RADIOCARBON CHRONOLOGY OF THE EARLIEST NEOLITHIC SITES IN EAST ASIA

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ABSTRACT. The radiocarbon age of the earliest pottery from Russian Far East—Gromatukha and Osipovka cultures—is between around 13,300 BP and around 10,400 BP. This shows that the Amur River basin was one of the centers of origin of pottery in East Asia, at the end of the Pleistocene. Today, there are three areas within East Asia with pottery-associated ^{14}C dates between around 14,000 BP and 13,000 BP—southern China, the Japanese Isles, and Russian Far East.

INTRODUCTION

The aim of this paper is to provide an updated overview of the radiocarbon chronology for the earliest Neolithic cultures in the Old World at the end of the Pleistocene, 14,000–10,000 BP. The term "Neolithic" refers to sites with the presence of well-developed pottery (cf. Chard 1974). The primary focus is the ^{14}C dating of the sites with the oldest pottery from the Russian Far East and their chronological correlation with the rest of East Asia.

The origins of pottery are one of the key problems in world archaeology. According to recent views, the "cradle" of pottery is located in East Asia. Within this region, the earliest pottery prior to the 1980s was found and ^{14}C-dated in Japan to around 12,700–12,200 BP (cf. Morlan 1967; Barnes 1993; Aikens 1995; Aikens and Akazawa 1996). Since the 1980s, Pleistocene-age pottery has been discovered in southern China (Chang 1986, 1992) and the Russian Far East (Okladnikov and Medvedev 1983).

BACKGROUND AND SIGNIFICANCE

The emergence of pottery was associated with changes in economy from mostly hunter-gatherer nomadic subsistence to more settled lifestyles with the emergence or further development of fishing, and the beginning of agriculture. However, in East Asia the human-environment interaction in the terminal Pleistocene and Early-Middle Holocene, around 15,000–6000 BP, was very complex. For example, dry land agriculture was developed in northern East Asia from around 8000–7000 BP, much later compared with the beginning of pottery making (Kuzmin et al. 1998a).

Another very important problem is the timing of the emergence of pottery in different parts of East Asia. The first findings of Paleolithic-Neolithic transitional sites at Fukui and Kamikuroiwa in southern Japan and their ^{14}C dating in the late 1950s and early 1960s allowed for proposal of this part of East Asia as the territory of pottery origins, dating back to about 13,000–12,000 BP (see reviews in Morlan 1967; Aikens and Higuchi 1982). Later, more ^{14}C dates older than 10,000 BP were obtained from the Incipient Jomon sites in Japan, for example, Iwashita Cave, 11,300 ± 130 BP (SI-503) (Keally and Muto 1982); and the Juno site, 11,270 ± 230 (GaK-10669)—10,520 ± 290 BP (GaK-9996) (Kobayashi 1994).

Significant progress was achieved in the last 15–20 years in the ^{14}C dating of the earliest Neolithic cultures in China (Chang 1986, 1992; Nelson 1995), Korea (Nelson 1993), and the Russian Far East (Kuzmin 1996, 1998a; Kuzmin et al. 1994, 1997). In the 1970s and early 1980s, several Incipient

Neolithic sites excavated in southern China and the Russian Far East were dated by ^{14}C earlier than 10,000 BP: Bazitou, 10,735 ± 200 BP (ZK-842); Zengpiyan, 11,310 ± 180 BP (ZK-279-1); and Gasya, 12,960 ± 120 BP (LE-1781) (Chang 1986, 1992; Okladnikov and Medvedev 1983).

In the 1990s, the number of Incipient Neolithic sites in East Asia outside the Japanese Islands increased even more, and some of sites have ^{14}C dates associated with pottery older than 11,000 BP, for example, Miaoyan, 13,710 ± 270 BP (BA92034-1) (Yuan et al. 1995); Khummi, 13,260 ± 100 BP (AA-13392) (Kuzmin et al. 1997); Goncharka 1, 12,500 ± 60 BP (LLNL-102169) (Shevkomud 1997); and Ust'-Karenga, 11,240 ± 180 BP (GIN-8066) (Vetrov 1995). The 1993 excavation results of the Xianrendong site in Jiangxi Province, South China, yielded the tentative pottery-associated ^{14}C determination of 14,610 ± 290 BP (BA-93181) (MacNeish and Libby 1995). The accelerator mass spectrometry (AMS) ^{14}C dating of food residues on the earliest pottery from the Odai Yamamoto 1 site, in the Tohoku region in Japan (Taniguchi 1999), revealed an average value of around 13,100 BP calculated using the approach proposed by Long and Rippeteau (1974). Today, we have more than 30 ^{14}C dates older than 10,000 BP, made on charcoal associated with the earliest pottery in East Asia (Table 1, with dates given for ^{14}C half-life equal to 5568 yr; Figure 1).

