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The Timing and Behavioral Context of the Late-Pleistocene Adoption of Ceramics in Greater East and Northeast Asia and the First People (Without Pottery) in the Americas

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ABSTRACT

Scholars have suggested that late Pleistocene foragers in greater East and Northeast Asia adopted pottery, but the chronology and behavioral contexts of pottery adoption are debated. This review evaluates those cases and debates, and places them into the context of the peopling of the Americas. Pottery was adopted (1) around the time of the adoption of (partially) domesticated plant foods in China, (2) by mobile foragers of the terminal Oldest Dryas in Honshu Japan, (3) by Bølling/Allerød period foragers with increased sedentism in the Russian Far East, and (4) by mobile foragers either in the Bølling/Allerød or early-mid Holocene in the Transbaikal. I suggest that mobile foragers without pottery migrated from East and Northeast Asia to Beringia prior to 15,000 calendar years ago. Alternatively, mobile pottery producers of Honshu (Oldest Dryas), or Hokkaido and/or Honshu (Bølling/Allerød) may have dispersed to Beringia and the Americas, but pottery has a low visibility.

1. Introduction

Mainly due to good preservation, a high volume of fragments, and ubiquitous uses, ceramics are among the most intensively studied artifacts in archaeology. Early influential thought about ceramic origins suggested that the adoption of the technology at the beginning of the Neolithic was triggered by climate change at the end of the last Ice Age (Childe [1936] 1951, 1954). In places such as the Middle East, northeastern Africa, and Europe, the Neolithic accompanied plant cultivation followed by animal domestication and the appearance of pottery, groundstone, food storage, weaving, and a population increase resulting in sedentary communities (Childe [1936] 1951, 1954). Although Childe ([1936] 1951) acknowledged the variability in the timing of the occurrence of behavioral traits, Neolithic components were often considered to have been adopted nearly simultaneously, inducing a dramatic change in lifestyle from frequently moving, small forager groups to people having control over nature with new technologies and behaviors. Ceramics in this context were thought to have emerged for utilitarian purposes, especially cereal preparation and storage, because of their advantageous performance in holding liquid and withstanding heat (Childe [1936] 1951, 76).

Reacting to the influence of this concept of the Neolithic Revolution, many archaeologists have focused attention on the timing of environmental changes during the Pleistocene–Holocene transition, agricultural origins, and the emergence of new technologies, evaluating mechanisms, and order of these changes (e.g., Binford 1968; Flannery 1969; Harris 1989; Janz, Odsuren, and Bukhchuluun 2017; Piperno 2011; Piperno and Pearsall 1998; Stiner and Kuhn 2016; Stiner, Munro, and Surovell 2000; Zeder 2009; Zeder and Smith 2009). Ceramic origins have been among the major topics of investigation in these studies. The current understanding is that the earliest ceramic evidence is found in forms of fired clays and figurines from Gravettian contexts of the early Upper Paleolithic in Europe, 32,000–27,000 calendar years ago (cal yr BP) (Farbstein and Davies 2017; Svoboda et al. 2015). Most scholars assume that these early ceramics were used for symbolic activities (Vandiver et al. 1989) by foragers with low residential mobility (Simonet 2017). In the Near East, pottery vessels likely built on pyrotechnology using clay and lime as well as gypsum-plaster technology came into use among sedentary agricultural communities, by around 10,000–9000 cal yr BP (Akkermans et al. 2006; Gibbs 2015; Kingery, Vandiver, and Prickett 1988; Moore 1995; Vandiver 1987; Zeder 2009). In northern Africa, the
first pottery technology appeared coincident with the Pleistocene–Holocene transition and was adopted by foragers and cattle keepers; these early ceramics were probably used for cooking newly available wild-plant or aquatic resources or for multiple purposes (Close 1995; Haaland 2007; Huyscom et al. 2009; Jórđeczka et al. 2011; Sutton 1974; Zedeño 2002). Across central Europe, pottery used by farming communities is found between about 7400 and 6900 cal yr BP, and possibly functioned in storage, transportation, and food preparation (Bogucki 1995).

The earliest pottery vessels in the world, however, appeared in East and Northeast Asia as early as the late Pleistocene (Barnes 2015; Cohen 2013; Gibbs and Jordan 2013; Jordan and Zvelebil 2009; Kaner and Taniguchi 2017; Kuzmin 2015, 2017b; Saotome and Natsuki 2017; Yanshina 2017), with studies suggesting an appearance in South China between 20,000 and 17,000 cal yr BP (Boaretto et al. 2009; Cohen et al. 2017; Wu et al. 2012), in North China around 11,500 cal yr BP (Li, Kunikita, and Kato 2017; Xia et al. 2001), in the Japanese Archipelago between 17,000/16,000 and 15,000 cal yr BP (Barnes 2015; Habu 2004; Kaner and Taniguchi 2017; 2018; Keally, Taniguchi, and Kuzmin 2003; Kudo 2012; Morisaki and Natsuki 2017; National Museum of Japanese History 2009; Taniguchi 2005, 2006), in the Russian Far East between 16,000 and 14,000 cal yr BP (Buvit and Terry 2011; Hashizume, Shevkomud, and Uchida 2016, 2017), and in the Transbaikal region of Siberia between 14,000 and 12,900 cal yr BP (Kuzmin 2015, 2017b; Kuzmin and Vetrov 2007). In these contexts, ceramics had to have been adopted by hunter-gatherers with varying degrees of mobility. Nevertheless, these dates for the appearance of Asian ceramics and their behavioral contexts have been debated. Regional cases of early pottery also require critical examination by site and area.

In this essay, I critically evaluate the empirical evidence and related debates concerning early pottery from the late Pleistocene of East and Northeast Asia, focusing on contexts dating before 11,500 cal yr BP (Figure 1). I review dates and stratigraphic contexts, pottery technologies, associated lithics and other technologies, features, degrees of residential mobility, and subsistence practices, when data are available. This is an important record because the timing of the adoption of pottery in East and Northeast Asia overlaps with the period commonly inferred for the dispersal of humans to Beringia and the Americas. Hence, I also consider the relations between Pleistocene pottery producers and users of the eastern Old World and the first people who migrated to the New World.

2. Problems and contexts

In this section, I describe the general archaeological problems related to studying the timing of the adoption of pottery in greater East and Northeast Asia as well as its environmental and archaeological contexts.

2.1. Problems

Obtaining a proper chronology is essential for this study, but there are multiple issues that relate to reaching this objective. In South China, for example, potentially inaccurate older dates have been obtained from difficult environmental and depositional contexts. In the Transbaikal region, radiocarbon dates versus assumptions of ages based on stratigraphic observations give great discrepancies. Sites in the Amur River basin tend to have compressed stratigraphy which makes the separation of artifacts into microages difficult. In the Korean Peninsula, pottery appears to have been adopted later; and although the reason for this needs to be investigated, the non-Pleistocene contexts from this peninsula are excluded from this review.

Another problem stems from considering data from old excavations that lacked fine stratigraphic control or detailed reports. Also, the total number of Pleistocene sites with ceramics is often unclear in the English archaeological literature.

Overall, in research into the origin of pottery, establishing a firm chronology is essential. Without it, we cannot easily evaluate responses to commonly asked archaeological questions like: (1) When, where, and why did the earliest ceramics emerge? (2) Did pottery emerge in a single region with technological transmission to other areas? And, if so, can we reconstruct that mechanism? Or (3) did multiple in situ inventions occur across greater East and Northeast Asia? And, if so, what were the processes of invention and their behavioral contexts? (4) What degree of variability existed in early pottery technology? And (5) are there correspondences between environmental factors and behavioral variability and changes over time?

2.2. Contexts

Paleoclimatic fluctuations worldwide during the late Pleistocene also need to be acknowledged. After the Last Glacial Maximum (LGM) (which occurred between 26,500 and 20,000–19,000 cal yr BP), from about 19,000 cal yr BP (Clark et al. 2012) to the end of the Late Glacial (LG) ca. 11,500 cal yr BP (Bradley 1999), there were three major transitions: (1) the Oldest
Dryas (OD) cold period to Bølling/Allerød (B/A) warm interval around 15,000 cal yr BP, (2) the B/A to Younger Dryas (YD) cold interval around 12,900 cal yr BP, and (3) the YD to Preboreal warming about 11,500 cal yr BP (Iizuka and Izuho 2017, 106). Abrupt warming began in the Holocene, between 11,500 and 8800 cal yr BP, and this continued during the Preboreal (11,500–9900 cal yr BP) and early Boreal (9900–8800 cal yr BP). Late Boreal (8800–7800 cal yr BP) and Atlantic (7800–5700 cal yr BP) periods followed (Gedda, Lemandh, and Gaillard 1999; in Gedda 2001, 13; Iizuka and Izuho 2017, 106).

What are the archaeological contexts for the first pottery makers in greater East and Northeast Asia for explaining the late Pleistocene migration of humans to the Americas, especially in terms of the lithic-technological systems that are often considered by archaeologists when attempting to track the movement of Upper Paleolithic people?

In South China, the cobble-tool industry from the LGM to the early Holocene was the dominant technology (Qu et al. 2013). In the terminal Pleistocene, wild rice is documented to have been collected by foragers in the Yangtze Valley, while rice cultivation started in the early Holocene about 10,000 cal yr BP (Higham and Lu 1998). If we unequivocally accept the earliest direct dates on pottery, then we have to conclude that this technology emerged during the LGM; however, if
we instead focus on other evidence of the earliest rice domestication (e.g., Jordan and Zvelebil 2009; Pearson 2005; Zhang 2002b), the emergence of pottery may not have happened until the Preboreal.

In North China, the Upper Paleolithic period is dominated by microblade industries (Qu et al. 2013). The timing of the adoption of pottery, according to the current chronology, is during the transition between the YD and the Preboreal, in association with microblades.

In the Paleo-Sakhalin-Hokkaido-Kuril Peninsula (PSHK), microblade technology developed around 26,800 cal yr BP, but microblades disappeared from the record by about 13,000 cal yr BP (Buvit et al. 2016, 117). Buvit et al. (2016, 117) suggest that a favorable environment is found in Kamchatka after the Bolling (Razjigaeva et al. 2011), and that microblades emerged there at this time. He further speculates that this may be due to the population pressure from the arrival of the Jomon people. Around 17,000–15,000 cal yr BP, people who possessed the Yubetsu microblade reduction method in PSHK seem to have migrated to various areas of Paleo-Honshu that had bifacial technology; subsequently, inter-regional stone tool variabilities emerged (Morisaki 2016, 30). About this time, people with a high degree of residential mobility adopted pottery (Morisaki and Natsuki 2017).

In Siberia, the late Upper Paleolithic hunter-gatherers who produced microblades began to re-occupy the Siberian steppe after the LGM, when climate extremes ameliorated, and they subsequently expanded into far northeast Asia, quickly reaching the arctic coastal plain (Goebel 1999, 223; see also Graf and Buvit 2017). These people were presumably small, highly mobile groups with logistical subsistence strategies and efficient hunting skills directed at a few key mammal species. In the late Pleistocene, at some early pottery sites, ceramics are found in association with microblades and/or microblade cores in the Amur River basin of the Russian Far East (Buvit and Terry 2011; Hashizume et al. 2017) and in the Transbaikal (Buvit and Terry 2011; Kuzmin and Vetrov 2007). The former is presumed to have the oldest dates of about 16,000–15,000 cal yr BP, and the latter, 14,000–13,000 cal yr BP (after Kuzmin 2015). However, as discussed in greater detail below, the reliability of the dates for the pottery of Transbaikal is debated.

In North America, Clovis sites with well-defined contexts are dated between 13,200 and 12,900 cal yr BP, with its end coinciding with the onset of the YD and the extinction of megafauna (Goebel, Waters, and O’Rourke 2008; Izuho 2018; Waters and Stafford 2007). Whether megafauna and associated species began disappearing prior to the emergence of Clovis groups is disputed (Meltzer 2015). Clovis sites are typically associated with megafauna, but the extent of hunting them is unclear in the pre-Clovis context. Combining genetic, paleoenvironmental, and archaeological data, Goebel, Waters, and O’Rourke (2008, 1501) suggest that humans first arrived in the Americas around 15,000 cal yr BP through the coastal corridor by boat, which in a general sense may correlate with the dispersal of microblade producers in northern Siberia and Beringia, the ancestors of Clovis-producing populations; or there was a second migration of Clovis producers via land using the inland ice-free corridor around 13,600–13,500 cal yr BP (Izuho 2018). Recent genetic studies confirm that Asian ancestors and ancestral Native Americans diverged between 23,000 and 20,000 cal yr BP (Graf and Buvit 2017; Raghavan et al. 2015). Similarly, gene flow from northern Eurasians may have persisted as late as 20,000 cal yr BP and 18,100 cal yr BP (Moreno-Mayar et al. 2018). People were isolated in Beringia for up to 10,000 years, according to the Beringian Standstill Model (BSM), followed by a migration south before 13,500–13,000 cal yr BP (Graf and Buvit 2017; Raghavan et al. 2015). This may have occurred through terrestrial (or both coastal and terrestrial) migration between 16,000 cal yr BP and before 13,500 cal yr BP (Potter et al. 2018). An alternative suggestion (Buvit and Terry 2016) is that the genetic standstill occurred in PSHK, the refugium, after receiving migrants from southern Siberia; these people migrated rapidly from PSHK to Beringia after the standstill.

We can explain the absence of pottery in the Pleistocene sites of the New World thus: if the first Americans migrating from Northeast and/or East Asia were mobile hunter-gatherers, who did not use pottery, the primary reason for the absence of pottery may have been migration prior to the adoption of pottery technology. However, if the earliest claims for pottery in East and Northeast Asia predate the hypothesized spread of humans into the Beringia, the reasons for the absence of pottery may have been (1) changes in subsistence practices, for example, from a broad diet without megafauna and related species; (2) the low-fired characteristics of the pottery and freeze-thaw processes in the cold, subarctic climate leading to rapid disintegration of broken pottery; or (3) small quantity produced and used. A firm understanding of the chronology is obviously indispensable in responding to these alternatives.

To evaluate the timing of the adoption of pottery in light of Neolithization processes and possibilities of the presence/absence of pottery producers migrating to the Americas, this essay weighs degrees of mobility and sedentism at early pottery sites in Asia. This expands the above-mentioned behavioral elements
accompanying the Neolithic proposed by Childe ([1936] 1951). The adoption of broad-spectrum diet and domesticates, increased variability and frequent appearance of features and ground stones, increased size and weight of tools, appearance of food storage, change from round/oval to rectangular structures, and production of boats, nets, and pit-traps (tools giving delayed subsistence returns) among others, have commonly been used in archaeology as signatures of reduced mobility (e.g., Binford 1980; Flannery 1969, 1973; Habu 2000; Iizuka et al. 2018, 73; Kelly 1992, 1995; Price and Brown 1985; Shott 1986; Woodburn 1982). Signatures of high mobility include the use of tools and weapons that are utilitarian, portable, and give immediate labor return (Woodburn 1982). For example, the adoption of microblades, blades, and bifaces are considered in association with high mobility (i.e., the late Upper Paleolithic of Japan; Morrisaki and Natsuki 2017).

3. Early ceramic sites of greater East and Northeast Asia

3.1. South China

In South China, most Pleistocene sites with ceramics come from caves situated in the hilly areas of limestone regions (Lu 2010, 16, 21). The groundwater in the region’s limestone cave sites contains abundant CaCO₃ derived from limestone and is depleted of radiocarbon, potentially leading to inaccurately old radiocarbon dates (An 1991; Lu 2010). A test on modern plants growing in the region has yielded dates as much as 1000–2000 years old (An 1991, 198). The approximate total number of early ceramic sites is unclear in the English-based literature. For example, commonly presented sites are Xianrendong and Diaotonghuan, Xianrendong is a multi-component site (MacNeish 1999). Excavations in the 1990s were conducted in the East Area and West Area, and the excavators considered the stratigraphy to be continuous as revealed by their giving the same numbering system to both areas; however, the most recent investigations revealed that the layers were horizontally discontinuous (Cohen et al. 2017, 38). Following the original labeling, Cohen et al. (2017) found that the layers in the West Area were 4B to 1, and in the East Area, 6B to 1 (Wu et al. 2012, 1697). In the stratigraphic drawings of Wu et al. (2012) and Cohen et al. (2017), the larger the first number, the lower the layer; and a sub-layer with the letter A is above B. The third number works in the same way; thus 3A2 is a layer below 3A1.

Xianrendong (28°44′10.05″N, 117°10′23.15″E) and Diaotonghuan are in the Jiangxi Province about 100 km south of the Yangtze River (Boaretto et al. 2009; Lu 2010) and along a tributary of the Pearl River (Lu 2010) and along a tributary of the Yangtze River (Boaretto et al. 2009; Lu 2010) and along a tributary of the Pearl River (Lu 2010) and along a tributary of the Pearl River (Lu 2010) and along a tributary of the Pearl River (Lu 2010) and along a tributary of the Pearl River (Lu 2010) and along a tributary of the Pearl River (Lu 2010) and along a tributary of the Pearl River (Lu 2010).

At Xianrendong, archaeological occupations have been found in the rockshelter-like roofed area in front of the cave (Cohen et al. 2017). Xianrendong was excavated by Li, in 1961 and 1964, and by a Sino-American team led by Wenning and MacNeish, in 1993 and 1995, and by a joint excavation team of Peking University and Jiangxi Provincial Institute of Cultural Relics and Archaeology in 1999 and 2000. In 2009, Wu and colleagues re-opened two trenches and sampled sediment blocks of a few centimeters thickness to re-date and study micromorphology of the deposits (Cohen et al. 2017, 41; MacNeish 1999; Wu et al. 2012, 1697). Xianrendong is a multi-component site (MacNeish 1999). Excavations in the 1990s were conducted in the East Area and West Area, and the excavators considered the stratigraphy to be continuous as revealed by their giving the same numbering system to both areas; however, the most recent investigations revealed that the layers were horizontally discontinuous (Cohen et al. 2017, 38). Following the original labeling, Cohen et al. (2017) found that the layers in the West Area were 4B to 1, and in the East Area, 6B to 1 (Wu et al. 2012, 1697). In the stratigraphic drawings of Wu et al. (2012) and Cohen et al. (2017), the larger the first number, the lower the layer; and a sub-layer with the letter A is above B. The third number works in the same way; thus 3A2 is a layer below 3A1.

In the Sino-American excavation, the dates for the earliest ceramics, from the Xian Ren Phase, ranged between 17,625–16,775 cal yr BP (UCR-3440) and 15,225–14,165 cal yr BP (BK95145) (Table 1). These calculations are from feature 3 of layer 3C1A (MacNeish
Table 1 Radiocarbon dates and contexts discussed in this paper.

<table>
<thead>
<tr>
<th>Region</th>
<th>Site</th>
<th>Layer</th>
<th>Lab number</th>
<th>14C yr BP</th>
<th>cal yr BP (2σ)*</th>
<th>Material</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>South China</td>
<td>Xianrendong</td>
<td>3C1A</td>
<td>BK95145</td>
<td>12,530 ± 140</td>
<td>15,225–14,165</td>
<td>Charcoal</td>
<td>MacNeish (1999)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>UCR3440</td>
<td>14,160 ± 140</td>
<td>17,625–16,775</td>
<td>Charcoal</td>
<td>MacNeish (1999)</td>
</tr>
<tr>
<td></td>
<td>3C1B, West Area</td>
<td>UCR3440</td>
<td>15,180 ± 90</td>
<td>18,675–18,190</td>
<td>Charcoal</td>
<td>MacNeish (1999); Wu et al. (2012)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3C1A, West Area</td>
<td>BA00006</td>
<td>15,210 ± 190</td>
<td>18,845–18,010</td>
<td>Human skull</td>
<td>Wu and Zhao (2003)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3C1A, West Area</td>
<td>BA00006</td>
<td>15,655 ± 194</td>
<td>19,440–18,540</td>
<td>Bone</td>
<td>Wu and Zhao (2003)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3C1B, West Area</td>
<td>UCR3300</td>
<td>14,160 ± 120</td>
<td>17,625–16,775</td>
<td>Charcoal</td>
<td>Wu et al. (2012)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2A, East Area</td>
<td>BA00004</td>
<td>10,160 ± 120</td>
<td>12,380–11,310</td>
<td>Bone</td>
<td>Wu and Zhao (2003)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2B, East Area</td>
<td>BA00004</td>
<td>10,456 ± 118</td>
<td>12,680–11,980</td>
<td>Bone</td>
<td>Wu et al. (2012)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td>BA09872</td>
<td>15,210 ± 190</td>
<td>18,845–18,010</td>
<td>Bone</td>
<td>Wu and Zhao (2003)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2B, East Area</td>
<td>BA00015</td>
<td>15,655 ± 194</td>
<td>19,440–18,540</td>
<td>Bone</td>
<td>Wu and Zhao (2003)</td>
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<tr>
<td></td>
<td>N/A</td>
<td>ZK39</td>
<td>10,870 ± 240</td>
<td>13,265–12,150</td>
<td>N/A</td>
<td>MacNeish (1999) referring to data from the 1964 excavation</td>
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<td></td>
<td>3C1B, West Area</td>
<td>AA15005</td>
<td>17,420 ± 130</td>
<td>21,435–20,660</td>
<td>Charcoal</td>
<td>Wu et al. (2012)</td>
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</tr>
<tr>
<td></td>
<td>3C1A, West Area</td>
<td>BA95138</td>
<td>11,840 ± 150</td>
<td>14,060–13,390</td>
<td>Charcoal</td>
<td>MacNeish (1999)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diatonghuan</td>
<td>D</td>
<td>BA00004</td>
<td>15,090 ± 210</td>
<td>18,780–17,875</td>
<td>Bone</td>
<td>Wu and Zhao (2003)</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>BA95138</td>
<td>11,840 ± 150</td>
<td>14,060–13,390</td>
<td>Charcoal</td>
<td>MacNeish (1999)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yuchanyan</td>
<td>T1, layer 3H</td>
<td>BA95057b</td>
<td>14,390 ± 230</td>
<td>18,100–16,880</td>
<td>Pottery residue</td>
<td>Wu and Zhao (2003); Boaretto et al. (2009)</td>
</tr>
<tr>
<td></td>
<td>T1, layer 3E</td>
<td>BA95058</td>
<td>13,680 ± 270</td>
<td>17,365–15,800</td>
<td>Charcoal</td>
<td>Wu and Zhao (2003); Boaretto et al. (2009)</td>
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<tr>
<td></td>
<td>T1, layer 3H</td>
<td>BA95057a</td>
<td>11,970 ± 120</td>
<td>14,122–13,551</td>
<td>Humic substance from potsherd</td>
<td>Wu and Zhao (2003); Boaretto et al. (2009)</td>
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<tr>
<td>North China</td>
<td>Nanzhuangtou</td>
<td>3H</td>
<td>BA95057a</td>
<td>12,320 ± 120</td>
<td>18,580–17,490</td>
<td>Humic acid residue (pottery)</td>
<td>Yuan et al. (1997)</td>
</tr>
<tr>
<td></td>
<td>3H, sublayer 3E at 255 cm</td>
<td>BA05421</td>
<td>12,735 ± 70</td>
<td>15,425–14,780</td>
<td>Residue (pottery)</td>
<td>Yuan et al. (1997)</td>
<td></td>
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<tr>
<td></td>
<td>T11c, layer 3E at 255 cm</td>
<td>BA05421</td>
<td>13,890 ± 50</td>
<td>17,045–16,575</td>
<td>Charcoal</td>
<td>Boaretto et al. (2009)</td>
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<td></td>
<td>T12, layer 3E</td>
<td>BA95057a</td>
<td>11,970 ± 120</td>
<td>14,122–13,551</td>
<td>Humic substance from potsherd</td>
<td>Wu and Zhao (2003); Boaretto et al. (2009)</td>
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<td></td>
<td>3L</td>
<td>BA92033-1</td>
<td>13,710 ± 270</td>
<td>17,400–15,845</td>
<td>Charcoal</td>
<td>Wu and Zhao (2003); Boaretto et al. (2009)</td>
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</tr>
<tr>
<td></td>
<td>The middle of layer 5</td>
<td>BA94137a</td>
<td>15,560 ± 50</td>
<td>20,100–17,770</td>
<td>Huminic acid (pottery)</td>
<td>Yuan et al. (1997)</td>
<td></td>
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<tr>
<td></td>
<td>The middle of layer 5</td>
<td>BA94137b</td>
<td>15,600 ± 260</td>
<td>19,580–18,390</td>
<td>Residue (pottery)</td>
<td>Yuan et al. (1997)</td>
<td></td>
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<tr>
<td></td>
<td>Layer 3 (middle)</td>
<td>BA92033</td>
<td>12,630 ± 450</td>
<td>16,280–13,610</td>
<td>Walnut-rind charcoal</td>
<td>Chen (1999); Yuan et al. (1997)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layer 2</td>
<td>ZK-2839</td>
<td>12,707 ± 155</td>
<td>15,645–14,345</td>
<td>Shell</td>
<td>Chen (1999); Lu (2010)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layer 2</td>
<td>ZK-2830</td>
<td>13,547 ± 168</td>
<td>16,885–15,855</td>
<td>Shell</td>
<td>Chen (1999); Lu (2010)</td>
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*14C yr BP: Radiocarbon years before present.
*cal yr BP (2σ): calibrated years before present with 2σ uncertainty.
*Material: Type of material from which the radiocarbon dates were obtained.
*Reference: Sources of the radiocarbon dates and context information.
<table>
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<tr>
<th>Layer</th>
<th>Locality</th>
<th>Sample Code</th>
<th>Chronological Period</th>
<th>Material</th>
<th>Findings</th>
<th>Reference</th>
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<tr>
<td>T2, bottom of layer 6</td>
<td>Lingjing</td>
<td>BK87075</td>
<td>10,510 ± 110</td>
<td>Charcoal</td>
<td>12,690–12,080</td>
<td>Yuan, Chen, and Zhou (1992)</td>
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<tr>
<td>T1, layers 5 to 6</td>
<td>Lingjing</td>
<td>BK86121</td>
<td>9690 ± 95</td>
<td>Wood</td>
<td>11,250–10,745</td>
<td>Yuan, Chen, and Zhou (1992)</td>
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<td>T1, layer 5 to 6</td>
<td>Lingjing</td>
<td>BK86120</td>
<td>9875 ± 160</td>
<td>Wood</td>
<td>11,980–10,785</td>
<td>Yuan, Chen, and Zhou (1992)</td>
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<td>Secondary sediment of layer 5</td>
<td>T1, layer 5 to 6</td>
<td>BK86120</td>
<td>11,480 ± 50</td>
<td>Carbonized samples</td>
<td>13,445–13,210</td>
<td>Li, Kunikita, and Kato (2017)</td>
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<td>Secondary sediment of layer 5</td>
<td>T1, layer 5 to 6</td>
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<td>11,940 ± 50</td>
<td>Carbonized samples (burnt bone)</td>
<td>13,965–13,585</td>
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<td>Secondary sediment of layer 5</td>
<td>Lingjing</td>
<td>MTC-17584</td>
<td>10,820 ± 130</td>
<td>Carbonized residue and clay (interior)</td>
<td>13,040–12,530</td>
<td>Li, Kunikita, and Kato (2017)</td>
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<td>Secondary sediment of layer 5</td>
<td>Houtaomuga</td>
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<td>12,470 ± 60</td>
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<td>15,025–14,250</td>
<td>Nakazawa et al. (2011); Obihiro City Board of Education (2006)</td>
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<td>Houtaomuga</td>
<td>NUTA-6510</td>
<td>13,780 ± 170</td>
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<td>17,195–16,170</td>
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<td>Houtaomuga</td>
<td>Nuta-6506</td>
<td>12,680 ± 140</td>
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<td>15,565–14,345</td>
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<td>Secondary sediment of layer 5</td>
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<td>Beta-133848</td>
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<td>13,995–13,740</td>
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<td>Kamikuroiwa</td>
<td>Layer 9</td>
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<td>Fukui Cave</td>
<td>Layer 2</td>
<td>PLD-25713</td>
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<td>Carbonized residue on pottery (interior)</td>
<td>Sasebo City Board of Education (2016)</td>
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<td>Kennesho-Atos</td>
<td>Soil burying S212, Zone B5</td>
<td>Beta-163810</td>
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<td>Carbonized remain</td>
<td>Aira City Board of Education (2005)</td>
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<td>Sankakuyama I</td>
<td>Soil burying an earth pit, Zone C2</td>
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<td>Layer V, Zone B-8</td>
<td>IAAA-10309</td>
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<td>Layer V, Zone B-8, Pithouse 1</td>
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<td>Russian Far East</td>
<td>Gasya</td>
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<td>Lower layer/depth 2.1–2.4 m, hearth</td>
<td>Le-1781</td>
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<td>8980–8370</td>
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<td>LLNL-102169</td>
<td>12,500 ± 60</td>
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<td>Kuzmin (2006b); Jull et al. (2001) in Buvit and Terry (2011)</td>
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<td>Novotroitskoye</td>
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<td>10,120–9480</td>
<td>Charcoal</td>
<td>Derevianko et al. (2004)</td>
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<th>Region</th>
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<th>Layer</th>
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<th>cal yr BP (2σ)*</th>
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<td>1.3 m below surface (cultural layer 3)</td>
<td></td>
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<td>MTC-05936</td>
<td>12,340 ± 70</td>
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<td>AA-21378</td>
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<td>Carbonized residue on pottery</td>
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*Calibration of dates was performed with OxCal 4.3 and IntCal13 calibration curve by the author at 2-sigma standard error.

