analysis

The main focus of this paper is not to establish archaeological chronology but to investigate human behavioral responses to environmental change. Therefore, we mainly discuss lithic technology that reflects human behavioral strategies, focusing on the composition of stone hunting weapons and primary reduction sequences. Four main stone weaponry systems of the time period of focus can be identified: chipped or ground arrowheads, bifacial points, bifacial stemmed points, and microblades which are slotted in organic shafts (Fig. 6.3). Besides them, backed points and trapezoids are seen in only a few sites. Primary reduction is divided into four types: flake, blade, biface, and microblade.

Intensity of Occupation

Various archaeological features such as pit dwellings, pebble clusters, hearths (earth oven), hearths with chimney, stone-lined hearths, storage pits, and trap pits are known within the time period of focus in this paper (Fig. 6.3g–j). Since their

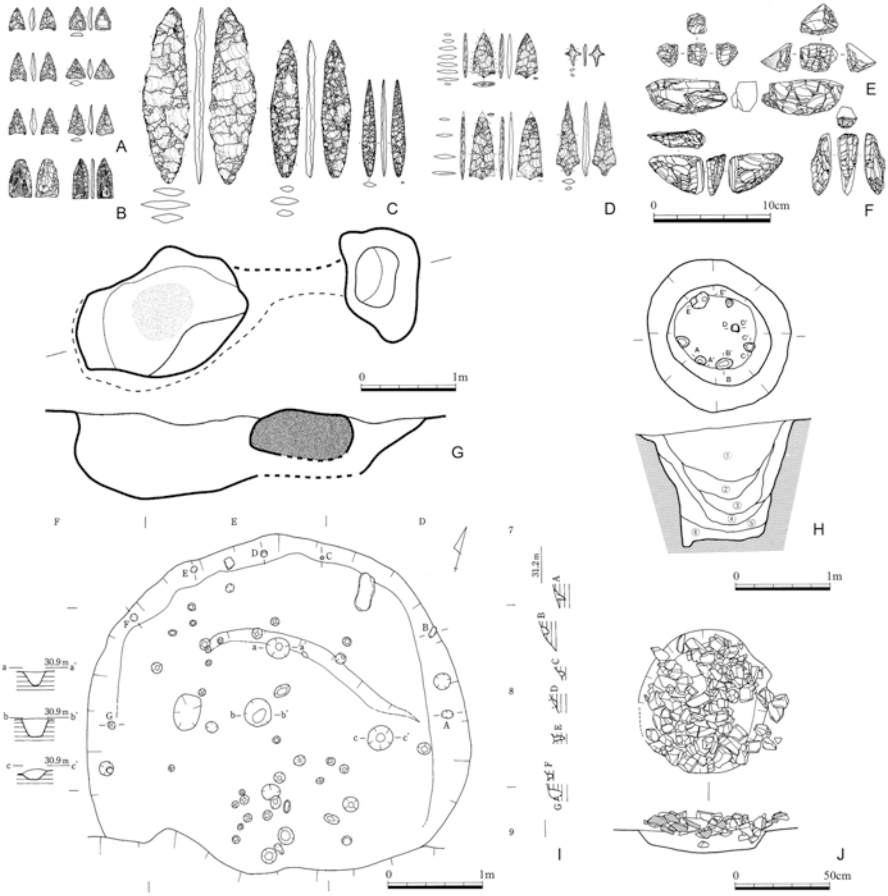

Fig. 6.3 Examples of stone hunting weapons and archaeological features, 15,000 ~ 10,000 cal BP in the Japanese archipelago. (**a**) chipped arrowhead, (**b**) ground arrowhead, (**c**) bifacial point, (**d**) bifacial stemmed point, (**e**) prismatic microblade core, (**f**) wedge-shaped microblade core, (**g**) hearth with chimney, (**h**) trap pit, (**i**) pit dwelling, (**j**) pebble cluster

construction requires much labor, these different features can serve as a proxy of intensified occupation or more sedentary lifeways. To estimate the degree of occupation intensity objectively, we scored the total number of different structures. There are seven types of archaeological features from the sites considered here, with scores ranked from 0 to 7 (with 7 being the highest). High score means labor-intensive occupation, while low scores indicate small investment in occupation activities. Apart from this, we also considered the timing of the appearance of pit dwellings, the most time-consuming structure providing evidence for occupation intensity.