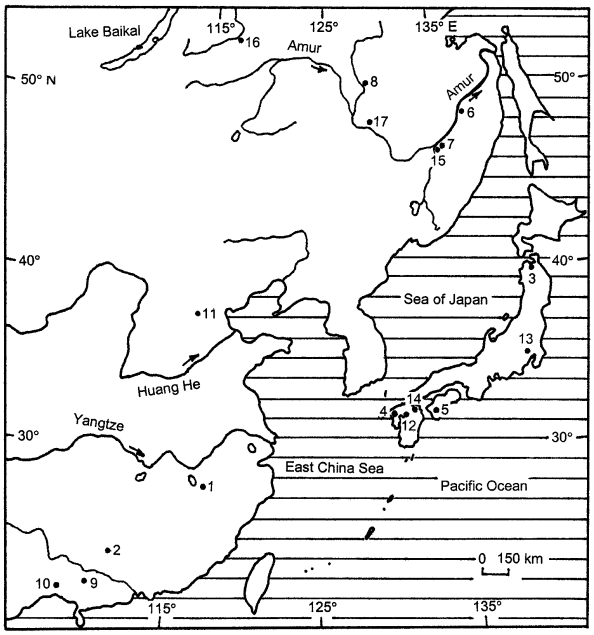

Figure 1 The location of the earliest ^{14}C-dated Neolithic sites in East Asia: 1–Xianrendong; 2–Miaoyan; 3–Odai Yamamoto 1; 4–Fukui Cave; 5–Kamikuroiwa; 6–Khummi; 7–Gasya; 8–Gromatukha; 9–Zengpiyan; 10–Bazitou; 11–Nanzhuantou; 12–Iwashita Cave; 13–Juno; 14–Jobutsu; 15–Goncharka 1; 16–Ust'-Karenga; 17–Novopetrovka.

Nevertheless, the problem of validating the stratigraphic association of the charcoal and the pottery remains. At most of the earliest Neolithic sites in East Asia, we have a compression of cultural materials of different stages in one layer (cf. Kuzmin et al. 1997, 1999). Thus, the direct ^{14}C dating of pottery is crucial for the construction of reliable chronology of the earliest Neolithic cultures in East

Table 1 ^{14}C dates associated with the earliest pottery in East Asia (spring 2000)

Site, layer	^{14}C date BP	Lab nr.	Material	Reference
A. The earliest ^{14}C dates				
Southern China				
Xianrendong, zone 2B1	14,185 ± 290	BA-93181	Charcoal	MacNeish, Libby 1995
Miaoyan, layer 4M	13,310 ± 270	BA-92034-1	Charcoal	Yuan et al. 1995
Japanese Isles				
Odai Yamamoto 1, I.4	13,780 ± 170	NUTA-6510	Food adhesion	Taniguchi 1999
Odai Yamamoto 1, I.4 (top)	12,680 ± 140	NUTA-6506	Food adhesion	Taniguchi 1999
Average of two	13,050 ± 108			
Odai Yamamoto 1, I.3	13,480 ± 70	Beta-125550	Charred wood	Taniguchi 1999
Odai Yamamoto 1, I.3	13,210 ± 160	NUTA-6515	Food adhesion	Taniguchi 1999
Odai Yamamoto 1, I.3 (lower)	13,030 ± 170	NUTA-6507	Food adhesion	Taniguchi 1999
Odai Yamamoto 1, I.3 (bottom)	12,720 ± 160	NUTA-6509	Food adhesion	Taniguchi 1999
Average of four	13,170 ± 56			
Fukui Cave, layer 3	12,700 ± 500	GaK-950	Charred wood	Morlan 1967
Fukui Cave, layer 2	12,400 ± 350	GaK-949	Charcoal	Morlan 1967
Kamikuroiwa, layer 9	12,165 ± 600	I-944	Charcoal	Morlan 1967
Russian Far East				
Khummi, lower layer	13,260 ± 100	AA-13392	Charcoal	Kuzmin et al. 1997
Khummi, lower layer	10,345 ± 110	AA-13391	Charcoal	Kuzmin et al. 1997
Gasya, lower layer	12,960 ± 120	LE-1781	Charcoal	Kuzmin et al. 1997
Gasya, lower layer	11,340 ± 60	GEO-1413	Charcoal	Kajiwara 1998
Gasya, lower layer	10,875 ± 90	AA-13393	Charcoal	Kuzmin et al. 1997
Gromatukha, lower layer	13,310 ± 110	AA-20940	Organic temper	O'Malley et al. 1999
Gromatukha, lower layer	13,240 ± 85	AA-20939	Organic temper	O'Malley et al. 1999
Gromatukha, lower layer	12,340 ± 60	AA-36079	Charcoal	This paper
B. ^{14}C dates between around 12,00 BP and around 10,000 BP				
China				
Zengpiyan, layer 3	10,980 ± 180	ZK-279-1	Freshwater shell	Chang 1992
Bazitou	10,425 ± 200	ZK-842	Freshwater shell	Chang 1992