<sup>b</sup>$\delta^{13}$C has not been measured.
Pottery, termed Xian Wiped, was found in layers 3C1B and 3C1A (MacNeish 1999, 238; Zhang 2002a). Two older dates associated with pottery, 20,350–19,375 cal yr BP (BA-00009) from layer 3C1B, and 20,090–19,260 cal yr BP (BA-00015) from layer 2B (Wu and Zhao 2003), were obtained later (Kuzmin 2006a, 365) (Table 1). Vandiver (2018, personal communication, May 24), who participated in MacNeish’s fieldwork and analyzed the ceramics, has recently indicated that there were porcelain fragments from the excavation, suggesting that sediments at the Xianrendong entrance may have been secondarily deposited. Nonetheless, considering all the dates together, Zhang (2002a, 189) suggests that the earliest ceramic dates derived from charcoal samples from excavation layers ranged between 19,780 ± 360 14C yr BP (24,790–22,930 cal yr BP) (without mentioning their provenience) and 12,430 ± 80 14C yr BP (14,992–14,164 cal yr BP) (3B1, West Area; Wu et al. 2012) at Xianrendong, and that dates for early ceramics from both areas can be no later than 14,992–14,164 cal yr BP, so that the materials from 3C1B at Xianrendong should be earlier than this.

The earliest pottery (layers 3C1B and 3C1A in the West Area; Cohen et al. 2017) was reported as having a flowerpot-shape with relatively vertical wall, presumed to be storage jars; inclusions/temper were large grains of quartz (MacNeish 1999). The slab technique was used for constructions; decorations were made by wiping with a tool like a fork; some lips were notched (MacNeish 1999 refers to an experiment by Vandiver and Hill). Vandiver (2018, personal communication, May 24) suggests firing temperatures were low enough that a study of sintering stage did not yield a result. Tools for the Xian Ren Phase are described as a projectile point complex, and for the Wang Phase, projectile points were made of antler or bone, including bilateral multi-barbed antler points, and groundstone triangular points (MacNeish 1999). For subsistence during the Wang Phase, humans relied on small animals (e.g., rabbit, canids, turtles) and shellfish (MacNeish 1999). Stone tools and faunal remains lack provenience; it is unclear whether they came from the Xianrendong or Diantongghuan site.

In surrounding layers, the pottery occurred above the preceramic Dayuan Phase, dated to 18,675–18,190 cal yr BP (UCR-3300, from layer 3C2) (MacNeish 1999). MacNeish (1999) found deposits of the Wang Phase, subsequent to the Xian Ren Phase, in layers 3B2 and 3B1 of the West Area (Zhang 2002a also includes 3A) with pottery named the Wang type. The date of the finds derived from the 1964 excavation was 13,265–12,150 cal yr BP (ZK39). The Jiangxi Phase followed the Wang Phase with materials from layers 2A, 2B, and 2C of the West Area, and layers 2A, 2A1, 2A3, 2B, 2B1, 2B2, and 2B3 of the East Area. There is also a date of 10,480–9465 cal yr BP (ZK-92) without a clear context, derived from the 1964 excavation (MacNeish 1999, 241).

In 2009, Wu et al. (2012) collected bone samples (n = 69) in situ and additional bigger bone samples (n = 30) from the 1993, 1995, and 1999 excavations (Wu et al. 2012, supplementary materials S3, 1). The associated micromorphological study suggested that the samples had not moved post-depositionally more than 1 cm. In Wu et al. (2012, supplementary materials S3, 1), the authors suggest that only 28 samples were in good condition (from the 2009 section, and previous excavations) and selected for radiocarbon dating, although in the text, they (Wu et al. 2012, 1698) also write that a total of 45 samples were radiocarbon dated (n = 13 from the sediment blocks of 2009; the rest of the samples were from 1999 and 2000, as well as 1993 and 1995 that had been dated earlier). The final total number of radiocarbon dates obtained in the new study by Wu et al. (2012) does not match between the text and the supplementary material.

In Wu et al. (2012, 1699), dates (n = 5) within layer 3C1B range between 21,435–20,660 cal yr BP (AA-15005) and 19,700–19,295 cal yr BP (BA-10264 (sample code and/or error range mistyped in Wu et al. 2012, as BA-10267 or the information in table 1 is an error)) with the sixth date, 22,705–21,975 cal yr BP (UCR-3440), considered an outlier. Layer 3C1A has dates ranging between 20,230–19,205 cal yr BP (BA-95143) and 17,540–17,115 cal yr BP (BA-09872), which are suggested to be consistent; these layers are associated with pottery and have been used to represent the oldest dates (20,000–19,000 cal yr BP) of the earliest pots. Wu et al. (2012) argue that the age-depth reversal found between upper layers 3B1 and 3B2, as well as the date from a human bone in layer 3C2 (UCR3300) derived from the preceramic Dayuan phase in MacNeish (1999), are the result of post-depositional burial intrusions. Cohen et al. (2017, 41–42), however, report observing little post-depositional disturbance, especially in the Western Area. Since pottery was not recovered from the profile samples in 2009, except for one sherd in the micromorphological sample (Wu et al. 2012, 1697), Kuzmin (2015) critically notes that the pottery was not directly associated with the dated materials, deer bones. In their defense, Cohen et al. (2017) maintain the validity of their sampling because the stratigraphic contexts from which the profile samples were taken were the same as the stratigraphic context of the excavations. Cohen et al. (2017, 38) also suggest that MacNeish’s dates are skewed towards accepting much more recent dates than Wu et al.
The earliest pottery from 3C1B and 3C1A was described as (1) having parallel striations on the exterior and interior surfaces or plain surfaces, with sometimes both notches and punctuates on the rims, (2) constructed with layered slabs, (3) having a wall thickness of 0.7–1.2 cm, and with a round base (Cohen et al. 2017; Wu et al. 2012) (Figure 2). The second pottery type (at and above layer 3B2, assumed to be from the West Area) has (1) quartzite and/or some crushed pottery temper, (2) coil and paddling construction, and (3) mainly, exterior surfaces marked with impressions with a cord (or paddle wrapped with cord) (Cohen et al. 2017; Wu et al. 2012) (Figure 2). The early pottery was probably for cooking (e.g., of marrow and grease due to many fragmented bones found at the site) due to soot and scorch marks on the exterior surfaces (Wu et al. 2012).

Stratigraphic orders, unearthed artifacts, and descriptions/interpretations from excavations of 1964, 1993, and 1995 (MacNeish 1999; Zhang 2002a) do not seem to sufficiently correlate with data and interpretations presented by the archaeologists who took sediment blocks in 2009 (Wu et al. 2012). The recent presentation by the same group (Cohen et al. 2017) also tends to differ not only from MacNeish (1999) and Zhang (2002a) but also from Wu et al. (2012). Radiocarbon dates require further contextual information. Discrepancies/inconsistencies are detailed below.

Figure 2 Pottery sherds from the Xianrendong site. Sherds are drawn from photos in Wu et al. (2012), supplementary materials S1. Scales are not provided in the original photos. (1) A sherd from layer 3C1B with striations (also used in Cohen et al. 2017) from Figure S1, photo A, upper sherd; (2) this is possibly the punctuated rim mentioned in Cohen et al. (2017); Figure S3, a photo of a sherd from West section, layer 2A; (3) the surface has possible cord-marked impression likely paralleling the cord-impressed sherds mentioned in Cohen et al. (2017); Figure S9, a photo of an interior of a sherd from East section, layer 2A2.

(1) Ambiguous provenience descriptions. Though Cohen et al. (2017, 41; based on Peking University and Jiangxi Province 2014) suggest only a total of 12 earliest pottery sherds were found in 3C1B in the West Area and 2B1 of the East Area during 1993, 1995, and 1999 excavations, Cohen et al. (2017, 43), in the same paper, write that the early pottery was also found clustered in layers 2A2, 2B1, and 2B2 of the East Area. Although Cohen et al. (2017, 43) reported that the second early pottery type was found in layers 3B2 and above (3B1), they (Cohen et al. 2017, 41) write, contra Kuzmin (2015), that 3B1 and 3B2 do not show age-depth reversals because these layers are above the early pottery layers, thereby contradicting their own descriptions. Additionally, in Wu et al. (2012, 1698), the earliest pottery is suggested to have been found in layers 3C1B of the West trench and layers 2B and 2B1 of the East trench; this only partially correlates with 3C1B and 3C1A in MacNeish (1999) and Zhang (2002b) and 3C1B and 2B1 of Cohen et al. (2017, 41). Also, although Cohen et al. (2017, 41, 43) suggest that early pottery fragments were found from 3C1B and 3C1A of the West Area and 2B1 (and add 2A2 and 2B2) of the East Area, and a second early pottery type was found at and above 3B2 (assumed to be in the West Area), the photos of the early ceramics in the supplementary materials of Wu et al. (2012, supplementary materials S1, figures S2–S6) have sherds coming from layer 2A in the West Area and 1B of the East Area. What makes this even more confusing is that there is no layer 2A in the West Area in the stratigraphic figures in Wu et al. (2012) and Cohen et al. (2017). Even if the East and West are mistakenly reversed in Wu et al.’s (2012) supplementary materials, their photo (supplementary materials S1, figure S9) with punctate rim should come from layer 2A of the East Area and cord-impressed pottery from layer 2A2; an age-depth reversal of pottery typology occurs here (Figure 2). In Cohen et al. (2017), the chronology of these two pottery types is described as having the punctuated rim emerging before the cord-impressed style. Moreover, in the texts, the punctated pottery was rare in number and not reported to have come from layer 2A (Cohen et al. 2017).

(2) Inconsistent reporting of lab numbers. Although the same “lab numbers” seem to be used for the re-dated materials (and some can be compared with those in references such as MacNeish (1999) and Wu and Zhao (2003), for example, UCR-3440, BA00004, BA00009, and BA00006), in Wu et al.
(2012), it is difficult to clearly distinguish samples that were from the section of 2009 and from previous excavations. Furthermore, the re-dated materials should be clearly identified because there are possible re-dated samples in Wu et al. (2012) with the same lab numbers with very close or exactly the same dates (e.g., UCR-3300, BA00015) as the dates in old publications of MacNeish (1999) and Wu and Zhao (2003) (Table 1). Additionally, since the supplementary material (Wu et al. 2012, S3) suggests that 28 samples were dated, it is difficult to know how the 45 AMS dates mentioned in the text and tables 1 and 2 of Wu et al. (2012) were obtained, so that we cannot resolve the doubts about age-depth reversals.

3. Inconsistencies in archaeological contexts between authors. Sample BA00009 from layer 3C1B in Wu and Zhao (2003) is presented in Wu et al. (2012) and Cohen et al. (2017) as derived from layer 4A instead. Additionally, layer 2A3 in figure 3 of Wu et al. (2012) has a slightly older date than the two dates in the layer below (2B) showing an age-depth reversal. However, this layer 2A3 is missing in Cohen et al. (2017, figure 4), but not missing in their table 2. It is placed in the layer 2B below (Cohen et al. 2017, figure 4), but no explanations are given for the changes.

4. Differences in acknowledgements of disturbance. The disturbance of the site context inferred from earlier descriptions (MacNeish 1999) is not mentioned in Wu et al. (2012) regarding, for example, the pottery materials from the Wang (3B2, 3B1, West) and Jiangxi phases (2A, 2B, and 2C, West; and 2A, 2A1, 2A3, 2B, 2B1, 2B2, and 2B3, East) (MacNeish 1999). There is no mention of non-early ceramics and their stratigraphic contexts other than 28 sherds encountered below the mixed layer 1A, in Wu et al. (2012, 1697).

With regards to stone tools, Xianrendong has cobble tools associated with the early ceramic layers (Cohen et al. 2017, 43–44). Although MacNeish (1999) writes that the remains of rice found from layers 3Cb and 3C1a were mainly wild rice, paleobotanical study suggests that there were phytoliths of wild rice (in layers 3C1B and 3C1A; MacNeish 1999) and domesticated rice (Oryza sativa in layer 3C1A; Zhang 2002a, based on Zhao 1996) in the Xian Ren Phase context, and wild and domesticated rice phytoliths continued to appear in layers 3B1 and 3B2 (of the West Area; Zhang 2002a). Domesticated rice at Xianrendong is also suggested to date between 8400 and 8000 cal yr BP or a little earlier (Higham and Lu 1998). Faunal remains of deer (Cervus nippon), predominant in the assemblage, and lesser amounts of another deer (Muntiacus sp., and Hydropotes inermis), wild boars, carnivores, and rodents are reported (Cohen et al. 2017, 43), but without the exact provenience of fauna. In Wu et al. (2012, 1699–1700), the subsistence practice and mobility of the Xianrendong pottery users is presented as being of non-sedentary hunters and gatherers prior to the cultivation of wild rice.

Importantly, many AMS dates were obtained following a rigorous procedure by Wu et al. (2012), and the stratigraphic disturbances were checked with soil micro-morphology. However, due to all of the above inconsistencies and ambiguities, the early ceramic dates given for Xianrendong by Wu et al. (2012) and Cohen et al. (2017) require careful re-evaluation and further consideration. Also, if the earliest ceramics from Xianrendong are associated with both wild and domesticated rice, this presents great discrepancies in our conventional understanding of the chronology between the terminal LGM-incipient OD timing of the appearance of pottery and the early Holocene appearance of domesticated rice or the domestication processes (e.g., Zuo et al. 2017).

3.1.2. Diatonghuan (Wang Dong)

Diatonghuan rock shelter was excavated by the Sino-American project led by Wenming and MacNeish in 1993 and 1995 (MacNeish 1999; Zhang 2002a). In 1993, Cunnar excavated in the shelter, to a maximum extent of 42 m² and 2 m deep, making a pit in the center of the cave (MacNeish 1999; Zhao 1998). Sixteen stratigraphic zones (layers) were identified, with the order from lower to the upper layers, P to A (Zhao 1998).

Early ceramic characteristics and the related sequence are suggested to match those at Xianrendong (MacNeish 1999; Zhang 2002a). The earliest ceramic date for Diatonghuan has been presented as the Xian Ren Phase derived from layer E, 14,060–13,390 cal yr BP (BK95138) (MacNeish 1999). Zhang (2002a), however, comparing both Xianrendong and Diatonghuan, suggests that the earliest ceramic dates are at least 12,430 ± 8014C yr BP (14,992–14,164 cal yr BP). A single date of 18,780–17,875 cal yr BP (BA00014) was obtained later (Wu and Zhao 2003), from layer D correlating with layers 3B2 and 3B1 of the Wang Phase at Xianrendong in MacNeish (1999) (Table 1). However, other archaeologists suggest conservative alternative ages (Kuzmin 2006a, 365), especially those who factor in the timing of rice domestication, including Zhao (1998, 887–888), with 10,000–9000 cal yr on layer E, and ca. 8000 cal yr BP on layer D, suggesting that the absolute dates were too old, while stratigraphy and cultural remains turned out to give a better chronology (Higham 2002 also follows this scheme).
Only a small quantity of early sherds was found: layer E contained cord-marked and plain ware, and layer D, cord-marked pottery (Zhang 2002a). The ceramics from layer E had coarse paste and large quartz fragment/crushed rock inclusions; they were slab constructed, had uneven wall thickness, and surface decorations were made by rough wiping or impression with grass or cord (Zhao 1998). They were unevenly fired. Ground stones were encountered from layer E. Pottery from layer D also had large amounts of quartz (Zhao 1998). In layer D, microlithics including microblades and tongue-shaped cores were encountered (Zhao 1998). Diatonghuan also yielded phytoliths interpreted as wild rice (MacNeish 1999) and domesticated rice (Zhang 2002a, 2002b) in layers E and D (Zhao 1998). The amount of interpreted domesticated rice spiked from layer G to E. There was a gradual increase of domesticated rice between layers E and D (inferred from Zhao 1998, 894, figure 4), with layer E estimated to be between 10,000 and 9000 cal yr BP. The very low counts of Oryza in layer F is suggested to be due to the disappearance of wild rice collection during the YD (Higham 2002; Zhao 1998, 894). Although a late Pleistocene date was obtained from layer D, Zhao (1998) thinks that the stratigraphic context, rather than the radiocarbon dates, are more reliable and suggest an early Holocene age for layers E and D. Therefore, at Diatonghuan, similar problems as Xianrendong exist in the interpreted co-occurrence of wild and domesticated rice with early pottery.

### 3.1.3. Yuchanyan

Yuchanyan Cave was first excavated in 1993 and 1995 by Jiarong Yuan, and the area covered 46 m² with 1.2–1.8-m deep cultural layers (Yuan 2002, 157). The sediments in the uppermost area had been removed in the historical period (Boaretto et al. 2009, 9596). About 40 natural layers were detected (Yuan 2002, 158). The excavation was made through a 10-cm thick sediment sequence that was relatively disturbed (Boaretto et al. 2009, 9599). There were fragments of two vessels (section T1, layer 3H) (Boaretto et al. 2009) encountered from near the base of a deposit (Yuan 2002, 161). Charcoal samples associated with sherds were dated to 18,100–16,880 cal yr BP (BA95057b) at T1, layer 3H, on potsherds residue; 17,365–15,800 cal yr BP (BA95058) at T1, layer 3E, on charcoal; and 14,122–13,551 cal yr BP (BA95057a) on humic substances from potsherds at T1, layer 3H (Boaretto et al. 2009, table 1, citing Yuan 2002) (Table 1). Another excavation followed, led by the group of Boaretto in 2004 and 2005, which subdivided the grid T1 and expanded the grid by adding four quadrants between the earlier grids, T1 and T3, and additionally excavating a square, T4 (Boaretto et al. 2009). They also obtained samples for micromorphology and mineralogy to comprehend the site-formation processes (Boaretto et al. 2009, 9596). The cave’s bedrock slopes steeply from east (2 m below datum) to west (3.2 m below datum). The western area (mainly T1) had about 80 cm of calcareous anthropogenic ash lenses in the uppermost deposits; they sometimes overlake discontinuous bands of red clay transported from elsewhere (Boaretto et al. 2009, 9596). These bands of fine sediments are separated by brown colored sediments composed mainly of calcite, quartz, and clay in T3 and T4; fewer lenses were found here (Boaretto et al. 2009, 9596). The stratigraphy of the eastern area (T3) was also checked; this consisted mostly of brown sediments without clear stratigraphy (Boaretto et al. 2009, 9596).

To overcome the dating errors typical of limestone caves in the Yangtze basin, the archaeologists carefully selected datable charcoal and bone samples, mainly from the western side of the cave, through prescreening and pretreatments for the final AMS dating (n = 27) (Boaretto et al. 2009, 9597). Ten samples went into duplicate analyses, and three samples from the 1990s excavations were added, leading to 40 samples (Boaretto et al. 2009). The results suggested that there was a tendency for ages to increase with stratigraphic depth (Boaretto et al. 2009, 9597). A sherd obtained in 2004 came from square T1A, sublayer 3E at 255 cm deep, with an associated radiocarbon date on charcoal of 15,425–14,780 cal yr BP (BA05421) (40–50 cm from the original pottery cluster found in 1993–1995) (Table 1). Another sherd came from Square T11, in sediments with a date range between 18,245 and 17,860 cal yr BP (BA06866) on bone at T11c, layer 3H, 257 cm, and 17,975–17,610 cal yr BP (BA06863) on charcoal at T11c, layer 3H, 255 cm. Pottery fragments of earlier excavations were associated with stratigraphic dates from the excavation in 2004. These dates ranged between 17,045 and 16,575 cal yr BP (BA05422) on charcoal at T1D-c, 3E, 251 cm deep, and 13,770 and 13,560 cal yr BP (BA05420) on charcoal at T1E, layer 3E, 254 cm deep. These dates come from the square T1 where Boaretto et al. (2009) suggest that they see some disturbed tendencies with age reversals. Boaretto et al. (2009), putting their dates together, conclude the early ceramic dates to as early as 18,300–17,500 cal yr BP (1 SD, in Boaretto et al.’s calibration). The upper (i.e., late) limit of the date for pottery is 15,000 cal yr BP.

There are some discrepancies in dates from previous excavations in 1993 and 1995 introduced by Boaretto et al. (2009), Yuan et al. (1997), and Yuan (2002) on the radiocarbon samples with the same laboratory number. Those include 14,810 ± 230 ¹³C yr BP (18,580-
17,490 cal yr BP) (BA95057b) on pottery residue and 12,320 ± 120 ¹⁴C yr BP (14980-13960 cal yr BP) (BA95057a) on humic acid residue from pottery (Yuan et al. 1997) which are likely adopted by Yuan (2002). Boaretto et al. (2009) citing Yuan’s (2002) dates are instead, identical to dates presented by Wu and Zhao (2003) citing Yuan et al. (1997) (but possibly, with Yuan et al.’s publication year mistakenly placed as “1996” in Wu and Zhao (2003)) (Table 1). These discrepancies are not mentioned by Boaretto et al. (2009). Nonetheless, the results of Boaretto et al. (2009) are based on new dates obtained after the earlier studies introduced by Yuan et al (1997), Yuan (2002), and Wu and Zhao (2003).