Pottery

A variety of Jomon pottery types are known from the time period considered. Although it is of course important to chronological studies and studies of social interaction, the presence or absence of pottery is only briefly discussed here to describe its appearance within the context of the research questions.

Results

Kyushu Region

From 23 archaeological sites, 30 assemblages were analyzed (Fig. 6.2a, Table 6.2: 44–66). Lithic assemblages can largely be divided into three stages: the Late Pleniglacial, the Bølling/Allerød, and the Preboreal.

Before the Bølling/Allerød, lithic assemblages in southern Kyushu have backed points and trapezoids produced by expedient flake reduction, while those in northern Kyushu already have a microblade industry originally with prismatic microblades and later with wedge-shaped microblade cores on small bifaces (Shiba 2011). In the southern Kyushu, expedient microblade technique, which uses low-quality small lithic raw materials, was adopted belatedly after 17/16,000 cal BP.

At the same time as, or a little earlier than the beginning of the Bølling/Allerød warm period, the microblade industry with wedge-shaped microblade cores was associated with pottery in northern Kyushu. In contrast, the arrowhead industry, concomitant with the expedient boat-shaped microblade industry, started to be used between 16,000 and 14,000 cal BP in southern Kyushu (Morisaki 2015; Morisaki and Sato 2014). Moreover, ground arrowheads (Fig. 6.3b) are also found on Tanegashima Island (Sankakuyama I site, etc.), in the southernmost Kyushu region. Frequent use of ground arrowheads seems to have started earlier than previously mentioned (Miyata 2003). At the end of the Bølling/Allerød, the microblade industry disappeared, and stone hunting weaponry was completely replaced by chipped arrowheads made on blanks produced by expedient flake reduction.

Several types of archaeological features such as pit dwellings, pebble clusters, several kinds of hearths, and trap pits have been reported from sites after the Bølling/Allerød. The average of the occupation intensity score of whole Kyushu during the time period considered is 1.43 and that of northern Kyushu is 0.92, while that of southern Kyushu is 1.82; the score of assemblages during the Bølling/Allerød is 1.25 for northern Kyushu, and 2.50 for southern Kyushu which is the highest score among the regions focused here.

As seen in the example from Obaru D site in Fukuoka Prefecture in northern Kyushu, the cultural complex composed of arrowhead production on flake blanks, Jomon pottery production, and pit dwellings (Fig. 6.3i), the so-called Jomon cultural complex, continued during the Younger Dryas chronozone.

Kinki, Chugoku, and Shikoku Regions

Nine assemblages from eight archaeological sites from Kinki and Shikoku region were investigated (Fig. 6.2a; Table 6.2: 36–43). There is just one site whose archaeological context is evident in Chugoku region. Although samples are few, lithic assemblages can be largely divided into three stages: the Late Pleniglacial, the Bølling/Allerød, and the Preboreal.

Pre-Bølling/Allerød lithic assemblages such as those from the Wasajima and Okutani-minami sites contain microblade industries with mainly boat-shaped microblade cores and bifacial points made on flakes. Although these sites have no radiocarbon dates, their chronological position should be assigned to this time period because the previous period was comprised of different lithic assemblages such as the backed point assemblages (~20,000 cal BP; Morikawa 2010; Morisaki 2010).

Archaeological sites during the Bølling/Allerød are characterized by stemmed points, bifacial points, arrowheads, and pottery. Blanks for these bifacial tools were supplied by simple flake reduction. The stemmed point style (Fig. 6.3d, left) differs from those found in the Kanto region (Fig. 6.3d, right). Bifacial stemmed points and other bifacial points seem to have been phased out of use by the Younger Dryas (YD) at the latest. Arrowhead and simple flake reduction dominated after the onset of the Younger Dryas, as evidenced by assemblage from trench No. 83 of Torihama site and Aidani-kumahara site.

Pit dwellings first appear around the end of the Bølling/Allerød to the YD at the Aidani-kumahara site. A site that is not mentioned in this paper also has four pit dwellings (Kayumi-ijiri site) and which may be positioned to the Bølling/Allerød chronozone on the basis of pottery typology. The average of the occupation intensity score is very low (0.22), but it should be noted that three sites (Okutani-minami site, Taishakukyo-mawatari site, and Kamikuroiwa site) are rock-shelter or cave sites which might have supplemented for housing.