Table 1 ^{14}C dates associated with the earliest pottery in East Asia (spring 2000) (*Continued*)

Site, layer	^{14}C date BP	Lab nr.	Material	Reference
Nanzhuantou, layer 6	10,500 ± 140	BK-87088	Silt	Zhou et al. 1992
Nanzhuantou, layer 6	10,205 ± 110	BK-87075	Charcoal	Zhou et al. 1992
Japanese Isles				
Iwashita Cave, layer 9	11,300 ± 130	SI-503	Charcoal	Keally, Muto 1982
Juno	11,270 ± 170	I-12229	Wood	Saitama 1984
Juno	11,270 ± 230	GaK-10669	Wood	Saitama 1984
Juno	10,520 ± 290	GaK-9996	Wood	Saitama 1984
Jobutsu, layer V2	10,240 ± 200	GaK-4399	Marine shell	Keally, Muto 1982
Russian Far East				
Goncharka 1	12,500 ± 60	LLNL-102169	Charcoal	Shevkomud 1997
Goncharka 1	12,055 ± 75	AA-25437	Charcoal	Kuzmin 1998
Goncharka 1, layer 3B	9,890 ± 230	GaK-18981	Charcoal	Shevkomud 1997
Gromatukha, lower layer	9,895 ± 50	AA-36447	Charcoal	This paper
Novopetrovka	9,765 ± 70	AA-20937	Organic temper	O'Malley et al. 1999
Transbaikal				
Ust'-Karenga, layer 7	11,240 ± 180	GIN-8066	Charcoal	Vetrov 1995
Ust'-Karenga, layer 7	11,065 ± 70	AA-38101	Organic temper	This paper

Asia. During the last decade, we conducted an extensive geoarchaeological study of the Paleolithic and Neolithic cultures in the Russian Far East (Kuzmin 1994, 1996, 1997, 1998a, 1998b; Kuzmin et al. 1994, 1997, 1998b; Kuzmin and Jull 1997; Jull et al. 1994, 1998, etc.). In 1996, we began direct ^{14}C AMS dating of pottery from the Russian Far East at the NSF-Arizona AMS Facility, University of Arizona, USA.

MATERIALS AND METHODS

For study of the ^{14}C chronology of the earliest Neolithic cultures, we choose several sites in the Russian Far East, in the Amur River basin. They belong to the Osipovka, Gromatukha, and Novopetrovka cultures, and their ages were provisionally estimated as around 13,000 BP (Osipovka), around 11,000 BP (Gromatukha), and around 9000 BP (Novopetrovka) (cf. Derevianko and Medvedev 1995; Derevianko and Petrin 1995). The stone and pottery assemblages of both Osipovka and Gromatukha cultures are quite similar, but stone tools (with abundant blades) and pottery from the Novopetrovka culture are quite different from Osipovka and Gromatukha ones (Derevianko 1970; Okladnikov and Derevianko 1977). Thus, both Osipovka and Gromatukha cultures seem to represent the initial stage of the Neolithic on the Russian Far East, and the Novopetrovka cultures might be associated with early stage of the Neolithic.