At Yuchanyan, the dating procedure is rigorous since the excavation in 2004 conducted micro-sampling of bones and charcoal samples at 2-3 cm interval. Results give clean sequences except for at T1 where a majority of ceramics from the earlier excavation, and one sherd from the 2004 excavation, were encountered. Examining the dates from the 1993 to 1995 excavation, dated materials from the same context T1, layer 3H (although it is unknown whether the sherds come from the same vessel) have a 2000-year discrepancy in age. T11 from the 2004 excavation yielded consistent dates ranging between 18,245–17,860 and 17,975–17,610 cal yr BP, with a sherd sandwiched by sediments of that antiquity range. The T11 dates must be reliable; however, the sherd seems like an isolate from the cluster in this excavation. Thus, the Yuchanyan pottery dates should be in the late Pleistocene and can be as early as 18,245–17,860 cal yr BP, but more safely date between 15,425–14,780 and 13,770–13,560 cal yr BP.

From the 1993 to 1995 excavation, pottery (1) was reconstructed to be about 31 cm in diameter and 29 cm in height, (2) had a pointed base, (3) had wall thickness of up to 2 cm, (4) had inclusions of coarse charcoal, crushed quartz, and water-worn pebbles, (5) was slab constructed, (6) had a high content of kaolinite in paste, and (7) was fired at temperatures between 400°C and 500°C, based on infrared spectra (Boaretto et al. 2009, 9596; Yuan 2002), or 600°C (Cohen et al. 2017). Decorations on the interior and exterior surfaces were possibly cordage impressed (Boaretto et al. 2009, 9596).

The stone tools at Yuchanyan are mainly oval-shaped pebble choppers flaked on one side (Yuan 2002, 159). Tools are made with hard-hammer percussion without retouch; polishing is also absent. Many implements are also produced from small flakes, hoe-shaped implements and scrapers. The raw materials are sandstone, quartz, and pebbles. Yuan (2002) suggested that lithics be classified into a pebble industry. Additionally, animal bone tools such as spades and chisels, antlers with a working edge, shells with sharp edges, ornaments of deer, and carnivore teeth have been found (Yuan 2002).

Yuchanyan has fish, shells, land snails, birds, and mammals (28 species), and wild plants and rice phytoliths suggesting a broad-spectrum diet (Lu 2010; Qu et al. 2013, 5; Yuan 2002). Rice husks were found at Yuchanyan from the lower deposit, without the information on the specific provenience, while the ceramics were found near the base (Yuan 2002). Through the analysis, wild rice (indica and japonica) and rice in an early stage of domestication were identified, interpreted as possibly under cultivation by the occupants (Yuan 2002, 161). However, Boaretto et al. (2009) suggest that the cave was used as a camp by foragers.

Although Boaretto et al. (2009) suggest the pottery dates between 18,300 and 15,000 cal yr BP, if we consider the later dates for these ceramics, between 15,425–14,780 and 17,190 cal yr BP, and combine them with the contextual information from this site, the pottery may instead parallel the time of the early process of rice domestication occurring after this period.

3.1.4. Miaoyan Cave

Miaoyan Cave had six layers, with the site deposit reaching 2.5 m thick (Chen 1999; Yuan et al. 1995). Several pottery sherds were found from the middle of layer 5 (Yuan et al. 1995). In Yuan et al. (1995), the lower level of layer 5 was AMS dated to 22,670–21,105 cal yr BP (BA-92036-1) and the middle level of layer 4 to 17,400–15,845 cal yr BP (BA92034-1) (also in Yuan et al. 1997). Therefore, the age is evaluated as contemporaneous to or older than 17,200–16,800 cal yr BP (Yuan et al. 1995, 248). Pottery residue was dated to 19,010–17,885 cal yr BP (BA94137b), and humic acids obtained were dated to 19,590–17,190 cal yr BP (BA94137a), both taken from layer 5 (Wu and Zhao 2003). The samples with the same or possibly the same laboratory numbers as Yuan et al.’s (1995) numbers are presented differently by Wu and Zhao (2003) citing Yuan et al. (1995). For example, samples BA92036-1 and BA92034-1 from Yuan et al. (1995) are cited as BA92036 (17,630 ± 320 ¹⁴C yr BP) and BA92034 (13,320 ± 270 ¹⁴C yr BP) in Wu and Zhao (2003) giving a few hundred years of difference from the value provided by Yuan et al. (1995) (see Table 1). However, the reasons for these discrepancies are not mentioned in Wu and Zhao (2003). Similarly, the samples with the same laboratory numbers presented by Yuan et al. (1997) are cited differently by Wu and Zhao (2003) (but possibly, the year is mistyped as Yuan et al. (1996)). In the actual Yuan et al. (1997), the sample BA94137a is presented as 15,560 ± 500 ¹⁴C yr BP and
Zhang (2002a, 189), referring to Yuan (1997). Zhang dated to 19,575 (plain) characteristics is similar to that of Miaoyan ghuan suggests that early pottery with non-decorative and animal bones (Chen 1999; Lu 2010). Other tools found include at Xianrendong and Diatonghuan. Other tools found also mention that in South China, early ceramics (Chen 1999; Lu 2010) (Table 1).

Obviously, layer 5 itself has wide-ranging dates and there are age-depth reversals in the upper layers (Lu 2010). The excavation layers are also thick, and dates presented by Chen are from shells, presumably freshwater, which Yuan (1993) and Lu (2010) suggested yield older dates by a few hundred to 2500 years in limestone geological areas. Therefore, tentatively, the pottery likely dates somewhere between 19,010 and 15,845 cal yr BP.

The pottery technology at Miaoyan is hand-built plain ware with quartz sand inclusions, with thick walls, grayish brown paste, and with low firing characteristics (Chen 1999; Lu 2010; Yuan et al. 1995). Zhang (2002a, 189) suggested that paste and manufacturing technique of Miaoyan pottery is similar to that of early ceramics at Xianrendong and Diaotonghuan. Other tools found include flaked pebble tools and those made of shells and animal bones (Chen 1999; Lu 2010).

Finally, the evidence of Xianrendong and Diaotonghuan suggests that early pottery with non-decorative (plain) characteristics is similar to that of Miaoyan Cave, dated to 19,575–18,390 cal yr BP (residue) and 18,480–18,070 cal yr BP (humic acid) according to Zhang (2002a, 189), referring to Yuan (1997). Zhang (2002a, 189) also mentions that in South China, early pottery (e.g., from Xianrendong, Diaotonghuan, Miaoyan, Yuchanyan, and Liyuzui) shows decorative patterns appearing in the order of line-impressed, plain, cord-impressed, and weave-impressed. Yuchanyan has cord-marked/weave impressed pottery; Liyuzui has cord-marked pottery (Zhang 2002a, 189).

3.2. North China

In northern China, early pottery is dated generally into the early Holocene, and limited sites have terminal Pleistocene dates (Li, Kunikita, and Kato 2017). However, the late Pleistocene and Pleistocene/Holocene transition sites containing pottery include Hutouliang and Nanzhuangtou in the Hebei Province (Li, Kunikita, and Kato 2017; Yang et al. 2012), Donghulin near Beijing (Lu 2010, 1–2), Lingjing along the southern edge of the North China Plain, and Yujiagou (Li, Kunikita, and Kato 2017) and Houtaomuga in northeastern China (Kunikita et al. 2017). Several excavators have associated Donghulin with the very early part of the Holocene (Li, Kunikita, and Kato 2017; Xia et al. 2012).

I focus here on the Nanzhuangtou (Yang et al. 2012), Lingjing, Yujiagou, and Houtaomuga sites (Figure 1). Nanzhuangtou (39°6′40″N, 115°39′25″E) is located in the Hebei Province on the plains, 21 m above sea level, at the foot of the Taihangsha Mountains, 35 km west of Lake Baiyangdian (Li, Kunikita, and Kato 2017, 52; Xiaoyan et al. 2012; Yang et al. 2012). The Nanzhuangtou site deposits were found sealed in fluvial and lacustrine sediments (Xiaoyan et al. 2012, 3726). Yujiagou (40°9′N, 114°29′E) is located in the northwestern Hebei Province, on the third terrace of the Sanganghe River of the Nihewan Basin (Li, Kunikita, and Kato 2017, 52; Xia et al. 2001). The Houtaomuga site (45°39′27.5″N, 123°47′15.1″E) is located in the foothills on the southeastern coast of Lake Xinhuangpao in the Jilin Province (Kunikita et al. 2017, 63). The Lingjing site (34°04′N, 113°41′E) is situated between the foot of the Songshan Mountains and Huang-Huai Plain, in the southern edge of the North China Plain (Li, Kunikita, and Kato 2017, 53) (Figure 1).

3.2.1. Nanzhuangtou

The Nanzhuangtou site was excavated in 1986, 1987, and 1997 (Yang et al. 2012). The pottery sherds (n = 44) were found in layer 5 as the midden deposit of a ditch in layer 6, a bedrock stratum or floor. The ditch also contained bone tools, animal bones, pits, ditches, hearths, a slab, and a muller (Li, Kunikita, and Kato 2017, 52; Yang et al. 2012). The pottery consists of flat-based deep vessels and lesser amounts of flat-based shallow vessels with 0.8–1 cm wall thickness, crushed shell and quartz inclusions, and gray or brown colored paste. Decorations are cord-marked, likely created by rolling a stick wrapped with a twisted thread, with thick linear relief, and minor amounts of incisions (Guo and Li 2000, in Lu 2010, 2; Li, Kunikita, and Kato 2017, 52). Radiocarbon dates associated with the pottery are 11,705–11,095 cal yr BP (BK-89064) and 12,690–12,080 cal yr BP (BK-87075) (Yuan, Chen, and Zhou 1992) (Table 1). However, Yang et al. (2012) exclude the dates coming from silt due to potential inclusions of old carbon, resulting in the dating of layer 5 of Nanzhuangtou to 11,980–10,785 cal yr BP (BK-86120) and 11,250–10,745 cal yr BP (BK-86121) (Yuan, Chen, and Zhou 1992), with a calibrated age between ca. 11,500 and 11,000 cal yr BP (Li, Kunikita, and Kato 2017, 52).

A broad-spectrum diet is indicated with major faunal remains including deer, rat, rabbit, dog, wild boar, water buffalo, bird, turtle, and fish (Yuan and Li 2010, in Li,
Paleobotanical data on starch suggest the site has millet (foxtail millet, *Setaria italica* L. Beauv.), Triticeae, and geophytes on a stone slab and a muller (Yang et al. 2012). The starch grain analysis of millet indicates that it is semi-wild or undergoing domestication between 11,000 and 9500 cal yr BP (Yang et al. 2012). Plants associated with this site from this age range include *Pinus, Picea, Abies, Quercus, Artemisia, Gramineae, Cyperaceae* and *Typha* (Yuan, Chen, and Zhou 1992).

### 3.2.2. Yujiagou

At Yujiagou, eight layers were encountered and a fragment of pottery was found in layer 4 (Li, Kunikita, and Kato 2017), in a context of dark-yellow loessy silt at a depth of between 3.68 and 5.48 m (Xia et al. 2001). The TL date for pottery was 11,600 BP (Xia et al. 2001), and a TL age from the stratigraphic profile suggests that the middle part of layer 4, at a depth of 4.28 m, dates to 11,100 ± 900 BP (TL age) and is associated with the pottery (Li, Kunikita, and Kato 2017; Xia et al. 2001). The pottery has a flat base, thick walls, and plain surfaces; however, there are also cordage marks likely impressed through rolling a stick and giving fingernail-like impressions (Li, Kunikita, and Kato 2017). Associated stone tools were many microblades, which have been classified as the Northern microblade industry/Yubetsu method, as well as slabs/handstones (Cohen 2013; Li, Kunikita, and Kato 2017; Sato and Tsutsumi 2007). Xia et al. (2001, 781) suggest that the microlith technology at this site began no later than 13,700 cal yr BP, was intensively used between 11,900 and 6600 cal yr BP, and declined but continued to 2100 cal yr BP, while Neoliths appeared at 8700 cal yr BP. Other materials found include freshwater shell ornaments and an ostrich eggshell (Li, Kunikita, and Kato 2017, 52).

### 3.2.3. Lingjing

The Lingjing site was discovered in 1965 (Zhou 1974) and has been excavated on several occasions since 2005 by the Henan Provincial Institute of Cultural Relics and Archaeology (Li, Kunikita, and Kato 2017). Eleven layers have been discovered reaching 9 m depth. Layer 5 yielded the earliest ceramics (*n* = 58) and associated artifacts (a figurine made of bone, ornaments of ostrich eggshell, microblades, microcores, and small flake tools). However, due to a well digging, layer 5 had been disturbed and the artifacts obtained were found in the remains of layer 5, in the transported sediment (Li, Kunikita, and Kato 2017). Samples (*n* = 26) were collected from the secondary sediments from layer 5, and pottery clay and temper (*n* = 2) and residue (*n* = 5) were AMS dated. The samples from the secondary sediment yielded dates between 13,965–13,585 cal yr BP (IAAA-92125) and 13,445–13,210 cal yr BP (IAAA-102634) (observed from Li, Kunikita, and Kato 2017). AMS dates from pottery yielded dates between 12,095–10,705 cal yr BP (TKa-15555) on clay/paste body and 8980–8555 cal yr BP (MTC-16894) on carbonized residue (Table 1). The large discrepancies between the sediment samples and pottery is explained in Li, Kunikita, and Kato (2017): the sediment may have been from the period of deposition while the pottery likely dates around 9800 cal yr BP and probably between 13,450 and 9800 cal yr BP; the microblade industry dates to about 13,450 cal yr BP. As suggested by the authors (Li, Kunikita, and Kato 2017), determination of the pottery’s dates requires further testing.

The pottery consists of rim fragments with thickness between 0.73 and 2.20 cm, mostly undecorated with a few exceptions having cordage marks, linear relief, impressions, and incisions, and appears to have been fired at low temperatures; carbonized residue and soot are on some sherds (Li, Kunikita, and Kato 2017). Carbon and nitrogen isotope analyses on the pottery residue suggest the possibility of land animals, C3 plants, and freshwater fish (Li, Kunikita, and Kato 2017). Secondary sediments of layer 5 also contained microblades, microcores (pyramidal cores, boat-shaped cores, and a wedge-shaped core), small flake tools, and polished pebbles. There were also bone needles, worked molar tooth flakes (Perissodactyla), and perforated fragments of ostrich eggshell (Li, Kunikita, and Kato 2017, 55).

### 3.2.4. Houtaomuga

Discovered in 1957, the Houtaomuga site was excavated by the Jilin University and the Jilin Provincial Institute of Cultural Relics and Archaeology between 2011 and 2012 (Kunikita et al. 2017, 63). There were six cultural strata. It is a multi-component site with the earliest phase, Phase I, at the lowest of the cultural strata, having the oldest dates associated with pottery in northern North China (Kunikita et al. 2017). Samples (*n* = 20) for AMS dating were obtained from the Phase I context with consistent results obtained among varied sample types (pottery clay with organic content, carbonized residue of vessels, catfish bone, and freshwater bivalve) (Kunikita et al. 2017, 64). Pottery clay, often yielding dates several hundred years older than other sample types, were carefully evaluated, and samples of the same type (e.g., freshwater bivalve and charred residues) were compared yielding similar results; marine reservoir effects were absent (Kunikita et al. 2017). Pottery dates obtained from Phase I ranged between 13,040-12,530 cal yr BP (MTC-17584) on carbonized residue and clay and...
11,400-10,775 cal yr BP (MTC-17752), based on pottery residue (Table 1). The pottery was low-fired with decorations of pressed-combed pattern. Pits, ditches, postholes, and burials were also associated with Phase I (Kunikita et al. 2017, 63–64). Additionally, carbon and nitrogen isotope and C/N ratios were examined on the carbonized residue on the pottery; although samples sizes were small, the consumption of freshwater fish was indicated (Kunikita et al. 2017, 68). Kunikita et al. (2017) do not provide information on the depths of stratigraphic layers; however, dates of Phase I are close enough and are distinct from dates for later phases that the site seems to have a reliable chronology.

### 3.3. Japanese archipelago

The sites containing ceramics from the late Pleistocene in Japan are presented below by dividing the region into three main geographic areas: the island of Hokkaido, the island of Honshu, and the islands of Shikoku and Kyushu. In Japan, there are at least 2400 Incipient Jomon sites (Japanese Paleolithic Research Association 2010), but systematic analyses that encompass all of the Incipient Jomon sites are still absent in the Japanese scientific literature. Relative chronology based on the pottery style has commonly been used in association with radiocarbon methodology. Styles of the Incipient Jomon period have been suggested as: (1) the earliest phase with plain ware (momon) (National Museum of Japanese History 2009) or plain types and incision types during ca. 16,000–15,000 cal yr BP (Kaner and Taniguchi [2017] 2018), (2) the second phase with linear relief (ryusenmon which can include ryukisenmon and toryumon), and banded relief (ryutaimon), dated between ca. 15,100 and 13,700 cal yr BP (Kaner and Taniguchi [2017] 2018), (3) the third phase with nail-impressed (tumegatamon) and cord-impressed (oatsumon), dated between ca. 14,500 and 12,000 cal yr BP, with others classifying nail impressed coming before cord-impressed (National Museum of Japanese History 2009), and (4) the fourth phase with rolled cord-marking (kaiten jomon or tajomon) (National Museum of Japanese History 2009) with fiber cord rolled on vessel surfaces dated between ca. 12,000 and 11,300 cal yr BP (Kaner and Taniguchi [2017] 2018). In this paper, these pottery terms are used citing previous work, but the focus is on the critical evaluation of absolute dates and stratigraphic contexts.

### 3.3.1. Hokkaido

On the island of Hokkaido, the approximate number of sites with microblade cores and microblades is about 288, assumed to be from the late Pleistocene. A study (Natsuki 2018, 59, 64, 68) based on the stone tool technological analysis (excluding sites with only pottery) suggests there are about 29 sites from the Incipient Jomon period, dated between 15,000 and 13,500 cal yr BP. These sites are classified into two groups: a first group with serrated willow-leaf projectile points, previously called the Shirataki-5 assemblage, and a second group with willow-leaf arrowheads called the Taisho-3 assemblage. The Incipient Jomon sites with pottery are very limited. Although there have been the Higashirokugou 1 and 2, Oasa 1, Masuda, and Taisho 3 sites yielding pottery dated to the late Pleistocene; only Oasa 1 and Taisho 3 are considered to be more confidently assigned to the late Pleistocene (Furano City Board of Education 1987; D. Kunikita, 2018, personal communication; Kunikita and Yoshida 2009; Naganuma 2003; National Museum of Japanese History 2009; Tsurumaru 1983). Therefore, here I discuss the Oasa 1 and Taisho 3 sites (Figure 1).

Oasa 1 is in Ebetsu City (43°5′20.4′′N, 141°29′49.2′′E) in the southwestern area of the Hokkaido Island. It is located on a terrace (29–34 masl) on the right side of a stream with a common name, Yoshiinosawa (Hokkaido Center for Buried Cultural Property 2009; Tsurumaru 1983). Taisho 3 (42°48′03″N, 143°11′55″E) is in the Tokachi Plain of eastern Hokkaido surrounded by the Hidaka Mountains in the west, the Daisetu Mountains in the north, the Akan Mountains and the Shiranuka Hills in the east, and the Pacific Ocean in the south; the Tokachi Plain was formed from a flow of the Tokachi River (Moriyoshi and Natsuki 2017; Obihiro City Board of Education 2006, 3; Yamahara 2006). It is located 15 km south of Obihiro City. Taisho 3 is an open-air site in the lower river terrace formed between the Tobetsu and Satsunai rivers, tributaries of the Tokachi River; it is at an elevation of 97–98 masl, 2 m above the river, situated on the left side of the Tobetsu River (Obihiro Board of Education 2006; Yamahara 2006, 36).

#### 3.3.1.1. Oasa 1

Excavations covering 21,780 m² were conducted in the late 1970s to early 1980s as a cultural resource management project of the Hokkaido Center for Cultural Heritage (Hokkaido Center for Buried Cultural Property 1980, 1981). Excavation levels are layer 1 with the agricultural soil layer of about 20 cm thickness, layer 2, a black humus with a thickness of about 15 cm, layer 3, a dark brown soil with about 10 cm thickness, and layer 4, a yellowish brown loam soil (Hokkaido Center for Buried Cultural Property 1980, 13). Artifacts and features derived from the Initial Jomon and ceramics from the Incipient Jomon were uncovered from layer 3 and from a likely residual area of layer 2 (Hokkaido Center for Buried Cultural Property 1980, 13).
Pottery sherds \((n = 27)\) were likely derived from the same vessel. The materials have been excavated in a context of artifacts of the Initial Jomon (Hokkaido Center for Buried Cultural Property 1980, 81). However, because these materials are technologically distinct from the Initial Jomon pottery from the same context, and due to the similarity in style with the Muroyakasoushiki (type) pottery (e.g., defined from pottery found in the Muroya Cave of the Niigata Prefecture), assigned to the Incipient Jomon period, they are assumed to be from the Incipient Jomon context (Hokkaido Center for Buried Cultural Property 1980; Naganuma 2003, 65). The Incipient Jomon pottery from Oasa 1 uncovered in mixed contexts will require absolute dates for certainty.

The excavators only published brief descriptions of the pottery. Sherds \((n = 27)\), likely derived from a single vessel, have an open bowl or flowerpot form with a body thickness of about 0.4 cm, and a diameter of 30 cm. There are short, vertical impressions made with a thin rope near the rim (Hokkaido Center for Buried Cultural Property 1980, 81, 1981).

### 3.3.1.2. Taisho 3

In 2003, Obihiro Centennial City Museum conducted an excavation extending to 3625 m² as part of its cultural resource management (Obihiro City Board of Education 2006). At Taisho 3, strata I to VIII were encountered. Pottery from the Incipient Jomon (Period I) was encountered mainly from the lower part of layer Vb to the upper part of layer VIII but predominantly occurred between layers VIb and VIII. The pottery is associated mainly with layers VIb to VII or to the upper part of VIII (Obihiro City Board of Education 2006, 21). Layer V (Tarumae-c Tephra) was classified into three sections: layer Va with whitish yellow brown volcanic ash (Tarumae-c Tephra), layer Vb with dark brownish colored humus partially overlayered by Va, and Layer Vc, with Tarumae-d Tephra below Layer Vb. Layer VI is a loam layer classified into two sections, VIa with yellowish-brown soft loam, and VIb with yellowish brown hard loam. Layer VII is a yellowish brown sand and clay soil layer. Layer VIII is a sand-pebble mixed layer. Between layers VIb and VIII, a lithic tool assemblage associated with Period I pottery was found without the intrusions of other assemblages suggesting a secure chronological association (Obihiro City Board of Education 2006, 24). AMS dates \((n = 11)\) on the pottery residue are between 15,025–14,250 cal yr BP (IAAA-41606) and 14,140–13,830 (Beta-194631); the range is narrow (Obihiro City Board of Education 2006). Additional radiocarbon dates obtained more recently from the carbonized residue on the pottery \((n = 6)\) suggest an age between 14,745–14,060 (MTC-16149) and 13,955–13,565 cal yr BP (MTC-16152), a similar range to dates given earlier; however, the true age could be several hundred years younger due to the reservoir effect (Kunikita et al. 2013) (Table 1).

At Taisho 3, relatively large amounts of sherds \((n = 444)\) belonging to Period I were excavated (Obihiro City Board of Education 2006). Based on the excavation report, I classified the vessel forms into deep bowls and bowls with a rounded base and a pointed tip. Deep bowls can have a diameter of 19 cm with slightly everted rim with 0.5–0.85 cm wall thickness. Bowls can have an open mouth and a diameter of 16 cm, with a thickness of 0.5–0.8 cm. The manufacturing techniques (Obihiro City Board of Education 2006) are described in the report as coils. Decorations include impressions made with nails, fingers, or sticks (Obihiro City Board of Education 2006; Yama hara 2006). Inclusions are coarse minerals. Although the designs are distinct, the decorative techniques have similarities with the Incipient Jomon pottery in Honshu (Hashizume 2015; Yamahara 2006, 35).

Lithic artifacts associated with Period I pottery from terraces of Layers VIb and VIII contexts were encountered in abundance \((n = 8664)\) (Obihiro City Board of Education 2006, 51). The lithics include small points, bifaces, burins, spatula-shaped lithics, end scrapers, side scrapers, gimblets, and lithics with continuous flaking; but the lithics exclusively associated with the Period I pottery are points, spatula-shaped lithics, and a burin (Obihiro City Board of Education 2006; Yamahara 2006). From the lithic assemblage, it seems that bifaces were mainly produced at the site. They are stylistically parallel to lithics of more southern areas of the archipelago (Hashizume, Shevkomud, and Uchida 2016, 88). At Taisho 3 from this period, 99% of the lithic raw materials obtained were obsidian; part of the assemblage is non-local (Obihiro City Board of Education 2006).

Pottery residue studies have been conducted (Craig et al. 2013; Kunikita et al. 2013). Carbon and nitrogen isotope ratios and C/N values obtained from carbonized residue on the interior of vessels \((n = 6)\) dated to the late Pleistocene were used to process marine resources and anadromous fish (Kunikita et al. 2013, 1338). Kunikita et al. (2013, 1335) suggest that although Taisho 3 is about 40 km from the Pacific Ocean, salmonids and species of trout came up the Tokachi and Tobetsu rivers to spawn. Results from an analysis of lipid and organic substances remaining as charred residue encrusted on the pottery, studied through a molecular stable isotope analysis, suggest that the early pottery at this site was used to process aquatic products, especially marine resources (Craig et al. 2013). Both studies agree on the results.