Kanto/Chubu Region

Twenty assemblages from twenty archaeological sites were analyzed (Fig. 6.2a; Table 6.2: 16–35). In this region, lithic assemblages can be largely divided into three stages; the Late Pleniglacial, the Bølling/Allerød, and the Preboreal.

Pre-Bølling/Allerød lithic assemblages comprise bifacial points on flakes and a microblade industry, first with prismatic and later with boat-shaped cores. Some sites of this period in northern Kanto, which lack radiocarbon ages and are not included in this paper, have wedge-shaped bifacial microblade cores. Biface reduction strategies are rare, except for some sites in the northern Chubu region. Only a few sites, such as the Gotenyama 2 N site and Miyagase-kitahara site, have possible pottery fragments. If the dates given to this pottery assemblage (15,420 ~ 16,420 cal

BP) are correct, then they are almost as old as the oldest plain pottery assemblage from the Odai-yamamoto I site in Aomori prefecture. Judging from the large elaborated lanceolate points, large blade tools, and lack of pottery, the Mikoshiba sites should be placed in this period.

Coinciding with the onset of the Bølling/Allerød, distinct Jomon pottery came into use throughout the region. Lithic assemblages contain bifacial stemmed points, other bifacial points, and arrowheads. With the exception of the blanks of some bifacial points in the northern Chubu region that were produced by bifacial reduction, all stone tools (including hunting weapons) were produced by expedient flake reduction. Although rare, microblade reduction is also recognized at a few sites (e.g., Tsukimino-kamino site loc. 2).

There were only a few bifacial tools which predated the start of the Younger Dryas, at which point stone hunting weapons had different kinds of arrowheads, with blanks prepared by simple flake reduction (Table 6.2).

Some types of archaeological features such as pit dwellings and pebble clusters have been reported from some sites, mostly after the Bølling/Allerød. As seen at the Oshikakubo site, which has 11 pit dwellings from the Younger Dryas chronozone (Shibakawacho Board of Education 2006), pit dwellings increased during this period all around the coastal area of the Pacific Ocean. The average of the occupation intensity score is 0.63 and that of assemblages from the Bølling/Allerød is 0.67.

Tohoku Region

Thirteen assemblages from thirteen archaeological sites were investigated (Fig. 6.2a; Table 6.2:3–15). The lithic assemblages can also be largely divided into three stages but in a little different way from the aforementioned regions because lithic technology during the Younger Dryas chronozone seems similar to those in the Bølling/Allerød in the Tohoku region; the Late Pleniglacial, the Bølling/Allerød to the Younger Dryas, and the Preboreal.

Before the Bølling/Allerød, lithic assemblages were characterized by microblade industries, first with prismatic microblade cores, and later with wedge-shaped microblade cores on bifaces, and boat-shaped microblade cores that were elaborately shaped. In addition, another type of lithic assemblage (e.g., the Odai-yamamoto I site and Akahira I site), which consists of fine blade tools and/or large bifaces, is found during this stage. Plain pottery from Odai-yamamoto I site was dated to 14,760 ~ 16,940 cal BP and is accepted as one of the oldest pottery assemblages in the world (Keally et al. 2003). The relationship between the two types of assemblages is still unknown, but it is noteworthy that the bifacial reduction technique characterizes both.

Lithic assemblages during the Bølling/Allerød witnessed the abandonment of the microblade industry. Bifacial tools (Fig. 6.3c) and arrowheads produced by bifacial reduction and flake reduction replaced it. These tools are highly standardized, and small tools such as arrowheads are made on flakes produced through a curated-biface reduction process (Sagawa and Suzuki 2006). Jomon pottery with a variety of decoration types appeared at this stage.

If the Unoki-minami site could be placed chronologically in the Younger Dryas, it would then imply the continuation of bifacial tools and other tools produced by bifacial reduction (in addition to other flake reduction schemes) throughout the onset of the Post-Glacial (with bifacial points continuing until the Early Jomon period). Lithic technology in this region during the Pleistocene-Holocene transition was therefore characterized by bifacial reduction techniques.