Although there are charcoal ^{14}C dates for the Osipovka culture (Kuzmin et al. 1997), few charcoal and bone samples were collected during the excavations of the Gromatukha and Novopetrovka cultures in the 1960s–1970s (Derevianko 1970; Okladnikov and Derevianko 1977), and they were not

dated until 2000. Thus, one of the ways to make reliable age determinations for these cultures is to date by the ^{14}C AMS technique the pottery, which is plant-fiber-tempered (by blades of sedge, *Carex* sp.). The most reliable technique to extract the carbon from plant-fiber-tempered pottery, in our opinion, is the low-temperature combustion (at ca. 400 °C) of the interior part of sherds in an oxygen-enriched atmosphere (O'Malley et al. 1999).

RESULTS AND DISCUSSION

The ^{14}C ages of organic-tempered pottery from the Russian Far East were determined for carbon from the plant fiber, with $\delta^{13}C$ values between –28.6‰ and –24.9‰, typical for plants with C_3 type photosynthesis. The age of organic-tempered pottery from Gromatukha, the type-site of the same culture, is around 13,300–13,200 BP. The value of around 10,400 BP was obtained for the Gromatukha-type pottery excavated from the Novopetrovka site. The age of typical Novopetrovka pottery from the same site is significantly younger than majority of the Gromatukha dates, with ^{14}C value of around 9800 BP (Jull et al. 1998; O'Malley et al. 1999).

Thus, we now have strong evidence of very early pottery manufacture in the Russian Far East, in both the middle and the lower parts of the Amur River basin. The Osipovka and Gromatukha cultures represent the earliest Neolithic complexes in the whole region, including the Russian Far East, Northeast China (or Manchuria), and the Korean peninsula. The pottery vessels have flat bases, thick walls (up to 1 cm), and very primitive decoration represented by vertical grooves (Okladnikov and Derevianko 1977; Medvedev 1993; Kuzmin and Orlova 2000).

The compression of the earliest Neolithic cultural materials, corresponding to different occupation phases, within one lithological layer on the Gasya and Khummi sites does not allow us to calculate the average age of the Osipovka complex. On the other hand, it is clear that the ^{14}C age of Osipovka culture of around 13,300–10,400 BP is correct. Direct ^{14}C AMS dating of organic temper support this conclusion. For the Gasya and the Khummi sites, the ages are between around 11,400 BP and 11,900 BP (Jull et al. 1998; O'Malley et al. 1999), respectively. This is supported also by tentative thermoluminescence dating of the Gasya site pottery (Kuzmin et al. 2001).

According to recent information about the earliest ^{14}C-dated Neolithic sites (Table 1), pottery originated almost simultaneously, around 14,000–13,000 BP, in different areas within East Asia. In southern China, south of the Yangtze River, the earliest Neolithic sites are dated to around 14,200–13,300 BP. In Japan, the earliest Incipient Jomon is represented by three complexes, Fukui Cave, around 12,700 BP, on Kyushu Island; Kamikuroiwa, around 12,200 BP, on Shikoku Island; and Odai Yamamoto 1, northern part of Honshu Island, with an average age of around 13,100–13,200 BP. In the Russian Far East, the earliest Neolithic in the Amur River basin may be dated now to around 13,300 BP. There are no similarities between ceramic assemblages from early centers of pottery manufacture in East Asia; thus, most probably the pottery was invented in these three centers independently of one another.

After around 13,000 BP, pottery-making technology spread over all of East Asia, including North China (Nanzhuantou site, south of Beijing); Eastern Siberia, the Vitim River basin (Ust'-Karenga site); the Russian Far East; and the Japanese Islands (Table 1). No pre-7100 BP pottery has been found so far on the Korean peninsula (cf. Nelson 1993), and the routes of possible pottery expansion are not clear yet.

CONCLUSION

The updated situation with the ^{14}C age of the earliest Neolithic cultures in East Asia shows clearly that this region is the earliest in the world in terms of pottery-making technology. Chronological data along with archaeological evidence led us to the conclusion that pottery originated independently in different areas within East Asia, such as southern China, the Japanese Islands, and the Russian Far East. It is now clear that a multi-centered model should replace the long-accepted model, with a single center of pottery origin in southern Japan. The age estimate for the beginning of pottery manufacture in East Asia and in the world is around 14,000–13,000 BP.

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