From the data above and as archaeologists suggest (Hashizume 2015; Naganuma 2003), the Taisho 3 site
has the best conditions in regards to artifact recovery and stratigraphic contexts, and it provides reliable absolute dates in a late Pleistocene context also containing pottery in Hokkaido.

3.3.2. Northern and Central Honshu
There are at least 2130 sites (my calculation from Japan Paleolithic Research Association 2010, 5) in Honshu assigned to the Incipient Jomon period. In this section, I present five sites in detail: Odaiyamamoto I, Seikosanso-B, Gotenyama, Kubodera-Minami, and Miyagase.

The Odaiyamamoto I site (41°02′34.8″N, 140°37′55.2″E) is situated on the Odai Terrace on the left side of the Kanita River flowing in the northeastern part of the Tsugaru Peninsula of the Aomori Prefecture (Odai Yamamoto I Site Excavation Team 1999). It was discovered near the cliff of the Odai Terrace. It is at an elevation of 26 m. The Seikosanso-B site (36°50′09″N, 138°11′12″E) (Morisaki and Natsuki 2017) is located in Shinanomachi Town, Kamiminochi County of Nagano Prefecture. It is situated along the edge of a flat terrace, at an elevation between 652 and 650 m, formed by the Ikejiri River cutting through the mountain range and continuing from the Kurohime Mountain. A small stream flows in the southern side of the study area (Nagano Center for Buried Cultural Property 2000, 28). The site was excavated as part of a cultural resource management project in mid-1990s. The Gotenyama site (35°42′01″N, 139°34′12″E) is located in Musashino City, north of Inogashira-Ike, a pond, the water source of the Kanda River, which flows through the urban areas of central Tokyo merging with the Sumida River. The site is on the Musashino Plateau, an alluvial plateau surrounded by three rivers to the east, north, and south, and Kanto Mountains in the west. There is an accumulation of volcanic ash, Kanto Loam layers, from the central Tokyo merging with the Sumida River. The site is on the Odaiyamamoto I site is the characteristic of the final part of the Upper Paleolithic to the early Incipient Jomon period (Odai Yamamoto I Site Excavation Team 1999). At this site, the Chojakubo Lithic Assemblage was uncovered with ceramic sherds in the 1970s. This assemblage is also known as the Chojakubomikoshiba Lithic Assemblage (taken from the Chojakubosite in Aomori and Mikoshiba site in Nagano Prefectures), having Upper Paleolithic-like characteristics with points, blades, end scrapers, and burins, combined with large non-Paleolithic-like Mikoshiba-type edge-polished axes and rounded chisel-like axes (Sotogahamachi Board of Education 2011, 93–94). Material from Odaiyamamoto I has yielded some of the oldest radiocarbon dates in the Japanese archipelago (Kaner 2009; Nakamura et al. 2001; Odai-Yamamoto I Site Excavation Team 1999).

The ceramics (n = 46) and lithics (n = 262) that likely belong to the early Incipient Jomon period were mainly uncovered from layer III, and lesser amounts were found from layers IIIa to IV (Odai Yamamoto I Site Excavation Team 1999, 13). Layer II was a dark brown volcanic ash layer, layer IIIa was a dull yellowish-brown residual loam, layer III was a yellowish-brown loam layer, layer IV was a light yellowish-brown sandy silt loam, and layer V was composed of sand and silt. Ceramics were found in association with Chojakubo-type lithics (Odai Yamamoto I Site Excavation Team 1999).

Radiocarbon dates obtained from the carbonized residue of several sherds (n = 5) from layers III and IV were likely derived from the same vessel; however, the dates
ranged widely between 17,195–16,170 cal yr BP (Nuta-6510) and 15,565–14,345 cal yr BP (Nuta-6506) (Kudo 2012; Nakamura et al. 2001; National Museum of Japanese History 2009; Odai Yamamoto I Site Excavation Team 1999) (Table 1). Age estimates, therefore, were given tephrachronologically, with the presence of the Towada-Hachinohe Tephra, between 15,870 yr BP (Gak-205) and 15,474–14,235 cal yr BP (NUTA-2261), taken from the Chojakubo site in Aomori with a similar stone tool assemblage as Odaiyamamoto I, found below the tephra layer. Those stone tools at Chojakubo were not associated with pottery. Additional dates were obtained on carbonized wood ($n = 3$) from layer III, ranging between 16,496–15,996 cal yr BP (Beta-125550) and 7975–7795 cal yr BP (Beta-127791) (Kudo 2012; Nakamura et al. 2001; Odai Yamamoto I Site Excavation Team 1999).

Of 46 ceramics sherds encountered, 44 are considered to have been derived from the same vessel; all fragments are very small (Odai Yamamoto I Site Excavation Team 1999). The vessel is suggested to be a round bowl having a direct/vertical rim with slight thinning at the lip. The vessel has a large diameter. Average body thickness is about 0.8 cm. The pot was possibly used for cooking, as suggested from the carbonized residue (Odai Yamamoto I Site Excavation Team 1999). Inclusions are sand. Minor amounts of fragments also included materials derived from marine sediment, probably from somewhere within the Tsugaru Peninsula in the Aomori Prefecture (Sotogahama-machi Board of Education 2011). The pot was created with a coil-built manufacturing technique (Odai Yamamoto I Site Excavation Team 1999). No decoration was observed.

Stone tools ($n = 167$) associated with pottery include a chipped stone ax, projectile points, scrapers, arrowheads, burins, blades, and cores (Odai Yamamoto I Site Excavation Team 1999). At this site, if the similarity in stone tool types from a site without ceramics correlates with the Towada-Hachinohe Tephra, and if there is a thousand-year difference in the dates obtained from the ceramic residue from the same vessel, there are ambiguities in the dates. Although ceramics were mainly found from layer III, other layers also contained pottery. Post-depositional movement of materials needs to be considered.

3.3.2.2. Seikosanso-B. About 4000 m$^2$ was excavated at Seikosano-B. Seven stratigraphic layers were encountered. Incipient Jomon artifacts were found between the lower part of Layer II and the middle part of Layer III (Nagano Center for Buried Cultural Property 2000, 30). Layers III and V were subdivided into III-upper, III-middle, and III-lower, and Va, Vb, and Vc. The Heian Period dwellings, and the Initial to Late Jomon pit houses and pits, were encountered from the upper part of layer II. Layer II was the Kashiwabara Black Volcanic Ash layer with dark brown color. Layer III-upper had a dark brown color with 10% of a marbling of slightly different dark brown soil. Layer III-middle had light-brown color with a 70% marbling of black-colored soil. Layer III-lower had light brown color with 50% marbling of black-colored soil. Layers III-middle and III-lower had a marbling of light brown and black soils called the moya layers, equivalent to the Nojiri-Lake context dated between 14,000 and 10,000 cal yr BP (Nagano Center for Buried Cultural Property 2000, 58). AMS dates were obtained on encrusted residue on the pottery with thin linear reliefs (ryukisenmon) ($n = 3$). The dates for this encrusted residue ranged between 14,690–14,100 (Beta-133847) and 13,995–13,740 cal yr BP (Beta-133848) (Nagano Center for Buried Cultural Property 2000, 52) (Table 1).

Within layer III, there were pottery fragments ($n = 1284$) assigned to the Incipient Jomon with thin linear reliefs (ryukisenmon). The vessel forms consist of deep bowls with round bases with open to vertical mouths. Sand inclusions were observed. Some were rich in quartz, and quartz and feldspars, or included andesites or mica. Stone tools that are suggested to have been found in association with the Incipient Jomon pottery are tanged points, willow-leaf shaped projectile points, half-moon shaped points, boat-base shaped tools, scrapers, and an edge-ground ax (Nagano Center for Buried Cultural Property 2000).

Three artifact concentration areas (SQ01–SQ03), likely from the Incipient Jomon, were found in the upper part of layer III. These include pottery, ground stone, an edge-ground stone axe, flakes, projectile points, scrapers, stamp-shaped lithics, stemmed points, and drills. SQ05 from layer III is a possible hearth from the Incipient Jomon period, with round and angular pebbles ($n = 7$), ceramic sherds ($n = 19$), and a sherd from Late Jomon times (Nagano Center for Buried Cultural Property 2000, 31–32). There was a concentration of pebbles (SH01) between the upper and lower parts of layer III, a possible hearth, likely associated with the Incipient Jomon (Nagano Center for Buried Cultural Property 2000).

3.3.2.3. Gotenyama. The Gotenyama site was excavated (96.4 m$^2$) as part of a cultural resource management project. Layers IIa-1 to IIb had a mixture of pottery dated to the Incipient to Late-Middle Jomon periods. The lower part of layer IIb-2 contained the Incipient Jomon pottery. Layer IIC had exclusively Incipient Jomon ceramics (Kato Construction Company Buried Cultural Property
Layer IIa-1 had black soil with minor inclusions of fine scoria. IIa-2 was black soil similar to IIa-1 but with a lighter color and finer texture. Layer IIb-1 was a blackish-brown soil with fine texture, layer IIb-2 was blackish-brown soil similar to but darker than IIb-1. Layer IIC was a blackish-brown soil with spotty inclusions of dark-brown to brown colored soft loam having abundant red-colored scorias in the lower part. Layer III was a soft loam layer with abundant red-colored scoria. Stratigraphic sections A and B were recorded, with B having many disturbances. Samples for \( n = 2 \) AMS dates were obtained on carbonized remains on vessel B (from SS1 and zone B Northwest, layer IIc) and on sample C1, carbonized material from layer IIc. Dates ranged between 16,540–16,160 cal yr BP (Beta-196087) (Vessel B) and 16,105–15,630 (MTC-05108) (sample C1) (Kato Construction Company Buried Cultural Property Investigation Sector 2004) (Table 1). They are close in age.

The pottery fragments were derived from two vessels, A and B \( (n = 268) \). Fragments of vessel A were found mainly in the northeastern area, and those of vessel B, from feature SS1 excavated in layer IIc. The vessels were likely deep bowls with somewhat open-mouth shapes. The vessel body thickness ranges between 0.5 and 1.5 cm. The manufacturing technique is layered slabs. Inclusions are animal hair and plant fiber and sand found in abundance. The firing temperature was suggested to have been relatively high, but the sherds are highly fragile and fragmented. Decorations are linear reliefs (called “ryutai” \( ryutaimon \) in the report) (Kato Construction Company Buried Cultural Property Investigation Sector 2004).

Stone tools associated with this Incipient Jomon pottery are a chipped stone ax, bifacial points, end scrapers, side scrapers, and microblade-like flakes. Stone aggregate (SS1), a feature, had traces of heat fracture (Kato Construction Company Buried Cultural Property Investigation Sector 2004).

**3.3.2.4. Kubodera-Minami.** The excavation was conducted as part of a cultural resource management project. An area of about 966 m² was excavated. There were three different layering contexts created in areas by the Shinano River: the main current (in the east), ancient natural bank, and aquifer (in the west). The pebble layer is a base layer of the terrace. It is overlain by silt layer(s) and sand layer(s). Major artifacts of the Incipient Jomon period were found in the ancient natural bank area deposited between the period when the pebble layer was exposed to the early stage of the silt and sand sedimentation (Nakasato Village Board of Education 2001, 19). Below the tilling layers 1 and 1’, there are natural bank and aquifer layers 2 and 3, and in the natural bank deposit, layers continue to the pebble deposit; in the aquifer, layers continue to layers 4 and 46 (Nakasato Village Board of Education 2001, 14). There are complicated and numerous layers, up to layer 49; however, large numbers of pottery fragments are found below layers 1–3 (e.g., 33, 35, and 45). The carbonized encrusted residue on the pottery was radiocarbon dated \( (n = 7) \). The oldest date is 15,210–14,745 cal yr BP (Beta-140495) without a provenience in the report (Nakasato Village Board of Education 2001). Among the samples with provenience, layer 2 in the upper part of the profile is dated between 15,200–14,730 cal yr BP (Beta-136746) and 15,060–14,285 cal yr BP (Beta-136745), the lower layers 33 and 35 were dated between 14,880–14,180 cal yr BP (Beta-136744) and 14,535–14,020 cal yr BP (Beta-136743) (Table 1). Thus, the upper layers are somewhat older than the lower layers. The excavators explain this as the period of sedimentation similar to depositional processes; layers below layer 33 are from secondary deposits (Nakasato Village Board of Education 2001, 213, 215).

Of 18 artifact concentration areas, 17 were from the Incipient Jomon period. Pottery was associated with the lithics. The Incipient Jomon pottery \( (n = 1500) \) had linear reliefs (\( ryukisenmon \)). In the conventional typology, this is classified as derived from the early half of the Incipient Jomon period. These ceramics were found in layers 2–4’ of the natural bank area and layers 8–40 of the inclined area of the natural bank (Nakasato Village Board of Education 2001). The vessel forms are a deep bowl with near vertical sides to somewhat closed-mouth opening and rounded base, a possible bowl with a somewhat opened-mouth top, and a vessel with a flat base. Measurable rims range in diameters between 20.5 and 40.8 cm. Limited data suggest a 0.3–0.8 cm vessel thickness. The manufacturing techniques are unclear. Some vessels seem well fired. Inclusions are sand. Decorations are, in general, thin and undulating or impressed leaner reliefs (\( ryusenmon \)) (Nakasato Village Board of Education 2001; National Museum of Japanese History 2009).

Lithics \( (n = 1810) \) likely associated with the Incipient Jomon pottery include end scrapers, side scrapers, flakes, chipped stone axes, and edge-ground stone axes, spears, pebble tool, cores, nodules, hammerstone, ground stone, whetstone, and fragments. Spears are bifaces that tend to have long leaf shapes of 6–8 mm thickness. With regards to features, no clear evidence of dwellings, storage pits, or trap pits was found.

**3.3.2.5. Miyagase-Kitappara (No. 10 and 11, North).** Miyagase-Kitappara (No. 10 and 11, North) was excavated as part of a cultural resource management project.
A total of about 3150 m² was excavated. At the site, layer IX is equivalent to the LIS layer of the Sagamihara Plateau, subdivided into a, b, and c. The sub-layers a and b are difficult to classify, and at the site only b and c are represented. Sub-layer b has a reddish-brown loam of 40–50 cm thickness, and at the bottom has a scoria layer (Y 139) of 3–5 cm in thickness (Kanagawa Foundation 1998, 8). Sublayer c has a yellowish-brown loam. Sub-layer b includes the materials from the Incipient Jomon period. Some translocated materials of the Incipient Jomon are found in the lower part of layer VIII. In layer IX, there were four areas with lithic concentration and five areas with pebble concentrations (Kanagawa Foundation 1998). Radiocarbon dates \((n = 6)\) from carbonized wood from layer IX ranged between 15,925–15,325 (geo-5546/Beta-105398) and 15,860–15,285 cal yr BP (geo-5550/Beta-105402) \((n = 5)\), giving a narrow time range, and a date that is an outlier 11,105–10,520 cal yr BP (geo-5547/Beta-105399) (Kanagawa Foundation 1998) (Table 1).

Ceramic sherds \((n = 13)\) were found overlapping with Lithic Concentration Area 3. The ceramics have no decorations (National Museum of Japanese History 2009). A thin section of a sherd was analyzed; a very low percent of sand inclusion (1.4%) was observed with a major inclusion of quartz and plagioclase. Minor/trace amounts of mudstone were also found. Abundant sponge-related fragments derived from marine deposits are also included. These materials are assumed to be natural inclusions (Kanagawa Foundation 1998) (Figure 3).

Lithics from Lithic Concentration Area 3 yielded projectile points, an end scraper, flakes with cortex, and flakes. Lithics from all the lithic concentration areas from layer IX include projectile points, end scrapers, side scrapers, burins, flakes with secondary reduction, flakes with use-wear, a perforator, pebble tools, ground stones, hammerstones, and flakes.

### 3.3.3. Shikoku and Northern and Southern Kyushu

On the islands of Shikoku and Kyushu, there are at least 290 sites assigned to the Incipient Jomon (my calculation from Japan Paleolithic Research Association 2010). In southern Kyushu, the Incipient Jomon is considered to have ended around 12,900/12,800 cal yr BP. On Shikoku Island, Kamikuroiwa Rockshelter (Harunari and Kobayashi 2009), which has been reported in detail, Fudogaiwaya-Douketsu, Okutaniminami, Anagamido Cave, and Tokawadasabasaki also have pottery from the Incipient Jomon period (Harunari and Kobayashi 2009). Kamikuroiwa Rockshelter, Fudogaiwaya-Doketsu, and Anagamido Cave are limestone cave sites. Okutaniminami is a rockshelter and Tokawadasabasaki is an open-air site (Kochi Prefecture Cultural Foundation Buried Cultural Property Center 2001). At Kamikuroiwa \((33°37′04″N, 132°57′39″E)\) (Morisaki and Natsuki 2017), radiocarbon dates on charred wood have yielded 16,185–12,975 cal yr BP (1-944) from layer 9 (Keally et al. 2004), from which the majority of pottery had linear reliefs \((ryukisenmon)\) (Harunari and Kobayashi 2009). However, this is an old excavation in a limestone rockshelter context requiring caution regarding the age and context.

In northern Kyushu, the Incipient Jomon sites include Senpukuji Cave, Fukui Cave, Kayawo-F, and Takahata-Otonohara (Morisaki and Natsuki 2017). Senpukuji Cave and Fukui Cave from Sasebo City, Nagasaki Prefecture, have been known for having the oldest pottery from western Japan (Bleed 1976; Ikawa-Smith 1976; Kaner 2009; Keally, Taniguchi, and Kuzmin 2003, 2004; Kuzmin 2015). Senpukuji \((33°12′16″N, 129°43′55″E)\) is in a sandstone cave, 89.5 masl. Radiocarbon dates of 14,535–13,830 cal yr BP are reported from layer 8 (Kuzmin 2017b; Morisaki and Natsuki 2017; Sato, Izuho, and Morisaki 2011). Layer 10 had ceramics with linear reliefs (with bean-shaped appliques, \(toryumon\)), and layers 9–7 with linear reliefs \((ryukisenmon)\); these are followed by nail-impressed \((tsunegatamon)\) pottery in layer 6, and pottery with drag and jab decoration (Aso 1985). These ceramics were associated with microblade cores and/or with microblades. The relative age of the pottery with linear reliefs, those with \(toryumon\) and those with \(ryukisenmon\) are still debated (Otsuka 1989). Fukui Cave \((33°17′21″N, 129°42′36″E)\) has been re-excavated and re-evaluated recently (Sasebo City Board of Education 2016). The cave is composed of sandstone, located 110 masl. Incipient Jomon materials were found in layers 2–3c. Layer 2 \((2a\) and \(2b)\) contained pottery including nail-impressed \((tsunegatamon)\) sherds (and minor amounts of linear reliefs \((ryukisenmon)\) and plain ware), microblade cores, microblades, and scrapers. Dates for layer 2 were between 15,210–148,00 cal yr BP (PLD-25713) \((\text{carbonized residue on pottery})\) and 14,990–14,270 cal yr BP (IAAA-123718) \((\text{carbonized wood})\); and dates for layer 2b were between 15,070–14,380 cal yr BP (PLD-25709) \((\text{carbonized wood})\) and 15,020–14,265 cal yr BP (PLD-21101) \((\text{carbonized wood})\). Layer 3 yielded a date of 16,060–15,710 cal yr BP (PLD-25708) \((\text{carbonized wood})\). Layer 3a contained linear relief \((ryukisenmon)\) and plain pottery, microblade cores, scrapers, and microblades. Dates for layer 3a \((n = 3)\) were between 15,990–15,575 (IAAA-120593) and 15,475–15,120 cal yr BP (PLD-25710). Layer 3c contained pottery with linear reliefs \((ryukisenmon)\), scrapers, microblades, and microblade cores. Dates for layer 3c \((n = 6)\) were between 16,300–15,940 cal yr BP (IAAA-
123720) (carbonized wood) and 15040–15675 cal yr BP (IAAA-123719) (carbonized wood) (Sasebo City Board of Education 2016) (Table 1). The narrow date ranges make it difficult to clearly differentiate certain occupational changes.

In this section, I focus on sites from southern Kyushu. This is a special place to pursue ceramic origins research. The Incipient Jomon occupation is separated from the Initial Jomon by the Satsuma Tephra (P14/Sz-S/Sz-14), dated to 12,800 cal yr BP (Iizuka and Izuho 2017; Okuno 2002). Thus, the Sz-S Tephra allows the identification of occupations with ceramics occurring prior to 12,800 cal yr BP. Among the sites that are found below the Sz-S Tephra, those with microblades earlier than the major occupations of the Incipient Jomon period, 14,000/13,500 cal yr BP, or with pottery encountered within Upper Paleolithic contexts, including the Kiriki, Nitao-Naka B, Tenjindan, and Yamaguchi sites, are not well-known internationally. Another set of sites includes the Incipient Jomon occupations dated between 14,000/13,500 and 12,800 cal yr BP. Those abundant sites include Oujiyama, Kenshojo-Ato, Soujiyama, Mukaiga-koijo-Ato, Nakao, Kakoinohara, Shikazegashira, Sanka-kuyama I, and Onigano. Below I introduce the

Figure 3 Ceramic sherds from Miyagase-Kitappara (No. 10-11. North). (1) Photos of the interior, exterior, and profiles of a sherd from layer IX (layer LIS of Sagamihara Plateau) (A, interior; B, exterior; C, the top profile viewed from the interior; D, the left profile seen from the interior). (2) Photos of the interior, exterior, and profiles of a sherd from a possible Incipient Jomon context (layer IX (layer LIS)) (A, interior; B, exterior; C, the top profile viewed from the interior; D, the left profile seen from the interior) (photos taken by Masami Izuho).
following sites: Kiriki, Nitao-Naka A-B, Kenshojo-Ato, Souijyama, Mukaigakojo-Ato, Nakao, Sankakuyama-I, and Onigano (Figure 1). All of them include ceramic analytical data that I have recently collected.

The Kiriki site (31°40′41″N, 130°56′26″E) is located in Sueyoshicho of Soo County, in northeastern Kagoshima Prefecture (Kagoshima Center for Buried Cultural Property 2004). It is on the pyroclastic plateau at 300 masl, overlooking the Kirishima mountains on the northern side. The Nitao-Naka A-B site (31°35′45.6″N, 130°27′36″E) is in Kagoshima City, about 10 km inland from Kagoshima Bay. It is at the edge of a pyroclastic plateau at 190 masl, at the point where the East China Sea and Kagoshima Bay meet; a valley runs from east to west and three rivers surround the site (Kagoshima Cen-
teau at 190 masl, at the point where the East China Sea

3.3.3.1. Kiriki and Nitao-Naka A-B sites. The Kiriki and Nitao-Naka A-B sites are potentially dated prior to 14,000/13,500 cal yr BP and are presented together.

Kiriki was excavated as part of a cultural resource management project. The total area excavated was 5500 m². At Kiriki, ceramics were found below layer IX with Tephra Sz-14. The lowest ceramic-containing layer is layer XIA, a light yellowish-brown colored loam; layer XB above it has dark brownish slightly clayish soil, and layer X even higher has blackish-brown soil (Kagoshima Center for Buried Cultural Property 2004). Layers XIa and Xb are also associated with microblades, and layer Xa is assigned to the Incipient Jomon period. Translocated materials from layers XIa and Xa are found in layer Xb (Kagoshima Center for Buried Cultural Property 2004). A carbonized sample obtained from an aggregate of carbonized remains in layer Xla, in zone h-3, at the outer edge of Artifact Concentration Area No. 19, was dated to 16,550–16,130 cal yr BP (PLD-1959) (Table 1). A carbonized sample from Stone Aggregate No. 1 in layer Xa was dated to 13,070–12,695 cal yr BP (Beta-141499). Below Tephra Sz-14, in layer VIII, Initial Jomon materials are found in the upper part. This layer, below layer VII, includes the Sz-12 Tephra, dated to about 9000 cal yr BP, partially translocated into layer VIII. Layers IXc and XIIa, found below the secondary deposition of the Ito Tephra, contain microblades, microblade cores, scrapers, and a ground hammer with no pottery in association.

In layer XIa, most sherds were found in Artifact Aggregate Area 1 (n = 97, out of total n = 99), where they were well-associated with microblades and microblade cores, arrowheads, stick-like hammer tools, and flakes with use-wear. The ceramics are all small fragments less than 3 cm in size (Kagoshima Center for Buried Cultural Property 2004, 208). Most sherds have no decorations, but a few appear to have subtle linear reliefs/appliques. Sherds with identifiable vessel shapes suggest deep bowls (Kagoshima Center for Buried Cultural Property 2004). According to my analysis (n = 12), however, most of these ceramic fragments observed under a stereoscope (Olympus SZ61) have little or no sign of post-firing fractures on the sides. These sherds initially appeared to me to be pellets. However, Vandiver (2018, personal communication, July 26-27), observing the fragments, suggests they are ceramic sherds that were likely water-worn. All samples have sand inclusions. There are fragments that seem to have thin layers of slabs placed together, and some with no clear indication of manufacturing lines. Mohs hardness was mainly 2, but there were also samples with 2.5 and 3.5. The thickness of the sherds ranges between ∼0.3 and 0.6 cm. The surfaces are mainly plain, but possible decorations, appliques, incisions, or indentations are found on certain samples. The majority of paste was oxidized, with some mixture of reduction and oxidation (Figure 4).