A small number of archaeological features such as pebble clusters and hearths have been reported from a few sites after the Bølling/Allerød. Clear evidence of pit dwellings first appeared during the YD (Kushibiki site), though some rock-shelter sites and one uncertain pit dwelling are known before that. The average of the occupation intensity score is 0.75, and that of assemblages from the Bølling/Allerød is 0.80.

Hokkaido Region

Paleolithic assemblages in Hokkaido (the southern Paleo-SHK peninsula), after 19,000 cal BP, contain a microblade industry which can be primarily characterized by the presence of a wide variety of microblade core types and reduction techniques (Nakazawa et al. 2005; Sato and Tsutsumi 2007).

The assemblages with microblade industries in Hokkaido can be divided into three stages on the basis of the presence of distinct microblade core types, radiocarbon data, and geochronology (Yamada 2006). These stages are an initial early stage (ca. 21,500–18,500 ^{14}C BP; 26,000 ~ 22,000 cal BP), a late early stage (ca. 15,500–13,500 ^{14}C BP; 19,000 ~ 16,000 cal BP), and a late stage (ca. 13,500–11,000 ^{14}C BP; 16,000 ~ 13,000 cal BP) (Morisaki et al. 2015).

Of these, the late early and the late stage are the focus of this paper. The late early stage (before the Bølling/Allerød) lithic assemblage has two types of microblade cores (Sakkotsu and Togeshita), burins, end scrapers, and sidescrapers. Blanks of these tools were bifaces, bifacial thinning flakes, and blades. Togeshita-type cores are made mainly on flakes. Consequently, reduction techniques are composed of microblade, biface, blade, and flake reduction processes. Therefore, tools and cores are highly portable and suit a broad ranging foraging subsistence. The late stage (the Bølling/Allerød) lithic assemblages contain at least three types of microblade cores (Shirataki, Oshorokko, Hirosato), bifacial stemmed points, adzes, axes, burins, end scrapers, and awls. Blank production techniques are composed of microblade, biface, and blade reduction processes.

In southeastern Hokkaido, one Jomon assemblage from the Taisho 3 site that has been dated to the Bølling/Allerød warm period is known. The Jomon pottery was well dated, and many lithic samples were collected from this site, but the lithics and pottery are supposed to be different from the Hokkaido cultural tradition and possibly left by migrants or by culturally related groups from the Tohoku region (Yamahara 2008).

To date, there has been no archaeological site firmly dated to the Younger Dryas in Hokkaido, so lithic technology and archaeological features for this period are undefined. There is a possibility that hunter-gatherer population density fluctuated. At least, they did not adopt a sedentary lifeway until the onset of the Holocene, when lithic assemblages containing arrowheads, flake reduction techniques, and Jomon pottery (e.g., Taisho 6 site) appear.

Microblade assemblages in Hokkaido contain highly standardized tools including microblades, burins, drills, end scrapers, and sidescrapers. Bifacial stemmed points and axes appeared during the late stage. Tool kit diversity became higher in the late stage than in the preceding stages. These tools were produced by several reduction techniques in combination. In the late early stage, variability of microblade production technology and tool types was relatively low, while high tool kit diversity and various microblade core types emerged in the later stage.

Hearths (earth oven) are the only features recorded for this region. Features constructed by digging down into the ground seem quite rare until the onset of Holocene, with the first appearance of pit dwellings.

Summary

Changes in lithic technology as well as the earliest occurrence of pottery and pit dwellings are summarized in Fig. 6.4. Three main points can be inferred from our analyses.

The first is that lithic technologies in Hokkaido and Honshu are different throughout the Pleistocene, until the onset of Holocene. Lithic technology in Hokkaido was highly elaborate and similar to its continental northeastern Asia counterpart (Sato 2003; Izuho and Sato 2008; Izuho 2013). They clearly differ from that of the Paleo-Honshu Island (Morisaki 2010; Morisaki et al. 2015).

The second is that Jomon pottery appears widely around 15,000 cal BP, except in Hokkaido (Kudo 2005) and a few other areas. The appearance of pottery coincides with changes in lithic technology toward flake tool industries and with the production of arrowheads by invasive thinning (using local lithic raw materials). This technological change characterizes the specific “Jomon lithic technology” for hunting weaponry systems.