In layers Xa and Xb, 28 (or 29) sherds were encountered and assigned to the Incipient Jomon period. Most sherds have no decoration, but two sherds have possible linear reliefs (ryukisenmon) (Kagoshima Center for Buried Cultural Property 2004, 171). Sherds with identifiable vessel form suggest deep bowls. According to my analysis
of ceramic fragments \((n = 12)\), those from layers Xa and Xb tend to have broken sherd-like post-firing fractures on the sides (Figure 4). They tend to be larger than the materials noted above and found exclusively in layer XIa. All inclusions are sand. The manufacturing technique is layered slabs. Mohs hardness ranged between 1 and 3.5. Body thickness ranged between about 0.5 and 0.7 cm. There are samples with appliques.

From layers XIa and Xb, lithics encountered in association with the ceramics include abundant microblades and microblade cores, arrowheads, scrapers, flakes with use wear, ground hammers, stick-like hammers, and
base stones (Kagoshima Center for Buried Cultural Property 2004). Raw material for the lithics was mainly obsidian procured from varied areas of mainland Kyushu. Features were pebble aggregates (n = 2), areas with aggregates of carbonized remains (n = 1), and aggregates of artifacts (n = 24) (Kagoshima Center for Buried Cultural Property 2004).

From layers Xa and Xb, lithics encountered include some microblades and microblade cores, arrowheads, scrapers, a wedge-shaped stone tool, stone axes, ground stones, hammerstones, stick-like hammerstones, and flakes with secondary reductions (Kagoshima Center for Buried Cultural Property 2004, 175). Since in layer Xa, no clear evidence of microblades or microblade cores are found where the layer is stable (without the influence of layers Xla or Xb), there remains no clear evidence for microblade use at this site during the Incipient Jomon period (Kagoshima Center for Buried Cultural Property 2004, 208). Encountered features were a ground stone (ground hammer) aggregate and stone aggregates.

The Nitao-Naka A-B site was excavated as part of a cultural resource management project. The total area excavated was 7700 m². At the site, the P-14 Tephra is found in layer VI (about 70 cm), with yellowish-range pumice. Layer VII below is divided into VIIa (about 5 cm) with blackish brown clayish soil containing microblades, arrowheads, and ceramics, and VIIb (about 15 cm) with preceramic materials (e.g., microblades, small knives, and small trapezoids). Layer VII is thin. Layer VIII (VIIa and VIIib) contained knife-shaped stone tools. Artifact density was extremely high; combining layers VII and VIII, about 290,000 artifacts were excavated (Kagoshima Center for Buried Cultural Property 2007). Radiocarbon dates obtained on carbonized wood from layer VIIa of Point 1 included 15,670–15,230 cal yr BP (Beta-152988); however, another sample (macro-botanical remain) from layer VIIa, Point 1, yielded a modern date suggesting the intrusion of a plant root (Kagoshima Center for Buried Cultural Property 2007, 263).

According to Kagoshima Center for Buried Cultural Property (2007), 24 ceramic sherds from VIIa were found (from varied grids) and described as having no decorations and being weathered (Kagoshima Center for Buried Cultural Property 2007). My brief analysis of limited number of ceramics (n = 5) suggests that they are sherd-like fragments with evidence of wall fracture (Figure 5). Inclusions consist of sand. The manufacturing technique is layered slabs except for a sherd that is unclear. Mohs hardness ranges between 1 and 2. Thicknesses range between 0.5 and 1.1 cm. Some sherds exhibit cracks; Vandiver (2018, personal communication, July 26-27) suggests these are thermal shocked. There may be a sherd with applique, but it is ambiguous (Figure 5).

Lithics from layer VIIa include arrowheads, scrapers, microblades, microblade cores, and ground stones, and there were also areas with hammerstone aggregate but also trifacial points, small trapezoids, and flakes partially overlapping with layer VIIb. Areas with pebble aggregates were also identified.

Kiriki and Nitao-Naka A-B serve as examples of the possible appearance of ceramics in southern Kyushu by 16,000–15,000 cal yr BP, within the context of Upper Paleolithic stone tool assemblages and behaviors. However, for both Kiriki and Nitao-Naka B, the precise antiquity of the earliest ceramics and behaviors needs to be evaluated further.

3.3.3.2. Kensoho-Ato, Soujiyama, Mukaigakoijo-Ato, and Nakao sites. Kensoho-Ato was excavated as part of a cultural resource management project. The total area excavated was 3845 m². Kensoho-Ato is a multi-component site. The Incipient Jomon materials are found in layer IX, below layer VIII, which contains the Sz-S Tephra (17 cm) (Aira City Board of Education 2005; Iizuka et al. 2018), and above layer X with the Iwamoto Tephra. Radiocarbon dates (n = 6) are 13,260–12,920 cal yr BP (Beta-163810, Zone B5, carbonized remains from fill soil of SZ12, a stone aggregate) and 12,915–12,700 cal yr BP (Beta-163812, Zone C2 earth pit burying soil) with a narrow range (Aira City Board of Education 2005) (Table 1).

A total of 491 sherds from an Incipient Jomon context are reported from Kensoho-Ato. Ceramic sherds found are predominantly from plainwares with vessel forms of deep bowls with raised bases, and a cylindrical form with a raised base (Aira City Board of Education 2005; Iizuka et al. 2018). My analysis of ceramics (n = 30) (Iizuka and Izuho 2017; Iizuka et al. 2018) suggests that inclusions are sand with no clear indication of non-local raw materials. The manufacturing technique is mainly layered slab construction. Mohs hardness results range between 1 and 2. The body thickness range is 0.8–1.4 cm. Most sherds have no decoration (Figure 6).

Stone tools include arrowheads, points, microblades, microblade cores, microblade-like flakes, scrapers, wedge-shaped tools, pebble tools, varied types of ground stones, and stone plates. Features were pit dwellings, stone aggregates, smoking pits, and soil pits (Aira City Board of Education 2005; Iizuka et al. 2018).

At Kensoho-Ato, phytolith-based paleoenvironmental data suggest cold conditions existed during the Incipient Jomon period, and only after the fall of the Sz-S
Tephra did evergreen trees emerge (Aira City Board of Education 2005; Iizuka and Izuho 2017).

The Soujiyama site was excavated as part of a cultural resource management project. The total area excavated was 700 m². At Soujiyama, the Incipient Jomon occupation is found in layer 6, a black, sticky soil layer, below layer 5 of the Sz-S Tephra (up to 110 cm) (Iizuka et al. 2018; Kagoshima City Board of Education 1992).

Figure 5 Ceramic sherds from Nitao-Naka A-B. (1) Photos of the interior and exterior surfaces of a sherd from layer VIIa (A is the interior, B is the exterior, C is from an angled position of the bottom viewed from the interior of the sherd). (2) Photos of the interior and exterior of a sherd from layer VIIa (A is the interior, B is the exterior).
Radiocarbon dates are not available from the Soujiyama site.

The total number of Incipient Jomon sherds reported from Soujiyama are over 200. The ceramics have decorations of linear relief (ryutaimon), and the vessel forms are deep and shallow bowls with a variety of base forms (Iizuka et al. 2018; Kagoshima City Board of Education 1992). My analysis of ceramics \((n = 29)\) (Iizuka and Izuho 2017; Iizuka et al. 2018) suggests that the inclusions are sand. Most sherds were gathered from within a 10 km radius. The manufacturing technique is layered slabs. The body thickness range is between \(\sim 0.7\)
and 1.4 cm. The Mohs hardness is between 1 and 2 (Figure 6).

Stone tools found in association with the ceramics include flakes, arrowheads, microblade-like flakes, a microblade core, scrapers, chipped flakes, a stone ax, varied types of ground stones, a pebble tool, hammer, whetstone, and stone plates. Features are pit-houses, a smoking pit, boat-shaped stone aligned hearths, stone alignments, stone aggregates, and soil pits (Iizuka et al. 2018; Kagoshima City Board of Education 1992).

At Soujiyama, after the fall of the Sz-S Tephra, the site was not occupied during the subsequent Initial Jomon period (Iizuka and Izuho 2017).

Mukaigakoijo-Ato was excavated as part of a cultural resource management project. The total area excavated was 16,000 m². At Mukaigakoijo-Ato, the Incipient Jomon occupation was found in layer VII, below layer VI with the Sz-S Tephra (Iizuka et al., under review; Kagoshima Center for Buried Cultural Property 2008). Incipient Jomon materials were encountered, mixed with Upper Paleolithic materials.

A total of 336 ceramic fragments (n = 17 after restoration) assigned to the Incipient Jomon were recovered from Mukaigakoijo-Ato. The ceramics encountered have decorations of linear relief (ryutaimon), a vessel form of deep bowls, and bases of rounded-flat form (Kagoshima Center for Buried Cultural Property 2008). My brief pottery analysis (n = 19) (Iizuka et al. under review) suggests that inclusions consist of sand likely procured from the vicinity. The manufacturing technique is mainly layered slabs. The thickness range of body sherds ranges between 0.9 and 1.5 cm. The Mohs hardness results are 2 and less than 2.

Stone tools from the Incipient Jomon period (Iizuka et al. under review; Kagoshima Center for Buried Cultural Property 2008) are arrowheads, ground stones, hammers, and pebble tools with indentation. Those that overlap with the Upper Paleolithic include knife-shaped tools, trapezoids, flaked points, points, trifacial points, scrapers, flakes with secondary reduction, wedge-shaped tools, microblades, microblade cores, and flakes with retouch. Features were stone alignments and stone aggregates.

The Nakao site was excavated as part of a cultural resource management project. The total area excavated was 25,000 m². Nakao is a multi-component site. The Incipient Jomon occupation was identified in layer VII (10 cm, light brown soil), and in layer VIII, mixed with Paleolithic artifacts (Iizuka et al. under review; Kagoshima Center for Buried Cultural Property 2009). Layer VII is found below layer VI with the Sz-S Tephra (15 cm, dark yellowish orange gray soil). Separating Paleolithic stone tools and the Incipient Jomon components from layer VIII was difficult (Iizuka et al under review; Kagoshima Center for Buried Cultural Property 2009).

A total of 103 sherds (after restoration) are reported from Nakao. Of the ceramics encountered some have decorations of linear relief (ryutaimon), and some are without decorations. The vessel forms are bowls and shallow bowls; base forms are roundish flat, raised base, and pointed base types (Kagoshima Center for Buried Cultural Property 2009). My pottery analysis (n = 21) (Iizuka et al., under review) suggests inclusions are sand, and raw materials were likely available from the vicinity. The manufacturing technique is mainly layered slabs. The thickness range of body sherds is between ~0.9 and 1.5 cm. The Mohs hardness range is from less than 2–3.

The lithics include arrowheads, wedge-shaped stone tools, scrapers, pebble tools, flakes, flakes with secondary reduction, round, chisel-shaped stone axes, ground-stone axes, hammers, and whetstones. Features found are stone aggregates, a smoking pit, game pits, and soil pits (Iizuka et al., under review; Kagoshima Center for Buried Cultural Property 2009).

The chronology and findings from layer 6 of the Soujiyama site are secure. The evidence for the chronology of Mukaigakoijo-Ato is ambiguous regarding stone tools as they were found with an Upper Paleolithic assemblage. However, the ceramics encountered under the Sz-S Tephra are clearly assigned to the Incipient Jomon period. The materials from layer VII of the Incipient Jomon are reliably assigned at the Nakao site.

3.3.3.3. Sankakuyama I and Onigano sites. Sankakuyama I was excavated as part of a cultural resource management project. The total area excavated was 58,620 m². Sankakuyama I is a multi-component site with Incipient, Initial, and Early Jomon, and Kofun period materials (Iizuka et al. 2016; Kagoshima Center for Buried Cultural Property 2006). At Sankakuyama I, the surrounding context and artifacts assigned to the Incipient Jomon period were found in layer V (20–15 cm), in a brownish clayey soil. Layer V was below layer IV, a brownish clayey soil, which contains the Sz-S Tephra in small blocks. Layer III contains the Initial Jomon materials in brownish clayey soil. Radiocarbon dates obtained from layer V on carbonized remains were 13,840–13,545 (Beta-88847; 2 T, or Trench 2) and 12,720–11,800 cal yr BP (Gak-19077) (Table 1). Carbonized residue on pottery (n = 5) dated from 14,000–13,570 (IAAA-10311; Pithouse 2, residue from exterior) to 13,355–13,075 cal yr BP (IAAA-10309; layer V, residue from exterior), with an outlier, 10,130–9515 cal yr.
BP (Beta-153028; layer V). A carbonized sample from Pithouse 1 yielded an additional date of 13,590–13,400 cal yr BP (Beta-175701). The exact proveniences of additional radiocarbon dates are difficult to determine from the excavation report. Radiocarbon dates prior to 12,800 cal yr BP match the dates derived from the Satsuma Tephra, even though anomalous dates are also included.

About 4000 Incipient Jomon sherds were excavated from Sankakuyama I (Kagoshima Center for Buried Cultural Property 2006). The ceramics had linear reliefs (ryusenmon and ryutaimon), but there are also non-decorative wares; the vessel forms are bowls, deep bowls, and shallow bowls (Iizuka and Izuho 2017; Iizuka et al. 2016; Kagoshima Center for Buried Property 2006). My analysis of the ceramics (n = 58) (Iizuka and Izuho 2017; Iizuka et al. 2016) suggests that the inclusions are sand. There are ceramics produced with locally available raw materials and from raw materials outside the Tanegashima Island. The manufacturing technique is mainly layered slabs. Body thicknesses range between 0.5 and 1.4 cm. Mohs hardness results range between 1.5 and 3 (Figure 7).

Stone tools include ground arrowheads, chipped arrowheads, wedge-shaped stone tools, cores, ground stone axes, stone plates, and various types of ground stones. The composition of these tools is local and non-local (from outside of Tanegashima) raw materials. Specialized hunting and felling tools were mostly made of non-local raw materials (Iizuka et al. 2016). Surrounding features from layer V included pit dwellings, pit aggregates, earth pits, pebble aggregates, and burnt soil (Iizuka et al. 2016; Kagoshima Center for Buried Property 2006). The phytolith record suggests evergreen trees appeared in layer VI and continued to layer V, and thus climatic warming presumably occurred prior to the Incipient Jomon (Iizuka and Izuho 2017; Kagoshima Center for Buried Property 2006).

The Onigano site was excavated as part of a cultural resource management project. The total area excavated was 4650 m². Onigano is a single component site containing Incipient Jomon materials. All the features, ceramics, and stone tools are found in layer VI (about 20 cm), with dark brownish clayey soil. A few pockets of the Sz-S Tephra, sparsely distributed, were found between layers IV and V. Partial movement of sediments occurred between layers IV and V. Radiocarbon dates were obtained on carbonized residue (n = 3) from the pottery interior. Results suggested dates of 14,200–13,940 cal yr BP (Beta-177290), 13,840–13,545 cal yr BP (Beta-177289), and 10,555–10,255 cal yr BP (IAAA-11505) (Nishinoomote Board of Education 2004). Decorative features were stylistically categorized as linear reliefs (ryutaimon) of the Incipient Jomon period.

A total of 14,352 pottery fragments remained after restoration. The decorative ceramics were classified into different types of linear reliefs (ryutaimon) and indented lines (Nishinoomote Board of Education). There were also non-decorative sherds. My analysis of the report reveals that there are deep bowls, shallow bowls, cylindrical/vertical-walled deep vessels, and those with round and flat bases. My brief analysis (Iizuka 2018) of the ceramic sherds (n = 35) suggests the inclusions are sand. The ceramics are likely made of raw materials available on Tanegashima and those transported from outside the island. The decorative devices are appliques. The manufacturing technique is layered slabs. The vessel wall thickness is mainly ≤ 1 cm. Mohs hardness on some materials suggested a range of 2–3.5.

Lithics encountered from this site include arrowheads, points, end scrapers, wedge-shaped stone tools, burins, flakes, cores, hammerstones, ground-stone axes, pebble tools, ground stones, hammers, stone plates, and base stones. Local and non-local (areas other than the Tanegashima Island) raw materials were used for chipped stone tools. Stone alignments, stone aggregates, pit structures, a pit dwelling, and earth pits also occur.

The problem of Onigano is the scarcity of the Sz-S Tephra and an anomaly found in the radiocarbon date obtained from carbonized residue of the Incipient Jomon pottery. However, because all the features and artifacts are encountered from layer VI, two layers below layer IV with the Sz-S Tephra, it seems that the site has had little disturbance and has a secure context of pre-12,800 cal yr BP.

3.4. The Russian Far East

In the Russian Far East, early pottery sites dated to the late Pleistocene to early Holocene in the Amur River Basin are concentrated in the lower Amur River basin, especially in the area where the Amur meets the Ussuri River; early pottery sites are also found in another tributary of the middle Amur River, the Zeya River (Hashizume, Shevkomud, and Uchida 2016; Kuzmin 2013; Yanshina 2017). Early pottery sites extend beyond the Russian-Chinese border (Hashizume, Shevkomud, and Uchida 2016, 12). In the Russian Far East, there are over 70 sites belonging to the earliest ceramic period, classified as the Osipovka culture (Hashizume et al. 2017). Just around the confluence of the Amur and Ussuri rivers, over 60 sites have been located (Hashizume, Shevkomud, and Uchida 2016); suggesting that about 80% of the Osipovka sites are concentrated in this region (Hashizume et al. 2017, 15). In addition to
pottery, the Osipovka culture has been characterized as having stone tools composed mainly of microblade cores (with the Yubetsu reduction method and use of small pebble and simple reduction) and varied bifaces (e.g., projectile points, arrowheads); they are accompanied by side scrapers, end scrapers, and stone axes (including partially ground-stone axes). Raw materials are in general rhyolite and shale and occasionally obsidians (Hashizume 2015; Hashizume, Shevkomud, and Uchida 2016, 12). The tendency of compressed late Pleistocene cultural layers of sites in the Amur River basin has led to a reliance on directly dating organic temper (short-lived grass, etc.) of pottery fragments (Kuzmin 2006a), but without clear corroboration from other contextual evidence or dating of other materials to check accuracy.

This section deals with six sites from the lower Amur basin: (1) Khummi (50°34′N, 137°06′E), located at the confluence of the Khummiiskaia River about 250 km north from the mouth of the Ussuri River; and, in the area where the Lower Amur and Ussuri Rivers join, (2) Gasya (48°45′N, 135°38′E) on a cliff 13–16 m above the Amur River, (3) Goncharka-1 (49°20′N, 134°55′E) on the terrace of the Amur River, (4) Novotroitskoye 10 (48°19′N, 134°51′E) on a terrace of the Amur River bank, (5) Osinovaya Rechka 12 (48°20′N, 134°54′E) on a cape-shaped edge of a cliff, 15–45 m above the present water level of the Amur River, and (6) Osinovaya Rechka 10 (48°20′N, 134°54′E) located in a similar topographic condition as Osynovaya Rechka 12 but about 20 m above the water level of the tributary of the Amur River (Buvit and Terry 2011, 385–386, 391–392;
Hashizume, Shevkomud, and Uchida 2016; Yanshina 2017; Zhushchikhovskaya 1997b). Another site, Gromatukha (51°49′N, 128°49′), is located in the middle Amur River basin on the bank of the Zeya River on a terrace 13 m above the water level (Nesterov et al. 2006, 47; Okladnikov and Derevianko 1977; Shevkomud and Yanshina 2012; Yanshina 2017) (Figure 1).

3.4.1. Gasya, Khummi, and Goncharka-1
Here I present three major sites from the Osipovka cultural complex (Kuzmin 2002; 2013; Yanshina 2017): Gasya, Khummi, and Goncharka-1.

Gasya was discovered by Okladnikov and Medvedev ([1983] 1990) between the late 1960s and early 1970s. They excavated the site in 1980, recovering a cultural layer pertaining to the Osipovka cultural complex with pottery in the lower layer (layer IV). In the 1980s, Derevianko and Medvedev (1993, in Buvit and Terry 2011) excavated a large portion of the site. Charcoal samples (n = 3) recovered from the lower layer yielded dates between 15,880-15,150 cal yr BP (Le-1781) and 12,995-12,660 cal yr BP (AA-13393) (Buvit and Terry 2011; Kuzmin 2003, 2006b; Kuzmin and Jull 1997; Kuzmin et al. 1996).

At Gasya, the pottery (a few fragments were encountered) manufacturing technique was molding or paddle and anvil technique. The pottery temper was plant fiber and sand (Kuzmin 2002; Zhushchikhovskaya 1997b). The firing temperature was low (≤400–500° C). The pottery has conchoidal form (or bucket-shaped, ca. 25–27 cm high) or an open mouth with a neck restriction (observed in Zhushchikhovskaya 1997b), with a flat base having a 1.5–1.7 cm wall thickness (Kuzmin 2002). The sherds are fragile with black (possibly reduced) paste. Decorations include partially crossed deep vertical grooves, as well as inclined and densely spaced thin grooves (Buvit and Terry 2011; Derevianko and Medvedev 1993; Kuzmin 2002; Okladnikov and Medvedev 1990 (1983); Zhushchikhovskaya 1997b). Medvedev recently allowed me to see pottery sherds from Gasya; plant fiber and sand were included in them.

The Gasya site contained points (bifacial and laurel-leaf shaped Mesolithic-like points), an ax, scrapers, blades, a knife, hammerstones, and cores (including the Gobi-type) (Okladnikov and Medvedev 1990 (1983)). Additional lithics reported later from this site were an adze (chipped and ground), knives, end scrapers, side scrapers, blades, flakes, burins, cobble tools, microblade cores (wedge-shaped and end-struck), and a figurine of a bird chipped from a silt-stone blade (Buvit and Terry 2011, 391; Derevianko and Medvedev 2006; Zhushchikhovskaya 1997b). Net sinkers were also encountered associated with the early Neolithic at Gasya (Derevianko and Medvedev 1993, 1994, 2006; Kuzmin 2002). Low-fired clay bear figurines were also found; these are suggested to represent art of the Osipovka culture (Buvit and Terry 2011, 391; Derevianko and Medvedev 2006, 128, 131–132). Okladnikov and Medvedev (1990 (1983)) reported a pit house in layer IV (a thick clay layer). In the excavation that followed, remains of two possible dwellings (3.5 × 4.5 m and 1.5 × 5.0 m) built on ground surfaces were found in association with artifacts (Buvit and Terry 2011, 391; Derevianko and Medvedev 2006).

At Khummi, pottery is found with Mesolithic stone tools (Lapshina 1995 in Zhushchikhovskaya 1997a) and classified as Initial Neolithic/Osipovka materials (Kuzmin 2006b). Radiocarbon dates on charcoal (n = 5) of late Pleistocene age range between 16,250–15,645 cal yr BP (AA-13392) (lower part of the lower layer) and 12,550–11,770 cal yr BP (middle part of the lower layer) (AA-13391); an early Holocene date of 8980–8370 cal yr BP (GIN-6945), from the upper part of the lower layer, also has been reported (Buvit and Terry 2011; Kuzmin 2006b; Zhushchikhovskaya 1997a). Kuzmin (2006b) explains the age gap as indicating long-term continuity of the Osipovka culture.

Khummi has pottery (about 20 sherds have been encountered) with sand and plant fiber temper (Kuzmin 2002; Zhushchikhovskaya 1997b). Decorations on the exterior are cross-hatch or reticular pattern, and the interior has parallel grooves impressed with a wooden tool. Vessels are conchoidal in form with a flat base, and the forming technique may have been molding in a basket (Buvit and Terry 2011; Zhushchikhovskaya 1997b, 162). The vessel wall thickness ranges between 0.7–1.0 cm (Kuzmin 2002). A re-firing test suggested a firing temperature of 600°C (Zhushchikhovskaya 1997b).

Lithics of the Khummi site that are related to the Osipovka complex include bifaces, large blades, microblade cores (wedge-shaped and end-struck), end scrapers, knives, adzes, pebble net sinkers, hammerstones, anvils, pestles, grooved tools, and stone beads and pendants (Buvit and Terry 2011, 391; Derevianko and Medvedev 2006; Zhushchikhovskaya 1997b). Lithics were found in association with a few sherds (Zhushchikhovskaya 1997b). There were two rectangular dwellings (one was semi-subterranean, 20–22 cm depth) with rounded corners containing stone-outlined hearths in the interior (Buvit and Terry 2011, 391; Derevianko and Medvedev 2006; Kuzmin 2003).

Goncharka-1 occurs within clayey loams; artifacts of the upper layers have been introduced to the lower layers through ice wedges that produce post-depositional features (Buvit and Terry 2011, 392). Ceramics and lithics were found in association with hearths in the upper
and lower layers (Shevkomud 2002, in Buvit and Terry 2011, 392). Layer 3b and the lower layer contained materials from the Osipovka complex. The radiocarbon dates on charcoal \( n = 6 \), associated with pottery of the Osipovka complex from the lower layer and layer 3b, are dated between 15,075–14,300 (LLNL-102169) and 14,105–13,745 cal yr BP (AA-25437) as well as between 12,690–12,420 (LLNL-102168) and 12,375–10,670 cal yr BP (GaK-18981) (Jull et al. 2001, in Buvit and Terry 2011; Kuzmin 2006b). Carbonized residue on pottery yielded dates of 13,360–13,090 cal yr BP (Tka-15004) and 13,090–12,805 cal yr BP (Tka-15003) (Kunikita et al. 2013).

Hundreds of sherds were found at Goncharka-1 (Kuzmin 2002). Vessel forms include a deep plate with a flat base and a somewhat open-mouthed rim but with straight walls (Buvit and Terry 2011, figure 6, after Shevkomud 2005). Firing temperatures were \( \leq 600 ^\circ C \) (Buvit and Terry 2011). Decorations are finely scratched/brushed patterns, wave-like indentations on the rims, vertical zigzag impressions, comb-like impressions, and cord-like impressions (Kuzmin 2002). Overall thickness ranges between 0.7 and 1.0 cm (Kuzmin 2002). Inclusions are sand (Buvit and Terry 2011; Kuzmin 2002). The possible uses of the ceramics \( n = 2 \) were deduced from the carbon and nitrogen isotope ratios and C/N values; the main signatures of marine resources, C\(_3\) plants, and terrestrial animals were noted (Kunikita et al. 2013, 1339). Kunikita et al. (2013) suggest that salmonids and trout came up the river to spawn despite the distance from the ocean.

At Goncharka-1, stone artifacts were found around the hearths along with ceramics, in the upper and lower layers. Lithics included flake pebble cores, microblade cores, end scrapers, pebble scrapers, scrapers, burins, dart and arrow points, and knives (Buvit and Terry 2011, 392; Shevkomud 2002). Most raw materials were obtained nearby from river edges, and a few high-quality materials (e.g., obsidian and siliceous silt stones) were transported in large blocks from remote locations. There were also edge-ground axes, net sinkers, and ground stones (Shevkomud 2002, 2005 in Buvit and Terry 2011, 392). At Goncharka-1, paleobotanical data suggest that the lower part of layer 4 and fill within the ice wedges formed under conditions of tundra grassland steppe; layer 4, between 3b and the fill within the ice wedges, had vegetation adapted for warm conditions; layer 3b was a period with a coniferous and birch forest steppe environment (Hashizume et al. 2017, 17).

### 3.4.2. Novotroitskoye 10

Novotroitskoye 10 was excavated by a Russian-Japanese team in 2003 and 2004 (Hashizume et al. 2017). Six stratigraphic layers were excavated. Below 5–10 cm of humus soil (layer 1) and a silt layer (layer 2) of 10–20 cm, the layers that contained Osipovka cultural materials were encountered. These include layer 3, a silt with dull yellowish-orange color, 10–30 cm; layer 4, a silt with yellowish-brown color, 10–20 cm; and layer 5, a sand layer < 10 cm to its base (Hashizume et al. 2017). Layer 6 had no artifacts. No clear evidence of ice wedges was observed at this site (Hashizume et al. 2017, 48–49). Novotroitskoye 10 was inferred to be a single-component site (Hashizume et al. 2017). Radiocarbon dates have been obtained on charcoal \( n = 17 \) and carbonized residue from the interior of pottery sherds \( n = 2 \) (Hashizume et al. 2017; Kunikita et al. 2013). Layer 4 yielded dates between 13,750–13,475 (Tka-13574) and 13,035–12,735 cal yr BP (Tka-13607), except for two samples yielding eleventh- to fourteenth-century dates. Layers 4–5 yielded dates of 14,125–13,760 (Tka-13610) and 13,310–13,065 cal yr BP (Tka-13611). Layer 5 yielded dates between 13,470–13,280 (Tka-13576) and 13,190–12,885 cal yr BP (Tka-13577) (Hashizume et al. 2017). Hearth 2 (unspecified but possibly from layer 3 or 4, assumed from the level, \( -1,634 \) m) yielded dates on charcoal between 13,010–12,710 (Tka-13604) and 13,220–12,860 cal yr BP (Tka-13603). The date range of carbonized residue was between 13,575–13,300 cal yr BP (TKa-15006) for layer 5 and 13,295–12,955 cal yr BP (TKa-15005) for layer 3 (Kunikita et al. 2013). Date reversals exist even after discarding the two obviously young dates, for example, between 13,190–12,885 cal yr BP for layer 5 and 13,035–12,735 cal yr BP for layer 4. These discrepancies may be due to the thin soil layers near the surface; however, the differences are not significant, and they do not differ from results of dating the carbonized residue on pottery. Therefore, the occupation of Novotroitskoye 10 seems to have occurred within a narrow time range in the late Pleistocene.

Sherds (about 80) were found in Feature 1 (upper layer 3), and layers 3, 4 and 5. The vessels seem to have been somewhat closed with vertical mouthed rim, and open-mouthed rim and a conchoidal form. The base may be flat. The manufacturing technique was coiling (Hashizume et al. 2017). Paste inclusions include sand (e.g., granite, mica, quartz, feldspar) and minor amounts of fiber impressions (burnt away?) (Hashizume et al. 2017). Decorations include comb-impressed marks and impressions with a tubular tool (Hashizume et al. 2017). Kunikita et al.’s (2013, 1339) study of the carbon and nitrogen isotope ratios on charred residue from pottery \( n = 2 \), with dates given above) indicates major signatures of marine foods, C\(_3\) plants, and terrestrial animals.
The lithics encountered at this site from 2003 and 2004 number about 351; they include points, tanged points, bifaces, partial bifaces, microblades, microblade cores, flakes, boat-shaped tools, edge-ground axes, side scrapers, end scrapers, arrowheads, flakes of secondary reduction, cores, ground stones, stone sinkers, hammers, a pebble with holes, and unworked nodules (Hashizume et al. 2017, 20). A feature similar to a pit house (4 m × 3 m × 0.6 m deep) was encountered in the upper layer 3, with its floor found on layer 6. This was noted as Feature 1. Another hearth (or more than one hearth) was found within the structure (Hashizume et al. 2017).

3.4.3. Osinovaya Rechka 10 and Osinovaya Rechka 12

Osinovaya Rechka 10 was excavated by a Japanese-Russian team in 2012 and 2013 after surveys that were conducted by Russian-Chinese (2001) and Japanese-Russian (2002 and 2005) teams (Hashizume, Shevkomud, and Uchida 2016). From the excavations of 2012 and 2013, a total of 284 artifacts were encountered. Most artifacts (except for n = 6, from layer III) were derived from layer IV (yellowish brown silt) divided into IVa (relatively darker color) and IVb (relatively lighter color). No unambiguous indications of post-depositional alterations caused by ice-wedges were observed. The site had no occupational sequence from the Holocene (Hashizume, Shevkomud, and Uchida 2016).

During early survey, Osinovaya Rechka 10 yielded a radiocarbon date of 13,050–12,240 cal yr BP (TKa-12954) on charcoal from an Osipovka context, and additional dates between 7000–6565 (TKa-12953) and 6300–5660 cal yr BP (TKa-12955) on charcoal samples (Shevkomud and Kuzmin 2009, in Hashizume, Shevkomud, and Uchida 2016). In addition to this, there are radiocarbon dates from the 2012/2013 excavation: five samples dated between 13,120–12,830 (MTC-17575) to 12,965–12,700 cal yr BP (MTC-17576) from artificial level 6 on bark (wood charcoal) and 13,120–12,830 cal yr BP (MTC-17579) to 13,090–12,800 cal yr BP (MTC-17577) from artificial level 7 on bark (Hashizume, Shevkomud, and Uchida 2016). Hashizume, Shevkomud, and Uchida (2016, 71) accept the late Pleistocene dates because, they argue, no clear Holocene artifacts have been found at Osinovaya Rechka 10 (without providing concrete examples of what those Holocene artifacts are, however).

The 2012/2013 excavation at Osinovaya Rechka 10 yielded 16 sherds assigned to the Osipovka complex. The pottery was heavily weathered, especially on one side. Decorative techniques involved comb stamping and incisions/indented lines on the surface (Hashizume, Shevkomud, and Uchida 2016). The vessel forms are unclear; there are sand inclusions along with chert and quartz.

At Osinovaya Rechka 10, the excavations from 2001 and 2002 unearthed lithics including microblades, microblade cores, arrowheads, projectile points, scrapers, drills, stone axes, and flakes. In 2012 and 2013, excavated lithics included an arrowhead, points, bifaces, microblade cores, microblades, flakes, side scrapers, end scrapers, wedges, retouched flakes, a ground stone (type unspecified), hammerstones, a net sinker, and a nodule. Microblade-related assemblage includes those associated with the Yubetsu reduction-like method (Hashizume, Shevkomud, and Uchida 2016, 47). A flake made of obsidian suggests material transported from a distant area. Net sinkers indicate fishing activity around this site (Hashizume, Shevkomud, and Uchida 2016, 53, 57).

Osinovaya Rechka 12 was excavated by a Japanese-Russian team in 2010 following a test excavation by Shevkomud in 2000 (Hashizume, Shevkomud, and Uchida 2016). There were six layers, with materials representing the Osipovka cultural complex being in layer 4 (silt with gravel inclusions, dull orange brown in color) downward to the top of layer 5 (Hashizume, Shevkomud, and Uchida 2016). Layer 5 ends at or somewhat below 1 m; no artifacts were found below layer 5. From a spatial distributional context, Hashizume, Shevkomud, and Uchida (2016) infer that stone tools (n = 306) at this site are attributable to the Osipovka cultural complex, but that ceramics (n = 15) range from Osipovka through the early Iron Age and into the medieval period. This site apparently received minor impact from the ice wedges; however, lithics have a rich encrustation of limonite and polished surface possibly caused by abrasion; this suggests that the stratigraphic layer was affected by conditions of a backswamp and floodplain (Hashizume, Shevkomud, and Uchida 2016, 28–31).

At Osinovaya Rechka 12, pottery samples (n = 2) possibly from the Osipovka context were uncovered from the lower layer (artificial level 6). They are described as being weathered and have sand inclusions with no decoration (Hashizume, Shevkomud, and Uchida 2016).

At Osinovaya Rechka 12, cores, chipped stone axes, projectile points, end scrapers, side scrapers, pebble tools, and flakes were found (Hashizume, Shevkomud, and Uchida 2016, 22). Shale used for various lithic tools were likely non-local, but minor amounts of lithics made of chalcedony probably are local (Hashizume, Shevkomud, and Uchida 2016).
3.4.4. Gromatukha

Okladnikov and Derevianko (1977) excavated Gromatukha I in the 1960s (Kuzmin 2002), and excavation was done again in 2004 by Derevianko. Although the Gromatukha site has ambiguous stratigraphic contexts (Buvit and Terry 2011; Derevianko et al. 2004), plant fiber-tempered pottery was found in the lower cultural layer (later suggested to be cultural layer 3) (Derevianko et al. 2004; Kuzmin 2002; O’Malley et al. 1999) and 12,560–12,100 cal yr BP (AA-38108) (Derevianko et al. 2004). However, there were younger pottery inclusions dated to the early Holocene, between 10,120–9480 cal yr BP (AA-38012) and 8200–8010 cal yr BP (AA-38107) (Derevianko et al. 2004). These discrepancies in pottery-inclusion dates are not clearly explained in Derevianko et al. (2004) but are instead associated with Gromatukha complex. From the excavation in 2004, charcoal samples (n = 4) from cultural layer 3 yielded AMS dates between 14,765–14,070 cal yr BP (MTC-05936) (1.3 m below surface) and 13,800–13,060 cal yr BP (SOAN-5762) (1.1–1.15 m below surface) (Nesterov et al. 2006). Kuzmin (2015), following Shewkomud and Yanshina (2012), suggests that the date most likely associated with the early pottery is 14,855–14,110 cal yr BP (MTC-05937), obtained on charcoal (Nesterov et al. 2006). Yanshina (2017) writes that Gromatukha relates to the Gromatukha culture.

At Gromatukha, several dozen ceramic sherds were excavated; the pottery had flat base, 0.7–0.8 cm (up to 1 cm) wall thickness, and grooved decorations on the exteriors and interior (Kuzmin 2002; O’Malley et al. 2006). These decorations are recently described as having vertical and parallel grooves placed on the exterior and in the interior by rolling a cord-wrapped tool (Yanshina 2017). Decorations, in addition, include zigzag lines and horizontal nail-shaped incised lines (Yanshina 2017). The manufacturing technique was suggested to be the “sandwich-technology” using double-layered slabs sandwiching a layer of plant fiber (Yanshina 2017). The firing temperature was around 470°C (Tsetlin 2010, in Kuzmin 2013). Yanshina’s (2017) slab technique sandwiching plant fibers needs more clarification. From the Initial Neolithic context (cultural layer 3) microblades, scrapers, knives, and bifaces (leaf-shaped) were found (Nesterov et al. 2006).

3.5. Transbaikal

The Transbaikal region is located on the eastern side of Lake Baikal in southeastern Siberia; this is another location where ceramics dated to the late Pleistocene are found (Buvit and Terry 2011; Tsydenova and Piezonka 2015; Tsydenova, Andreeva, and Zech 2017). At least five sites with early pottery have been reported in English language literature (Kuzmin and Vetrov 2007; Tsydenova, Andreeva, and Zech 2017). However, this area has disputed dates ranging from the late Pleistocene to the early to mid-Holocene transition (e.g., Konstantinov 2016; Konstantinov, Ekinova, and Bereshchagin 2016). Here I discuss five sites: Ust’-Karenga 12, Ust’-Kiakhta, Studenoe 1, Ust-Menza 1, and Krasnaya Gorka (Figure 1).

The Ust’-Karenga 12 site (54°28’N, 116°31’E) is on terraces adjoining the Karenga River of the Vitim River basin (Buvit and Terry 2011, 388; Kuzmin and Vetrov 2007; Tsydenova, Andreeva, and Zech 2017). Ust’-Kiakhta (53°32’N, 106°16’E) is located near the border of Mongolia on a terrace of the Selenga River (Buvit and Terry 2011, 384; Konstantinov 2001, in Buvit and Terry 2011; Kuzmin and Vetrov 2007). Studenoe 1 (50°03’N, 108°15’E) is located on the right bank of the Chikoi River on the first alluvial terrace (Buvit and Terry 2011, 388; Buvit et al. 2003). Ust’-Menza 1 (50°13’N, 108°37’E) is on the first terrace of the Menza River (Buvit and Terry 2011, 388). The Krasnaya Gorka site is located on the northern coast of Lake Bol’shoe Eravnoe (Tsydenova, Andreeva, and Zech 2017).

3.5.1. Ust’-Karenga 12

This site is one of a cluster of 16 sites encountered in the late 1970s by researchers of Irkutsk State University (Kuzmin and Vetrov 2007, 9). Ceramics, stone tools, and hearths are found in cultural layer 7 of Ust-Karenga 12. Ceramics from this cultural layer are the earliest from Ust’-Karenga. Cultural layer 7 (above 7a, 8, and 8a, of which 8 and 8a compose the uppermost cultural layer) is on the right bank of the Chikoi River on the first alluvial terrace (Buvit and Terry 2011, 388; Buvit et al. 2003). Dispersed charcoal from the cultural layer yielded dates of 14,245–13,830 (AA-60210) to 14,255–13,790 cal yr BP (AA-60202) (the layer at 1 m depth); charcoal from a hearth yielded dates of 13,285–12,930 (GIN-8066) to 12,745–12,580 cal yr BP (GIN-8067) (Vetrov 1995, in Buvit and Terry 2011); and short-lived plant fiber temper extracted from pottery yielded dates of 13,570–13,290 (AA-38101) to 12,730–12,150 cal yr BP (AA-21378) (Kuzmin and Vetrov 2007). On this basis, Kuzmin and Vetrov (2007, 12)
consider the age of the layer to be about 14,100–12,600 cal yr BP.

Pottery from Ust’-Karenga 12 has plant fiber temper. Vessel forms are parabolic with pointed bases having diameters of between 12 and 20 cm. Decorations are combed, zigzag, herringbone, and cobbled-stamped patterns (Kuzmin and Vetrov 2007, 12). Konstantinov (2016) writes that the stratigraphy from the excavation of Vetrov at Ust’-Karenga 12 may indicate that layer 7 is a humic layer from the Holocene Optimum. Kuzmin (2017b, 32) disagrees, suggesting that above-lying layer 4 is instead dated between 7930–6030 cal yr BP (6890 ± 80 14C yr BP (LE-1961) to 6100 ± 400 14C yr BP (IM-922)) (Kuzmin and Vetrov 2007, taken from Akse–Nov et al. 2000) and represents a better candidate for a Holocene Optimum layer because of its more developed humic layer (using “paleosol” for the humic layer). However, according to Kuzmin and Vetrov (2007), these dates are not from Ust’-Karenga 12 but from cultural component 4 at the Ust-Karenga 3 site.

Cultural layer 7 contained cores (wedge-shaped, prismatic, and subprismatic), burins (e.g., transverse), scrapers, knives on blades, chisels, microblades, points, and bifaces. Raw materials are mainly flint from pebbles of the Vitim and Karenga rivers (Kuzmin and Vetrov 2007, 11). Preforms of the wedge-shaped cores are biaxially chipped, probably remnants of the Yubetsu-like tradition (Vetrov 1995, in Tsydenova and Piezonka 2015).

3.5.2. Ust’-Kiakhta

The Ust’-Kiakhta site was excavated by Okladnikov in 1947, 1976, and 1978, and Tashak in the 1990s. Small amounts of pottery were uncovered with chipped stone tools and ostrich eggshell beads from cultural layer 1 (Buvit and Terry 2011; Kuzmin and Vetrov 2007). Cultural layer 1, discovered in 1978, was radiocarbon dated to 13,550–13,135 cal yr BP (SOAN-1552) (Kuzmin and Vetrov 2007) but its association with pottery has been debated (Buvit and Terry 2011; McKenzie 2009; Tsydenova and Piezonka 2015). Cultural layer 1 is reported to have plain pottery with sand (mineral particles) and crushed ostrich eggshells as temper, having thin walls, everted rims, and a maximum vessel diameter of 10 cm; exterior has some burnishing and interior has some thin line impressions (Buvit and Terry 2011; Kuzmin and Vetrov 2007; McKenzie 2009; Tsydenova and Piezonka 2015). The Ust’-Kiakhta site’s layer 1 yielded lithic wedge-shaped cores and scrapers as well as eggshell beads and bone artifacts (Aseev 2003; 37–38; Buvit and Terry 2011; Kuzmin and Vetrov 2007; in Tsydenova and Piezonka 2015, 107). According to Buvit and Terry (2011), these are from the Ust’-Kiakhta 17 site, but that pottery comes from the Ust’-Kiakhta 3 site in Tsydenova and Piezonka (2015). Other authors (e.g., Kuzmin and Orlova 2000; Kuzmin and Vetrov 2007; McKenzie 2009; Tsydenova and Piezonka 2015) use Ust’-Kiakhta without numbers, not distinguishing specific localities for the provenience of the pottery.

3.5.3. Studenoe 1

Studenoe 1 was excavated in 1998 with a total area extending to 1413 m² (Buvit et al. 2003). Archaeological materials were encountered in the alluvium of stratigraphic units IV, V, and VI, overlying colluvial unit VII (Buvit et al. 2003, 653). The Neolithic component occurred between cultural horizons 9 and 3 (within stratigraphic units VII and VI), while below this a Mesolithic component (cultural horizons 13/2 to 10a) and Paleolithic component (cultural horizons 19/4–14) occur (Buvit et al. 2003; Konstantinov 1994). The earliest pottery was found from cultural horizons 9 and 8 (within stratigraphic unit VI), with similar pottery continuing through cultural horizons 7a, 7, and 6 (Kuzmin and Vetrov 2007). The actual chronology of early pottery is debated. Is it 6500–5500 cal yr BP (Konstantinov 1994; Kuzmin and Vetrov 2007), 7000–6000 cal yr BP (Konstantinov 2016), or late Pleistocene? Cultural horizons have yielded radiocarbon ages, with 9G dated from 14,025–13,575 (TKa-15554) to 13,560–13,305 cal yr BP (MTC-16737) (Kuzmin 2017b; Razgildeeva, Kunikita, and Yanshina 2013), 8 from 13,725–13,445 (MTC-16736) to 13,545–13,275 cal yr BP (MTC-16734) (on pottery residue) (Razgildeeva, Kunikita, and Yanshina 2013), 7b to 12,855–11,265 cal yr BP (GIN-5493) (humates), 7 to 11,970–10,300 cal yr BP (GIN-5492) (humates), and 6 to 13,050–12,400 cal yr BP (GIN-4577) (charcoal) (Buvit and Terry 2011; Buvit et al. 2003; Kuzmin and Vetrov 2007).

Buvit and Terry (2011) point out the dating inconsistencies at this site, with Buvit et al. (2003) providing concrete examples. Stratigraphic unit V, containing the Paleolithic component, has very young dates of 13,275 (MTC-16736) and 13,050–12,400 (GIN-4577) (on pottery residue) (Razgildeeva, Kunikita, and Yanshina 2013), 7b to 12,855–11,265 cal yr BP (GIN-5493) (humates), 7 to 11,970–10,300 cal yr BP (GIN-5492) (humates), and 6 to 13,050–12,400 cal yr BP (GIN-4577) (charcoal) (Buvit and Terry 2011; Buvit et al. 2003; Kuzmin and Vetrov 2007).
13,470 cal yr BP (AA-33040) and using just older dates from below and younger dates from above a correct stratigraphic order can be achieved (Buvit et al. 2003, 659–660). For the overall discrepancies in stratigraphic unit VI, Buvit et al. (2003; following Konstantinov 1994) argue that in Siberia, most Neolithic components appear around 6000 cal yr BP, and that the Pleistocene dates from this layer seem anomalous. To resolve the dating issues, Buvit et al. (2003) eliminated samples taken on humates and stratigraphically inconsistent dates. As a result, most ages fit between 15,000 and 13,000 cal yr BP (Buvit et al. 2003). The explanation for the anomalies at Studenoe 1 is suggested to be due to atmospheric variations in carbon production, for example, between 15,000 and 13,800 cal yr BP, during the OD and B/A. Buvit et al. (2003, 657) suggest that unit V, with lower and middle portion having the late Upper Paleolithic materials, and unit VI, with basal and middle portions having Mesolithic artifacts and features, and its upper part, containing a Neolithic component, date to these periods. However, Buvit et al. (2003) do not explain the problem of how unit VI, the upper portion of which is the Neolithic component for the site, conventionally thought to have emerged around 6000 cal yr BP in other parts of Siberia, belongs to the years between 15,000 and 13,800 cal yr BP. In a recent report of the excavations at Studenoe 1 (Konstantinov, Ekimova, and Bereshchagin 2016, 120–121), humic layers are clearly drawn in the stratigraphic profile for cultural horizons 9, 7, 7b, and 7a. Also, Konstantinov (2016, 183), using a photo of the stratigraphic profile, reports layers 9–8 to be thick and dark in color; this tendency is pronounced in layer 9 (more so than in the site’s lower layers). He suggests that these layers 9–8 are an Early Neolithic component from the early period of climatic optimum, between 7000–6000 cal yr BP, of the Holocene.

At Studenoe 1, the earliest pottery in cultural horizons 9 and 8 (Khlobystin and Konstantinov 1996) was produced with a paddle and anvil technique, has pointed vessel bases, thin walls (0.2–0.3 cm), and string impressions as decorations (Tsetlin and Aseev 1982, in Kuzmin and Vetrov 2007).

At Studenoe 1, the Neolithic component from cultural horizons 9–3, in addition to pottery, had ground stone tools, microblades, microblade cores, scrapers, stone flakes, as well as hearths and faunal remains (Buvit et al. 2003, 666; Konstantinov 1994). Tsydenova and Piezonka (2015, 108) write that the early ceramic-containing layers (cultural layers 9–8) from Studenoe 1 have wedge-shaped cores, angular and transverse burins, blade inserts, scrapers, and choppers; they suggest the characteristic is the presence of microprismatic cores and absence of bifaces, and the unusual occurrence of bifacially prepared preforms. Tashak (2000) and Antonova (2012, cited in Tsydenova and Piezonka 2015, 106) suggest that the lithic industry at Studenoe changed from the Yubetsu-like tradition (20,000–16,000 cal yr BP) to the Selenga industry (12,000–9500 cal yr BP), but they note that Konstantinov (1994) sees that both late Paleolithic to early Neolithic complexes used wedge-shaped cores with no change in the reduction technology.

3.5.4. Ust’-Menza 1

Ust’-Menza 1 is located 50 km from Studenoe and has very similar stratigraphy to Studenoe (Buvit et al. 2003, 671). At Ust’-Menza 1, layer 8 has the earliest pottery, radiocarbon dated to 13,475–13,280 cal yr BP (MTC-16738) on carbonized residue on pottery (Razgildeeva, Kunikita, and Yanshina 2013). Konstantinov (2016), however, suggests it is derived from a layer with humic matter that developed in the Atlantic Optimum. Early pottery dates are instead suggested to be between 7000 and 6000 cal yr BP.

Tsydenova and Piezonka (2015) describe the early ceramic period (cultural layers 8–5 at Ust’-Menza) artifact assemblages of these sites together. Therefore, the general characteristics of pottery and lithics described in literature should refer to the description of Studenoe 1 above.