The third is that there were interregional and temporal differences in lithic technology and in the occurrence of archaeological features. Although the timing is synchronous in the southwestern Paleo-Honshu Island, there are also some notable differences in the specific components of lithic assemblages and technology.

Bifacial reduction was the main blank producing technique in the Tohoku region. Chipped arrowheads seem to dominate much later in lithic assemblages of the northeastern Paleo-Honshu Island (Sagawa and Suzuki 2006; Sato et al. 2011b). By contrast, ground arrowheads are used initially in the southernmost Kyushu since the

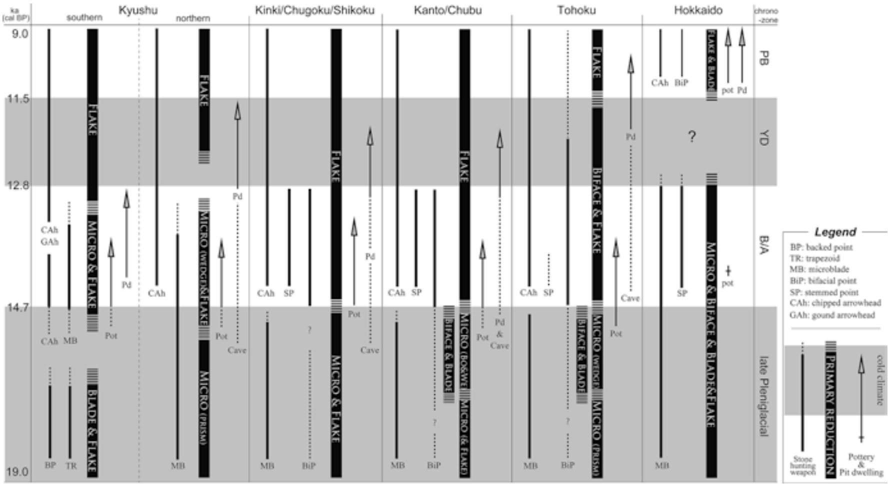

Fig. 6.4 Spatiotemporal diversity of lithic technology and timing of the appearance of pit dwellings and pottery in the Japanese archipelago from 19,000 to 10,000 cal BP

Bølling/Allerød. Meanwhile, bifacial stemmed points are often used in the Kinki, Shikoku, Kanto, and Chubu regions, except in the Kyushu region. As mentioned below, these differences are thought to reflect human behavioral variability. As for archaeological features, during the Bølling/Allerød, a number of pit dwellings and other features were more prevalent in the southern Kyushu region than in other regions (the highest occupation intensity score: 2.50).

Discussion

Lithic Technological Difference Between Hokkaido (the Southern Paleo-SHK Peninsula) and the Paleo-Honshu Island

It is possible to answer why the lithic technologies in Hokkaido differ from those in Honshu. As we mentioned earlier, environmental differences between Hokkaido and Honshu through the Late Pleniglacial must have caused humans to develop different lithic technology and behavioral strategies. Although continental dry and cold climates in Hokkaido were gradually changing to an island climate during the Late Glacial, stable warm and wet climates did not dominate until the end of Younger Dryas (11,500 cal BP). Except for the Taisho 3 site, which is supposed to have been occupied by migrants from the Paleo-Honshu Island during the Bølling/Allerød chronozone, the appearance of Jomon-type lithic assemblages and technology in Hokkaido occurred after the onset of the Holocene. Therefore, the uniqueness of lithic technology in Hokkaido throughout the terminal Pleistocene is plausibly explained by environmental differences with the Paleo-Honshu Island (Okamura 1997; Sato 2008a).

The highly portable, curated tool kit and relatively low tool assemblage richness in the late early stage of Hokkaido microblade assemblages indicate that foragers organized their technology to the dispersed distribution of lithic raw materials in a cold grassland landscape (even during the LG). But high tool kit diversity and various microblade core types in the late stage (the Bølling/Allerød) suggest the possibility that foraging territories were gradually becoming smaller, in keeping with the climatic amelioration and development of a forest environment (Morisaki et al. 2010; Yamada 2006).