My own visual analysis of the ceramics (approximately n = 177) from layer 8 of Ust’-Menza 1 made at the Zabaikal State University led to a classification of six types of pastes, and technological descriptions were made on a limited number of samples by paste type: (1) pottery with low inclusion density with some coarse fragments of quartz and fine felsic rocks (hardness 1.5, layered slab construction, body thickness of 0.78–0.94 cm), (2) burnt away plant fiber temper with sand inclusions (hardness 1.5, manufacturing by layered slabs, body thickness of 0.68–0.97 cm), (3) sand with large amounts of coarse quartz and mica and exterior of sherds having rope impressions (hardness 1.5, manufacturing by layered slabs, body thickness of 0.68–0.97 cm), (4) plant fiber inclusions (hardness 1.5, manufacturing by layered slabs, thickness of 0.8–1.2 cm); (5) sand inclusions with coarse quartz and felsic mica with possible plant fiber (hardness 1.5; manufacturing by layered slabs, thickness of 0.8–1.2 cm); and (6) sand inclusions of mica and fine textured felsic rock (hardness 1.5, manufacturing by layered slabs, thickness of 0.64–1.12 cm). A synthesis of the data shows that the layer 8 materials had a relatively thin body and low Mohs hardness, but all had a similar construction method of layering slabs (Figure 8).
3.5.5. Krasnaya Gorka

The Krasnaya Gorka site was discovered and excavated by Natalia Tsydenova. Six stratigraphic layers were observed in Trench 1. Stratigraphic layer 4 contained dense artifacts (lithics and ceramics) from the Initial Neolithic period that were classified as cultural level 2 (Tsydenova, Andreeva, and Zech 2017).

Krasnaya Gorska has yielded inconsistent results in terms of radiocarbon dates (Tsydenova, Andreeva, and Zech 2017). Radiocarbon dates taken from Trench 1, level 2, from varied materials (bone, charcoal, and carbonized residue of sherds) \((n = 5)\) ranged between 14,050–13,740 (Poz-68609) and 7245–6945 cal yr BP (Poz-68594) indicating chronological inconsistencies. Despite some variation in the pottery technology, Tsydenova, Andreeva, and Zech (2017) interpret them all to represent a single period, so that some of the dates have to be incorrect (e.g., due to insufficient amount of organic residue and the compression of layers containing artifacts), and because of the similarities in the lithics and pottery with other sites in the region (e.g., Studenoe 1 and Ust’-Menza 1), they conclude that the late Paleolithic dates are the correct ones.

As indicated by Tsydenova, Andreeva, and Zech (2017), the dates require re-examination since the age discrepancy is thousands of years within the same stratigraphic layer/cultural level.

Ceramics assigned to the Initial Neolithic are characterized by coarse, brown-colored paste, with sand and plant temper (Tsydenova and Piezonka 2015). These ceramics may be thin (0.4–0.5 cm) with no decoration or with thin incisions or cord impressions. Sherds with a thickness of 0.6–0.7 cm with smoothed cord impressions were also found. Fragments of pottery with pointed bases and comb-like impressions made by cords (Tsydenova, Andreeva, and Zech 2017) range between 0.4 and

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Figure 8 A ceramic sherd from Ust’-Menza 1, cultural layer 8 and lithological layer 3. (A is the interior, B is the exterior, C is the bottom profile, viewed from the interior, taken from an angled position, and D shows a decorative pattern of densely spaced cord impression).
0.5 cm in thickness; also found were sherds with no decoration or with thin incisions, cord marks with smooth surfaces, or comb-like impressions with a thickness range of 0.6–0.7 cm (Tsydenova, Andreeva, and Zech 2017). Further information on the ceramics awaits publication to assess performance characteristics, intended functions, and variability.

Lithics encountered at this site and stratum are chipped stone tools composed of cores (micro-wedge-shaped and micro-prismatic), core preforms (orthogonal and wedge-shaped), bifaces, burin spalls, burins (including transverse), scrapers (e.g., side scrapers, end scrapers, and round-form scrapers), microblades, and blades (Tsydenova, Andreeva, and Zech 2017; Tsydenova and Piezonka 2015). It is suggested that the Krasnaya Gorka population used a Selenga-like core reduction technique (Tsydenova and Piezonka 2015).

4. Discussion

4.1. South China

In the South China context, Xianrendong has yielded the oldest radiocarbon dates for pottery vessels in the world; however, there are inconsistencies among the various publications on the site, on the data presented and their interpretations. Most importantly, scholars who took sediment samples in 2009 from the excavation profiles have not provided convincing evidence of the antiquity of pottery claimed to be as old as 20,000–19,000 cal yr BP. In addition to the potentially aberrantly old radiocarbon dates obtained in limestone caves (An 1991; Lu 2010), cave sites located close to ground level are subject to floods, precipitation of groundwater, and eolian processes that can increase the post-depositional alteration of sediments (Waters 1996). Assessing the sedimentation processes and dating of materials at such a site is difficult. Xianrendong is reported to be at the foot of a hill (Zhang 2002a). Although from English-based literature, it is difficult to know the exact height from the floodplain, the site may be more susceptible to post-depositional alteration than cave sites located at much higher levels above the floodplain. Additionally, it has been suggested recently that the use of XAD resins for collagen purification (Devièse et al. 2018), and obtaining Hydroxyproline (HYP), a single amino acid, from bone collagen (Becerra-Valdivia et al. 2018, 7001) are essential in removing contaminants and obtaining accurate radiocarbon dates of bones. Bone samples for radiocarbon dating, included in samples from South China sites can also be re-dated with these methods for comparisons. Furthermore, at Xianrendong and Diatonghuan, the timing of the appearance of domesticated rice phytoliths in association with pottery and the assumed timing of the appearance of domesticated rice in South China differ by as much as 10,000 years, in the estimation of scholars who have examined the pottery and radiocarbon dates, versus those using paleobotanical data. Therefore, this issue needs further investigation. However, the timing of the appearance of pottery and rice in its initial stage of domestication, either contemporaneous with or somewhat later than the first pottery at Yuchanyan, is less problematic, especially if the dates of 15,425–14,780 cal yr BP and 13,770–13,560 cal yr BP are used. Needless to say, though, the relations between Yuchanyan and other early pottery sites with domesticated rice need to be clarified; and, similarly, the Yuchanyan dates and other paleobotanical studies that argue for rice domestication along the Yangtze River basin beginning only after the beginning of the Holocene require further elucidation. Miaoyan also has some dating issues, too, with the age-depth reversals found in the upper layer and the younger dates being ∼17,400 and 15,800 cal yr BP. Even if these dates are 2000 years older than the real age of the earliest pottery, due to the limestone problem, pottery still would have emerged there by the B/A. In South China, overall, ceramics emerged either during the OD or B/A, depending on which radiocarbon dates we rely on that are associated with pottery; however, the real age of the first pottery may be closer to the Pleistocene/Holocene transition or even the Pre-Boreal if we consider independent ages on the appearance of (partial) domesticates that are associated with the pottery (Figure 9, Table 2).

With regards to human behaviors and residential mobility, projectile points and other stone tools (MacNeish 1999) of the Xian Ren phase were found at Xianrendong, but the composition of raw materials is unclear, i.e., stones or antlers. At Diatonghuan, while level D has microblades and level E has a grinding stone, both D and E show evidence for domesticated rice, suggesting mixed signatures of mobility. At Yuchanyan, pebble chopper tools are common. In South China, these tools seem to be common throughout the Upper Paleolithic and continue into the early Holocene; thus they do not serve as precise chronological indicators. Regardless of the dates under debate, pottery emerged in the context of reduced residential mobility (or in residence patterns that mixed with activities involving some high mobility at a site like Diatonghuan) and with broad-spectrum diet through foraging, but also around the time when (partially) domesticated rice was becoming part of the diet. The earliest pottery vessels at Xianrendong,
Diatonghuan, and Yuchanyan have sand inclusions and are constructed with slab techniques. Intra- and intersite technological variability and change of pottery, and intended and actual functions, need to be further understood.

4.2. North China

At Nanzhuangtou, Yujiagou, and Houtaomuga, radiocarbon dates seem to reconcile with the context of pottery emerging around the Pleistocene-Holocene transition. Dates associated with early pottery for the Lingjing site, however, require further tests. The date ranges are 13,040–10,780 cal yr BP at Houtaomuga, 11,500–10,700 cal yr BP at Nanzhuangtou, and 11,600 BP (pottery TL) at Yujiagou. Regarding subsistence and mobility, the Yujiagou site has microblades and slabs associated with early pottery, and freshwater fish was procured. Microblades continued to be used deep into the Holocene. Residential mobility was becoming low at Yujiagou, but foraging that required high mobility also may have continued into the Holocene. Nanzhuangtou has semi-wild millet or millet in the initial stage of domestication processed with grinding stones, and faunal exploitation tended to be broad-spectrum. Pottery was used to process freshwater fish at Houtaomuga, implying broadening of diet. But pottery data from sites with reasonable dates are scarce in

Figure 9 Time chart showing the current genomic model for peopling of Beringia and the Americas (top) and timing of pottery origins for each of the regions discussed in this paper (bottom). Note that in all cases the earliest clear evidence of pottery post-dates the timing of the dispersal of humans to Beringia. However, if the current Beringian Standstill Model based on the genomic evidence is incorrect and human dispersal to Beringia occurred after the last glacial maximum during the terminal Oldest Dryas or Bolling/Allerød interstadial, then interpretations must explain how ancestral populations with pottery became Beringians/Americans without pottery.
the English-based literature. Thus, in North China, pottery was adopted around the YD-Preboreal transition. The adoption of pottery was in the context of reducing mobility and the broadening of diet, including millet in the process of domestication; but some highly mobile foraging activities continued (Figure 9, Table 2).

4.3. Japanese Archipelago

In the northern Japanese Archipelago, in Hokkaido, radiocarbon evidence from Taisho 3 suggests that ceramics emerged between 15,000 and 13,600 cal yr BP, perhaps as early as the onset of the B/A, but more likely well into the B/A, prior to the YD. Kunikita et al. (2013) observed marine reservoir effects on pottery residue from Taisho 3. Although the pottery is relatively well preserved, the number of ceramics at Pleistocene sites is small in Hokkaido. Pottery-making may not have been common, or if it was extensive, low-fired characteristics or freeze–thaw processes may have resulted in a low visibility of sherds in the archaeological sites. The site context at Taisho 3 has no features indicative of increased sedentism. Technological variability of lithics, clearly associated with pottery, is low, with points, spatula-shaped lithics, and burins; no indication of reduced mobility is suggested from these tools (Figure 9, Table 2).

In northern Honshu, Odaiyamamoto I, has vessel residue and carbonized wood dated between 17,200 and 14,300 cal yr BP, but it also has outliers from carbonized wood dated as young as 8000–7800 cal yr BP. Radiocarbon dates obtained from sherds likely derived from the same vessel had much beyond 1000 years of difference, and the outliers can be up to 9000 years younger. Tephrochronological studies were not conducted at Odaiyamamoto I, and correlations with Chojakubo, without pottery, between their stone tools were made simply on stylistic grounds. Lithics found from this site are varied, including chipped stone axes, projectile points, scrapers, arrowheads, burins, and blades, and reduced mobility is not suggested from this assemblage. The pottery has no obvious decoration, having relatively thin walls (0.8 cm in thickness) and inclusions mainly of sand combined with some marine sediment. The manufacturing technique was suggested to be coil construction, but a more detailed study is required to determine technology and use. Although the site has some of the oldest pottery in the Japanese Archipelago, one must use caution with the oldest dates. Taking the stone tool assemblage and its chronology into consideration, pottery may have emerged as early as the OD, but also at the beginning of or during the B/A (Figure 9).

In central Honshu, Seikosanso-B has a consistent date range, 14,700–13,700 cal yr BP, obtained on pottery residue. These ceramic materials seem to have emerged during the B/A. Stone tools include edge-ground axes, tanged points, arrow points, and scrapers. Although ground stones are possibly also included in the lithic assemblage and there are features of pebble concentrations, and even though the total number of Incipient Jomon pottery is large, the absence of heavy tools and substantial features suggests the mobility of the site occupants was relatively high. The ceramics are deep bowls with sand inclusions and thin appliques, but the technology and function need to be better understood. At Gote-nyama, results obtained from layer IIc, with exclusively Incipient Jomon materials, provide the dates of 16,500–15,600 cal yr BP. Those dates are associated with the OD. A high mobility pattern can be determined from the lithics (chipped stone axes, bifacial points, end scrapers, side scrapers, flakes, and microblade-like flakes) and the absence of significant features. Pottery fragments representing deep bowls have sand inclusions, moderate thickness, and slab construction. The ceramics are only derived from two vessels, and more needs to be understood about the associated dates, technology, and use. At Kubodera-Minami, radiocarbon dates on pottery are relatively consistent between 15,200 and 14,000 cal yr BP. They are dated to around the onset of or during the B/A. However, sedimentation at this site is quite complicated and requires further evaluation. Stone tools include ground stones, edge-ground stone axes, chipped stone axes, side scrapers, and bifacial spear points. Although ground stones include relatively heavy materials, they do not seem to be heavily invested; combining these characteristics with the lack of substantial features at the site suggests that the residential mobility was relatively high. The ceramics have thin appliques, with vessel thickness ranging only 0.3–0.8 cm, sand inclusions, and relatively well-fired characteristics. These characteristics suggest that the pottery was relatively well-suited for transportation, but the pottery technology needs to go through archaeometric tests. Although dates from Miyagase include an outlier, radiocarbon-dated materials and the context concentrated within layer IX suggest the ceramics are likely dated to 16,000–15,300 cal yr BP, thus emerging during the OD. Pottery is found in low quantity and has sand and sponge-related materials as inclusions. Substantial features are missing. The lithics that are in close association with the pottery are projectile points and flakes. The lithics that are likely contemporary with the Incipient Jomon pottery also include scrapers and ground stones. The ground stones do not appear to be highly invested. This site is associated with relatively high mobility (Figure 9, Table 2).
For southern Japan, evidence for early pottery in southern Kyushu tends to be highly reliable in terms of pre-YD dates due to the repeated association with the Satsuma Tephra. However, dates within the Incipient Jomon period must be better evaluated, especially at sites that contain pottery older than 14,000 cal yr BP. At the Kiriki site, the earliest layer (Xb) with ceramics has a radiocarbon date of 16,500–16,100 cal yr BP, thus associated with the OD. While there are microblades and microblade cores from layers XIa and Xb, ground stones are also included in the lithic assemblage; these patterns are not substantially different from those of the earlier Upper Paleolithic layers XIc and XIIa. No substantial features are found from layers XIa to Xb either. Ceramic sherds are mainly tiny fragments with unknown original size. High mobility is inferred from associated materials found in layer XIa and layer Xb, which contains mixed materials from XIa. The antiquity of layer Xa, established from the radiocarbon date of 13,100–12,700 cal yr BP, suggests a period around the fall of the Sz-S Tephra. No clear evidence of microblades occurs in a reliable context from layer Xa. However, excluding microblades from layers Xa and Xb at Kiriki, neither the stone tools nor the features show notable signs of reduced mobility. Most sherds are non-decorative with sand inclusions. The quantity is low. At Nitao-Naka A-B, the earliest layer containing ceramics, VIIa, is very thin, while artifact density is extremely high in layers VII and VIII. The lithics overlapped between layers VIIa and VIIb. Although the radiocarbon date obtained is 15,700–15,200 cal yr BP, further research is necessary to obtain a secure chronology. Layer VIIia, with varied chipped stone tools and with ground stones not highly invested, suggests high mobility. The ceramics are found in low density at this lithic-dense site, and no substantial investment on firing can be inferred. Pottery may not have been commonly used and was not likely made for frequent transportation (Figure 9, Table 2).

The earliest pottery-containing occupations from the Kenshojo-Ato, Soujiyama, Mukaigakojo-Ato, and Nakao sites in mainland southern Kyushu are all found below the Sz-S Tephra. These occupations likely emerged during the B/A. At Kenshojo-Ato, radiocarbon dates range between 13,200 and 12,900/12,700 cal yr BP, right before to around the onset of the YD. Although at Kenshojo-Ato and Soujiyama, microblades and microblade core-like materials are encountered and different types of chipped stone tools are found, ground stones are variable and include large and heavy plates. Additionally, residential features include pithouses and smoking pits. The ceramics I analyzed suggest that raw materials were available in the vicinity. Occupants of these sites were likely relatively sedentary with some mixture of high mobility. At Mukaigakojo-Ato and Nakao, the chronology of stone tools is ambiguous, but little indication of substantial reduction in mobility can be inferred in the mixed assemblage. At Mukaigakojo-Ato, no feature like a smoking pit and pithouses are found, which suggests no substantial signature of increased sedentism. At Nakao, however, features include a smoking pit, which suggests some characteristics of reduced mobility and contradicts the evidence observed from the stone tools. At both sites, pottery may have been produced locally. A higher quantity of pottery is found at Nakao. Nakao is 1.7 times larger than Mukaigakojo-Ato (Iizuka et al. 2018); the former site may have been more frequently occupied or used for longer times than Mukaigakojo-Ato. Despite the lack of radiocarbon dates, the position of artifacts with linear reliefs (ryutaimon) below the Sz-S Tephra suggests dates after 14,000–13,500 cal yr BP (Table 2).

On Tanegashima, the Sankakuyama I and Onigano sites likely began to be occupied prior to 12,800 cal yr BP, in association with climatic conditions of the B/A. Although radiocarbon dates for Sankakuyama I include some outliers, and the Sz-S Tephra in layer IV exists as pockets instead of a solid continuity, the occurrence of features and artifacts mostly within layer V suggests the reliability of the inference of an occupation prior to the fall of the Sz-S Tephra, by ~14,000 to 13,500 cal yr BP. The same can be said for layer VI at Onigano. Onigano has only the Incipient Jomon component adding to the reliability of the chronology, with a similar date range of the Incipient Jomon as Sankakuyama I. At these sites, despite arrowheads at Sankakuyama I and arrowheads, scrapers, a wedge-shaped tool, and flakes at Onigano, varied ground stones, relatively heavy stone plates, and pithouses can be considered signatures of increased sedentism. Unlike other sites on mainland southern Kyushu, however, the ceramics and stone tools (Iizuka 2018; Iizuka and Izuo 2017; Iizuka et al. 2016, 2018; Iizuka et al. under review; Kagoshima Center for Buried Cultural Property 2007; Nishinoomote City Board of Education 2004) are made with locally available raw materials and with materials from outside of Tanegashima. An abrupt sea level rise occurred around 14,300 cal yr BP (Moriwaki et al. 2015), likely disconnecting Tanegashima from mainland Kyushu (Iizuka and Izuo 2017). Non-local materials suggest that they were likely transported through navigation. According to in situ paleobotanical data, while warming began prior to the Incipient Jomon period on Tanegashima, at Kenshojo-Ato in central Kyushu, evidence for warming occurs only above the Sz-S Tephra (Aira City Board of Education 2005; Iizuka and Izuo 2017; Kagoshima
<table>
<thead>
<tr>
<th>Region</th>
<th>Important sites discussed in this paper</th>
<th>Acceptable calendar dates</th>
<th>Climatic conditions (OD, B/A, YD, Preboreal, Boreal, Late Boreal, or Atlantic) based on possible calendar dates</th>
<th>Pottery technology/style</th>
<th>Lithic technologies and other tools</th>
<th>Inferred subsistence and settlement</th>
</tr>
</thead>
<tbody>
<tr>
<td>South China</td>
<td>Xianrendong, Diatonghuan, Yuchanyan, Miaoyan</td>
<td>Wide range of possibilities: 18,250–17,500 cal yr BP but possibly closer to 15,400–13,600 cal yr BP or 10,000 cal yr BP if early rice domesticates are in association</td>
<td>A wide range of possibilities: OD, Terminal OD to B/A transitions, or Preboreal</td>
<td>Vessel forms: flower pot, conical deep bowl with pointed base, rounded based bowl; manufacturing techniques: slabs and coils; wall thickness: &lt; 1 cm to 2 cm; inclusions: sand; firing: low-fired; decorations: striations, plain, notches and punctates on rims, cord-marked, etc.</td>
<td>Pebble industry, ground stones, projectile points, microblades, tongue-shaped cores, tools of shells and bones</td>
<td>Wild rice, wild and domesticated rice phytoliths, and also suggestions (just before the appearance) of wild rice and rice in the process of domestication; broad spectrum fauna; cave use</td>
</tr>
<tr>
<td>North China</td>
<td>Nanzhuangtou, Yuyiqun, Lingjing, Houtaomuga</td>
<td>13,000–10,700 cal yr BP</td>
<td>Vessel forms: flat-based deep and shallow vessels; thickness: 0.7–2.2 cm; inclusions: crushed shell and sand inclusions; firing: low fired; decorations: cord-marked, linear relief, impressions, and incisions</td>
<td>Vessel forms: deep bowls and bowls, rounded base, pointed tip; inclusions: sand; thickness: 0.5–0.9 cm; manufacturing: coil; decorations: nails, fingers, or sticks (Taisho 3)</td>
<td>Muller, slab, bone tools, microblades, handstones</td>
<td>Broad spectrum fauna including possible consumption of freshwater fish, plant food including millet in the process of domestication; pits, ditches, postholes, and burials</td>
</tr>
<tr>
<td>Hokkaido</td>
<td>Oasa-1, Taisho 3</td>
<td>&lt; 15,000 to 13,600 cal yr BP (Taisho 3)</td>
<td>Vessel forms: deep bowls and bowls, rounded base, pointed tip; inclusions: sand; thickness: 0.5–0.9 cm; manufacturing: coil; decorations: nails, fingers, or sticks (Taisho 3)</td>
<td>Vessel forms: deep bowls (rounded base and flat base); inclusions: sand, animal hair, plant fiber, marine sediments; thickness: 0.3–1.5 cm; manufacture: coil, slabs; decorations: plain, linear-reliefs; firing: low fired to relatively high fired</td>
<td>Points, spatula-shaped lithics, burin (Taisho 3)</td>
<td>Possibly broad-spectrum; aquatic resource (e.g., marine resources and anadromous fish) processing inferred from pottery residue (Taisho 3)</td>
</tr>
<tr>
<td>Northern and central Honshu</td>
<td>Odaiyamamoto I, Seikosan-no-B, Gotenryama, Kubodera-Minami, Miyagase-Kitappara (No. 10 and 11, North)</td>
<td>16,500–15,300 cal yr BP to 13,700 cal yr BP</td>
<td>Vessel forms: deep bowls (rounded base and flat base); inclusions: sand, animal hair, plant fiber, marine sediments; thickness: 0.3–1.5 cm; manufacture: coil, slabs; decorations: plain, linear-reliefs; firing: low fired to relatively high fired</td>
<td>Vessel forms: deep bowls (rounded base and flat base); inclusions: sand, animal hair, plant fiber, marine sediments; thickness: 0.3–1.5 cm; manufacture: coil, slabs; decorations: plain, linear-reliefs; firing: low fired to relatively high fired</td>
<td>Chipped stone ax, edge-ground ax, projectile points (including willow-shaped), tapered points, scrapers, side scrapers, end scrapers, arrowheads, burns, blades, microblade-like flakes, pebble tools, ground stones, hammerstones, whetstones</td>
<td>Stone aggregate; artifact concentration areas (possible association); hearths</td>
</tr>
<tr>
<td>Southern Kyushu</td>
<td>Kiriki, Nita-Naka A-B, Kenkoujo-Ato, Soujyama, Mukaiigakouj-Ato, Nakao, Sankakuyama-I, Onigano</td>
<td>16,000–15,000 cal yr BP or before 14,000 cal yr BP, and 14,000/13,500–12,800 cal yr BP</td>
<td>Terminal OD to OD-B/A transitions (?) or early B/A, and B/A</td>
<td>Before 14,000 cal yr BP: inclusions: sand; manufacturing: slabs and unclear ones; thickness: 0.3–1.1 cm; Mohs: 1–3.5; decorations: plain, probable linear relief, and probable incisions, probable indentations; 14,000/13,500-12,800 cal yr BP: vessel forms: deep bowls, bowls with raise bases, cylindrical vessels with raise bases, vessels with bases</td>
<td>Before 14,000 cal yr BP: probable associations with ceramics are microblades, microblade cores, arrowheads, scrapers, flakes, ground hammers, base stones; 14,000/13,500-12,800 cal yr BP: microblades, microblade cores, arrowheads (chipped and ground), wedge-shaped tools, points, flakes, stone axes, pebble tools, ground</td>
<td>Before 14,000 cal yr BP: probable association of pebble aggregates; artifact aggregates 14,000/13,500-12,800 cal yr BP; ground stone aggregate, stone aggregate, soil pits, smoking pits, pithouses, stone aligned hearths, game pits</td>
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<tr>
<td>Region</td>
<td>Sites/Localities</td>
<td>Chronology</td>
<td>Vessel Forms</td>
<td>Decorations</td>
<td>Points</td>
<td>Other Artifacts</td>
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<td>Russian Far East</td>
<td>Gasya, Khummi, Goncharva-1, Novotroitskoye 10, Osinovaya Rechka 10, Osinovaya Rechka 12, Gromatukha</td>
<td>16,000-15,600 cal yr BP or by 14,000 cal yr BP, continued to 9000-8000 cal yr BP</td>
<td>Vessel forms: conchoidal, open mouth with neck restriction, flat base, deep plate; wall thickness: 0.7-1.7 cm; manufacturing techniques: molding or paddle and anvil, molding in a basket, slabs; inclusions/temper: plant-fiber and sand, sand; firing temperatures: low; decorations: cross-hatch, brushed/scratched, parallel grooves, wave-like indentations, impressions (wave-like zig-zag, comb-like, cord-like, tube-like), incised lines</td>
<td>Points (bifacial, laurel-leaf shaped), projectile points, dart and arrow points, arrowheads, microblades, microblade cores (wedge-shaped and end struck), tanged points, ax, scrapers, side scrapers, end scrapers, blades, knives, end scrapers, side scrapers, blades, flakes, burins, edge-ground axes, adze, anvils, hammerstones, pestles, cobbles tools, ground stones, net sinkers, stone beads, stone pendants, and a stone zoomorphic figure, low fired clay figurines (?)</td>
<td>stones, stick-like hammerstones, stone plates, chisel-shaped stone axes, ground-stone axes, base stones, end scrapers, burins</td>
<td></td>
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<tr>
<td>Transbaikal</td>
<td>Ust'-Karestya 12, Ust-Kiahtka, Studenoe 1, Ust'-Menza 1, Krasnaya Gorka</td>
<td>A wide range of possibilities: 14,250 to 12,600 cal yr BP (radiocarbon dates); or 7000-6000 cal yr BP (stratigraphy)</td>
<td>Vessel forms: parabolic with pointed vessel bases; thickness: 0.2-1.2 cm; manufacturing techniques: paddle and anvil, layered slabs; inclusions: sand and crushed ostrich eggshells, plant fiber and sand, plant fiber, sand; Mohs hardness: 1.5; decorations: string/cord and comb-like impressions, line impressions, plain</td>
<td>Cores (wedge-shaped, prismatic, and subprismatic), bifaces, burins, scrapers, microblades, blades, choppers, knives, chisels, chipped stone tools, ground stones, flakes, ostrich eggshell beads, bone artifacts</td>
<td>Pit house (?), ground surface dwellings, hearths containing rectangular dwellings (semi-subterranean included); pottery use for C3 plant, terrestrial animal, and marine resource processing</td>
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</table>
Center for Buried Cultural Property 2006). Also, during the LGM, Tanegashima, Yakushima, and the tip of southern Kyushu were warmer than the interior of mainland southern Kyushu and not only had deciduous broad-leaf trees common in mainland Kyushu but also a warm-temperate evergreen forest (Iizuka and Izuho 2017; Miyake 2013; Miyake and Momohara 2015). It is possible that high sedentism and materials transported to the sites over inter-island contacts may be connected with warm conditions, ecotones, and separation from mainland Kyushu by the onset of the Incipient Jomon period (see also Iizuka and Izuho 2017) (Table 2).