The Background of the Wide Appearance of Jomon Lithic Technology and Pottery

The next question is: why did pottery and Jomon lithic technology appear at the same time across Paleo-Honshu Island? It should be noted that the timing clearly coincided with the onset of the Bølling/Allerød. This climatic amelioration was responsible for an increase in precipitation, for the development of a forest landscape similar to the Holocene on Paleo-Honshu Island (Table 6.1), and for the disappearance of large mammals from Pleistocene faunal complex. These abrupt environmental changes must have had a strong impact that caused human populations to shift to a new Holocene type of hunting behavior in the forest environment. This is consistent with the characterization of Jomon lithic technology as supported by flake reduction as primary reduction, suitable to a more sedentary way of life in relatively small foraging areas, in a newly forested landscape. Moreover, it is also of importance that lithic technology changed at the onset of the Bølling/Allerød and did not return to the technology in the previous stage. This is counter to the idea of the Younger Dryas having a strong impact on lithic technology in Japan (Kanomata 2007; Miyoshi 2013). The amount of pottery, however, clearly decreased during the Younger Dryas cooling event, as some researcher already pointed out (Taniguchi 2004; Sato 2008; Nakazawa et al. 2011).

Regional Differences in Human Behavior During the Late Glacial

After 15,000 cal BP, the Jomon lithic technology makes an appearance, with regional differences. If we consider the evidence for the adoption of ground stone technology and the construction of many archaeological features, which are indicators of occupation intensity, then foragers in the southern Kyushu region will transitioned quickly to a sedentary way of life during the Bølling/Allerød chronozone, earlier than other regions on the Paleo-Honshu Island (Amemiya 1993; Okamura 1997). This is supported also by the fact that they adopted relatively expedient primary reduction techniques.

On the other hand, the above data suggests that instead of pit dwellings, rock overhangs and caves were occasionally utilized for shelter in all other regions except southern Kyushu (Suzuki 2009). As opposed to southern Kyushu, foragers in the Tohoku region habitually practiced curated bifacial reduction as a major tool and tool blank producing technique during the Late Glacial, alongside flake reduction (with all tools being elaborately produced). They did not use pit dwellings until the late Younger Dryas. These facts suggest that relatively high mobility continued in the Tohoku region during this period (Sato et al. 2011b).

Meanwhile, judging from lithic technology and archaeological features, foragers in the Kinki, Shikoku, Chubu, and Kanto regions seem to have been more mobile than those in the southern Kyushu region but less mobile than those in the Tohoku region. This interpretation is based on lower numbers of pit dwellings and the lack of evidence for sophisticated reduction techniques (as in the Tohoku region). Additionally, in these regions, the number of pit dwellings increased sharply since the onset of Holocene.

This geographic cline of lithic technology and occupation intensity during the Late Glacial (which includes Hokkaido) seems to coincide with the natural environment (e.g., Fig. 6.2b, Table 6.1). In short, these data imply that microblade industries are mostly related to high mobility and to less favorable environmental conditions, whereas flake industries are related to low mobility and to more favorable environmental conditions. Bifacial industries seem to be positioned between these spectrums. Future research should investigate how this diversity in technologies is related to foragers' adaptations to changing fauna, flora, and landscapes and whether there are additional transformations after the period considered here.

Conclusion

Our reassessment of Late Glacial and early Holocene archaeological chronology and lithic technological changes has revealed regional and diachronic differences. Lithic technologies in Hokkaido and Honshu were clearly different until the onset of Holocene, due to environmental variability between these regions. Most typical attributes of Jomon lithic technology and archaeological features did not appear in Hokkaido until after the onset of the Holocene due to delayed climatic amelioration, yet they appeared at the onset of the Late Glacial in Honshu. As early as this period, there are regional differences in the Jomon lithic technology of Honshu. It is likely that most of this regional variation is a reflection of adaptation to spatiotemporally variable environments.

Recent studies have revealed that exploitation of marine resource and processing in pots dates back to the Incipient Jomon period (Kunikita et al. 2013). This is also supported by other researchers (Craig et al. 2013). Although this paper doesn't have the space to mention these studies, it is likely that when future technological and behavioral studies of lithics integrate the important new results from isotope analyses, a more detailed and dynamic trajectory across time and space of subsistence changes from the Paleolithic to the Jomon period can be expected.

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