Ceramic analysis of selected sites from southern Kyushu in this paper (Iizuka 2018; Iizuka and Izuho 2017; Iizuka et al. 2016, 2018, under review) suggests that pottery produced during 14,000/13,500–12,800 cal yr BP was mainly constructed with layered slab techniques. This may indicate either that producers prioritized the performance characteristics and ease of manufacture of the layered slab technique (Iizuka and Izuho 2017; Iizuka and Skibo 1987) or its producers shared language and manufacturing technique (Gosselain 1998; Reina and Hill 1978). Additionally, all ceramics analyzed from this time period from southern Kyushu had sand inclusions and, depending on the site, very soft to relatively soft characteristics. Although further archaeometric tests are required to verify the inclusion density and firing temperatures, the visible amounts of inclusions and softness indicate that the ceramics are not impact resistant (Skibo, Schiffer, and Reid 1989); thus they were not likely produced for frequent long-distance transportation. Nevertheless, the transportability of pottery vessels of unknown original size, made earlier, as early as the terminal OD or before 14,000 cal yr BP at Kiriki, which are relatively hard, is unclear from the tiny fragments.

To summarize, ceramic-yielding sites from Hokkaido and Honshu for the OD and the B/A have few indicators of low residential mobility (Table 2). However, it is important to note that there are rare alternative cases like the Maedakochi site in Tokyo, not included in this paper, which has presented evidence of pit-houses, pottery, and points from the Incipient Jomon period, but as yet its age has not been disclosed with absolute dates (Kaner and Taniguchi 2017; Miyazaki and Keally 1986; Tokyo Ministry of Education Cultural Program of the Lifelong Learning Department 2002). In southern Kyushu, although no signature of reduced mobility is observed prior to 14,000 cal yr BP, there are sites with Incipient Jomon pottery and signatures of increased sedentism dated to 14,000/13,500–12,800 cal yr BP both in Tanegashima and the central and the northern parts of southern Kyushu. Inter-island material transportation is expected at the Tanegashima sites if the island had been disconnected from mainland Kyushu and Yakushima by 14,300 cal yr BP (Iizuka and Izuho 2017; Moriwaki et al. 2015). The substantial use of pottery and increased degree of sedentism in southern Kyushu, occurring by 14,000/13,500 cal yr BP, may be associated with sea level rise, warm conditions, and especially, on Tanegashima, the environmental characteristic of an ecotone of the region. Similarly, the adoption of ceramics in Hokkaido also corresponds with possible sea level rise during the B/A (Igarashi and Zharov 2011).

Among the limited cases introduced in this paper, no site has yielded evidence of Pleistocene pottery prior to the YD in the Japanese Archipelago that showed inclusions predominantly composed of plant fiber temper. The characteristics of high portability, high firing temperatures, thin vessel walls, and very low inclusion density are rare (e.g., Schiffer and Skibo 1987; Skibo, Schiffer, and Reid 1989). Only Kubodera-Minami has some such characteristics. Therefore, although the original state of the first pottery at the Kiriki site in southern Kyushu needs further investigation, there was no significant signature of pottery produced for high residential mobility. Overall, however, literature-based descriptions of pottery are not sufficient for further evaluation of the technology and possible performance characteristics.

### 4.4. Russian Far East

As observed in the Khummi chronology, dates of the early ceramic sites are between 16,250–15,600 cal yr BP and 9000–8400 cal yr BP, with long continuity. At Gromatukha, although charcoal dates range between about 14,850–14,100 cal yr BP and 11,600–11,200 cal yr BP corresponding to the B/A to around the YD/Preboreal, pottery organic temper/inclusion dates ranged widely, between about 16,300–15,700 cal yr BP and 8200–8000 cal yr BP. Other sites such as Novotroitskoye 10 indicate a single component site dated to 14,100–13,800 cal yr BP and 13,000–12,700 cal yr BP and provide only late Pleistocene ages during the B/A and to the time of the B/A and YD transition (Figure 9, Table 2). Why behaviors of people during the B/A were similar to those in the early Holocene is difficult to understand from the existing information. Cultural layers tend to be compressed making the micro-scale separation of artifacts and features by time period difficult; however, future efforts in doing so should help answer this question. Also, only a limited number within more than 70 Osipovka sites are introduced in non-Russian-language publications. This perforce adds to the limitation of the contextual understanding. From current data, the early
cultural sites and contexts have mixed signatures of mobility indicated by stone tools and features. For example, at Khummi, microblade cores, pebble net sinkers, and pit-houses are encountered within narrow layers. At Goncharka I, while ground-stone use, salmonids, C3 plants, and terrestrial animal processing inferred from pottery residue suggest substantial diet-breadth and reduced mobility, microblade cores, side scrapers, and end scrapers are also in the assemblage. Additionally, at Novotroitskoye 10, mixed signatures are suggested by microblades, microblade cores, side scrapers, end scrapers, ground stones, net sinkers, and a pit-house-like feature. Overall, among the well-described archaeological examples, no site with early pottery has the evidence of use exclusively by highly mobile hunter-gatherers. Pottery emerged in the context of reducing residential mobility. With regards to early ceramics, there seems to be variability, such as in sherd density, wall thickness, and inclusion types (e.g., fiber-temper and sand, and sand inclusions). Intra-site and inter-site variability in technology and possible uses should be investigated further (Table 2).

Reasons for the reduced signatures of mobility in the Amur Basin in more northern latitudes, compared to Hokkaido and Honshu, Japan, to the southeast, from similar periods (OD and B/A), should also be investigated.

4.5. Transbaikal

Early pottery chronology associated with the Transbaikal are debated, on the one hand, between the early limit of 14,250 and 13,300/12,600 cal yr BP in the late Pleistocene (as suggested by radiocarbon dates), and, on the other hand, during the early to mid Holocene transitions between 7000 and 6000 cal yr BP (as suggested from stratigraphic contexts with rich soils) (Figure 9, Table 2). The characteristics of the Transbaikal region are that pottery is found with chipped-stone tools with microblade cores, side scrapers, burins, side scrapers, and without features of high visibility (although ground stones are reported from the Neolithic component of Studene 1). This suggests the site users practiced high-mobility behaviors. Vessel thickness and inclusions vary and need further technological studies to explore inter-site differences. Excavation reports do not solve the problem of chronology. Determining whether the sites date to the terminal Pleistocene or early-mid Holocene transition requires further tests. In north-central Mongolia, at Tolbor-15, predicted dates for early ceramics are 8500 cal yr BP, in the early Holocene (Kuzmin 2014 referring to Kuzmin 2017b; Séféridès 2004). Tolbor-15 is about 300 km southwest of the Transbaikal. The pattern of early ceramic use in this area, located not too far from the Transbaikal region, should be included for comparison.

4.6. Inter-regional comparisons

Overall in greater East and Northeast Asia, ceramics appeared in varied contexts. In South China, dates are as early as the OD, likely within the late Pleistocene, but as late as the Preboreal. Associated people were likely foragers with reduced mobility right before adopting rice domesticates or foragers-farmers who consumed semi-domesticated or domesticated rice to varying degrees. In North China, people who were becoming increasingly sedentary when they began to incorporate domesticated millet started to use pottery as well. There are also some indications of the retention of foraging subsistence that required high mobility. In the northern and central Japanese Archipelago, pottery-adopting people were highly to relatively highly mobile between the OD and B/A. In southern Kyushu, high mobility is only inferred before 14,000 cal yr BP. After 14,000/13,500 cal yr BP, southern Kyushu’s pottery users seem to have adopted relatively sedentary behaviors although site(s) with signatures of relatively high mobility also exist there. In the Russian Far East, the earliest pottery is found in the OD and B/A with mixed signatures of mobility, but there are no sites in this region that show exclusively highly mobile behaviors. In the Transbaikal, highly mobile foragers may have adopted pottery as early as the B/A but as late as the early to mid-Holocene.

Unlike the expectation in the traditional concept of the Neolithic Revolution, in the Japanese Archipelago, the Russian Far East, and the Transbaikal, so far there is no evidence of domesticated plants or animals or those in the process of human modification associated with the first pottery making. Foragers adopted pottery in these areas. In the Japanese Archipelago, pottery-using foragers were highly to relatively highly mobile. Relatively sedentary behaviors of foragers and pottery use emerged first in the southern tip of the archipelago in the B/A, while relatively high mobility continued in Honshu and Hokkaido. In the Russian Far East, foragers with a yet to be evaluated degree of mobility used pottery at the initial stage but later, by the B/A, a mixture of signals of increased sedentism and some high mobility are observed. In the Transbaikal, highly mobile foragers first used ceramics. On the other hand, in South China, there is a possibility that the earliest pottery producers had intensive interactions with plant food, right before the process of domestication, or potters were consuming both domesticated or partially domesticated rice and wild rice. They were probably relatively sedentary but also engaged in some highly mobile activities. In North
China, while there is evidence of some high mobility and foraging, the site of Nanzhuangtou, for example, has evidence of consumption of semi-wild millet or millet in the early stage of domestication. Therefore, in North China, overall, people were in the process of becoming relatively sedentary and were beginning to domesticate plant food when they adopted ceramics, and similar to the early concept of the Neolithic Revolution, it occurred at the Pleistocene–Holocene transition.

5. Conclusions: Early pottery in East Asia and the origins of the first Americans

A main objective of this essay has been to consider the origins of pottery in East Asia in the context of the peopling of Beringia and the Americas. After all, genomic and archaeological models have consistently suggested that the origins of ancient Native Americans can be found in this area, somewhere between the Lake Baikal region of Siberia and the Japanese archipelago. Current models based primarily on ancient-genomic evidence indicate the process of the peopling of the Americas began as early as 23,000–20,000 cal yr BP (Graf and Buvit 2017; Raghavan et al. 2015). Between 22,000–18,100 cal yr BP (Moreno-Mayar et al. 2018), the Beringian population was isolated, being marked chiefly by a “standstill” of human populations in the Beringian region, during which the distinctive genetic signature of Native American population emerged. This process continued for the next 5000–10,000 years (Graf and Buvit 2017; Raghavan et al. 2015), until around 15,000 cal yr BP (Goebel, Waters, and O’Rourke 2008; Moreno-Mayer et al. 2018) or even 13,000 cal yr BP (Graf and Buvit 2017; Raghavan et al. 2015). After the standstill, human populations further expanded southward to temperate North America and beyond by about 15,000–14,000 cal yr BP (Waters et al. 2018).

An alternative scenario combining genetic (Adachi et al. 2011), paleoenvironmental (Igarashi 2016), and archaeological evidence (Izuho 2013; Kuzmin 2017a) predicts that the peopling of the Americas actually began as interior Siberians migrated to PSHK during the LGM, and that the genetic standstill occurred there instead of in Beringia (Buvit and Terry 2016). During a cold snap (Igarashi 2016) in PSHK around 14,000 cal yr BP, humans rapidly migrated to Beringia. Overall, though, the current models all suggest that the major Asian contribution to the first Americans came from somewhere in greater East Asia, while a minor contribution came from central Siberia (Graf and Buvit 2017). Given this context, what are the possible relations of the early pottery producers of East and Northeast Asia to the first people who migrated to the Americas in the late Pleistocene? And what are the implications of the early emergence of pottery in these regions?

In South China, when the first pottery vessels appeared alternatively during the ~17,500 cal yr BP (OD), 15,400–13,600 cal yr BP (OD to B/A), or 10,000–9000 cal yr BP (Preboreal to early Boreal) periods, people were likely in the transition stage between mobile to sedentary lifestyles (Figure 9). This occurred in the context of broadening diet with the consumption of a variety of mid- to small-sized wild fauna and of wild rice or both wild and (partially) domesticated rice. Occasional high mobility may have also existed. Although there is evidence for fish and shellfish (likely from freshwater settings) consumption, these subsistence and mobility patterns associated with pottery do not match the patterns found in the context of the first Americans. As far as we know now, South China’s early pottery users were not adapted to the seacoast and were not targeting large-bodied fauna with high return rates. Thus, if pottery did develop as early as currently suggested by some researchers working in South China, this setting would not have been conducive to the origins of the the first Americans, technologically or behaviorally.

In North China, people began using pottery at the Pleistocene–Holocene transition, about 13,000–10,700 cal yr BP. Considering the projected dates implied by the genomic model, this is too late to be relevant to the late Pleistocene peopling of Beringia and the Americas. Moreover, the origins of pottery in North China occurred in a transitional-to-agriculture setting, with sedentism being mixed with foraging activities that required some mobility, none expected to have given rise to the mobile big-game hunting character of the first Beringians. Thus, if the first Beringians emerged from a North China setting, they would have done so some millennia earlier than the emergence of pottery technology in the region.

In the Russian Far East, the earliest evidence of pottery use appears to date to the terminal OD, about 16,000–15,600 cal yr BP. However, distinguishing between OD and B/A dates with associated artifacts within the same sites such as Khummi is difficult. Mixed signatures of high mobility (e.g., large blades, bifaces, and end scrapers) and reduced mobility (e.g., semi-subterranean dwelling and net sinkers) are found. If there were signatures of decreasing mobility by the OD, pottery users from the Russian Far East may not have migrated to Beringia and the Americas. The same can be said regarding the evidence from the B/A. Simply put, if the process of the peopling of the Americas began in the Russian Far East region, the current archaeological evidence implies that this event had to have occurred before 16,000 cal yr BP (Figure 9).
In the Transbaikal, high mobility is associated with the first pottery producers. However, no ceramics were made prior to the B/A, before 14,300 cal yr BP; therefore, pottery makers from Transbaikal were too late to be ancestral to the first people who migrated to Beringia and the Americas before 15,000 cal yr BP (Figure 9). However, there is a possibility that highly mobile foragers with ceramics who used late Upper Paleolithic-like chipped stone tools, microblades, and blades migrated from this area to Beringia during the B/A, prior to 13,600/13,500 cal yr BP, becoming the ancestors of the Clovis people. Only the verification of the timing of the adoption of pottery in combination with genetic and paleoenvironmental evidence will determine whether these people during this period of pottery production contributed to human migration to the New World.

The current late migration model from PSHK excludes the B/A of the Transbaikal from the picture.

In the Japanese Archipelago, the earliest possible adoption of ceramics occurred between 16,500 and 15,300 cal yr BP during the mid to terminal OD in Paleo-Honshu (and probably also in Kyushu between 16,000 and 15,000 cal yr BP). Pottery adoption must have occurred securely by 15,300 cal yr BP (Figure 9). Of course, the parsimonious inference to this fact – that the presence of a culture (the Incipient Jomon or a period between the Upper Paleolithic and the Incipient Jomon of the B/A) with distinctive pottery technologies had emerged by 15,300 cal yr BP – is that a dispersal out of Japan to Beringia had to have occurred before this time, during the Upper Paleolithic. However, we should not simply rule out the possibility that Japan’s first pottery producers could have been the source population for the first Beringians and Americans. After all, in both Paleo-Honshu and Kyushu, early pottery users were highly mobile foragers. Despite this possibility, however, none of the early pottery-using people from north to south of the Japanese Archipelago presented in this paper were hunters of megafauna and ecologically associated species. Naumann’s elephants (P. naumanni) and associated species had disappeared from Paleo-Honshu Island between 30,000 and 23,000 cal yr BP; the woolly mammoth (M. primigenius) and associated species were gone from Paleo-Hokkaido through extinction or northward migration when warmer conditions emerged by the beginning of the OD (Iwase et al. 2012, 2015; Sato 2015). If pottery producers also migrated north from Paleo-Honshu (and probably Kyushu) during the mid to terminal OD, either via the coast by boat or partly through land, the reason must not have been due to the disappearance of the above-mentioned species. Additionally, there is little evidence from Paleo-Honshu (and probably Kyushu) that pottery users from the OD were consumers of marine resources, coastaly adapted, or skillful navigators. The only exception to this pattern is the continuous obsidian circulation found between the small island of Kozushima and the Pacific side of mainland central Honshu from the Upper Paleolithic to Middle Jomon period (e.g., Barnes 2015; Ikeya 2015; Oda 2015). If the coast was used for migration to Beringia and the Americas, there is little evidence from Japan to demonstrate it.

The main problem with the idea that early pottery producers from Paleo-Honshu (and probably Kyushu) migrated to the Americas is that no pottery has been recorded in the Americas in a Pleistocene context. Of course, this can be due to the low visibility of pottery vessels. Pottery vessels may not have been produced in large quantity, and they likely were not fired at high temperatures. Freeze–thaw processes in northern environments during the Pleistocene may have destroyed early ceramics. From sites introduced in this paper, signs of relatively well-fired pottery are uncommon from the OD and B/A in Honshu or Kyushu. Another possibility is that the mobile foragers from Paleo-Honshu (and probably Kyushu) could have abandoned ceramic use in response to northward migration. Dispersing to Beringia, they would have encountered large-bodied fauna providing high returns as well as other resources not known to them in Japan. Therefore, pottery users could have changed their technological and subsistence practices by the time they reached the Americas.

Is human migration, either by land or coast during the B/A, immediately prior to the emergence of Clovis groups in the Americas, a possibility? In Hokkaido, pottery-using people during the B/A were likely mobile foragers who had some diet breadth and processed marine resources and anadromous fish in pots (Craig et al. 2013; Kunikita et al. 2013). Contra Buvit et al. (2016), however, there is no evidence to suggest that Jomon people of Hokkaido were numerous enough for population pressure to have incited a northward migration of microblade using, Upper Paleolithic hunter-gatherers. Further, suggestions of a favorable environment in Kamchatka after the onset of the Bølling (Razjigaeva et al. 2011), and the extremely cold and arid condition experienced in the north-central zone of Hokkaido between 17,000 and 13,000 BP (Igarashi and Zharov 2011, 26) or 14,000 and 13,000 cal yr BP (Igarashi 2016) is insufficient to explain why, then, the pottery using foragers around this period also did not migrate north. The evidence from Honshu suggests high mobility continued into the B/A at pottery-yielding sites. In southern Kyushu, people may have been mobile during the initial B/A;
however, by 14,000/13,500 cal yr BP, indicators of increased sedentism are clear. There are possibilities of people with pottery migrating to the Americas during the B/A from Hokkaido and Honshu. However, as no megafauna and associated species existed in the Japanese Archipelago during the B/A, significant subsistence change would have had to have occurred for these people to eventually evolve behaviorally into Clovis hunters. In this case, the causality of migration needs to be investigated. The paleoenvironment became warmer with a consequent, sea level rise in Sakhalin, Habomai (Igarashi and Zharov 2011), and southern Kyushu (Moriwaki et al. 2015) during the B/A, which in southern Kyushu likely led to the disconnection of mainland Kyushu from Tanegashima. Therefore, sea level rise around the chain of islands of the Japanese Archipelago and change in human behaviors during the B/A should be discussed by region, as one among the various possible causalities.

With regards to oceanic adaptation, there is possible evidence of inter-island navigation of pottery users by 14,000/13,500 cal yr BP on Tanegashima. However, by this period, occupants of Tanegashima were hunter-gatherers with increased sedentism. They were also adapted to warmer conditions than people of, for example, Hokkaido. Rapid migration north to the Americas either by land or through coastal hopping would not be expected in such a context.

Incorporating all of these possibilities, three alternative hypotheses can be proposed concerning the relations between the Pleistocene pottery-makers of greater East and Northeast Asia and the first people without pottery in the Americas.

(1) Pleistocene pottery-producers from East and Northeast Asia were not the people who migrated to the Americas. Instead, the dispersal out of mainland Asia to Beringia must have occurred before 15,000 cal yr BP, originating from a preceramic or non-ceramic producing area (e.g., among groups that did not adopt the technology within the area where pottery making existed). Thus, unequivocally establishing the timing of the development of pottery technology in East and Northeast Asia provides an upper-limiting (i.e., ending) date for the beginning of the American dispersal out of Asia, and currently this date appears to be 18,250 or 10,000 cal yr BP for South China, 13,000 cal yr BP for North China, 16,000 cal yr BP for Kyushu, 16,500 cal yr BP for Honshu, 15,000 cal yr BP for Hokkaido, 16,200 cal yr BP for the Russian Far East, and 14,250 or 7000 cal yr BP for Transbaikal. These ages are younger than the time range of the most recent genetic-based migration model, 23,000–20,000 cal yr BP (discussed by Graf and Buvit 2017; Raghavan et al. 2015), with gene flow from Asia ending by 20,000 cal yr BP and divergence between Asians and Beringians occurring between 22,000 and 18,100 cal yr BP (Moreno-Mayar et al. 2018) (see Figure 9).

(2) The first Americans who began arriving to the Americas after 15,000 cal yr BP (Goebel, Waters, and O’Rourke 2008) may have been pottery-producing people who dispersed from paleo-Honshu (and probably Kyushu) of the Japanese Archipelago between 16,500 and 15,000 cal yr BP. In this model, pottery production was abandoned due to subsistence and behavioral changes during adaptation to more northern environments where not just a broad spectrum of food but also megafauna and related species existed; or pottery making continued as people (currently categorized as the Incipient Jomon people) dispersed northward, with the lack of ceramics being a product of archaeological invisibility.

(3) Pottery producers from Hokkaido and/or Honshu migrated towards Beringia during the B/A, after 15,000 cal yr BP. This fits with the PSHK standstill model (Buvit and Terry 2016). In addition to the cold snap hypothesis, a rise in sea level during the B/A could have been among the causes of such a migration, as ceramics-makers, especially in Hokkaido and/or Honshu where high mobility continued, found themselves increasingly deprived of formerly accessible resources and habitats, important places, and other human groups with whom they communicated, in a shrinking and disconnected terrestrial landscape.

Finally, due to chronological problems of early ceramic sites in greater East and Northeast Asia discussed in this paper, at this stage, it is nearly impossible to answer where exactly pottery first originated or to evaluate whether the technology emerged and spread from cultural contacts among different peoples. However, certain areas and sites have better chronological control than others. For example, in southern Kyushu of Japan, due to the Satsuma Tephra and additional radiocarbon dates, early pottery sites unequivocally occupied between 14,000/13,500 and 12,800 cal yr BP can be discussed in terms of early ceramic production and circulation, technology, and possible intended uses. At these sites, whether knowledge of pottery production was adopted from elsewhere or invented earlier in situ, the invention or re-invention processes by producers who responded to local conditions and needs can still be investigated (e.g., Schiffer 2011, 2013). Also, the study
of inter-regional pottery circulation between sites in southern Kyushu and outside of it is possible, if there are such well-established associated dates and technology in these other regions. At places that do not have such a firm chronology, at least degrees of variability in pottery technology per site can be measured. Additionally, in areas where chronology is not reliable, field-based re-evaluation of site contexts can be made, and if traditional dating methods do not work, new techniques can be explored. Step by step, continued research will allow more accurate comparisons of early ceramic sites and regions in the future. This approach will also make it possible to evaluate and compare the emergence contexts between Greater East and Northeast Asia and other regions of Eurasia, Africa, and beyond.

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