

# The Advent and Spread of Early Pottery in East Asia: New Dates and New Considerations for the World's Earliest Ceramic Vessels

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## ABSTRACT

*This paper discusses recent data from North and South China, Japan, and the Russian Far East and eastern Siberia on the dating and function of early pottery during the Late Pleistocene period and shows how reconsiderations are needed for the patterns and reasons for its emergence and spread. Early pottery typically appears in contexts that, except for containing small amounts of pottery, are otherwise similar to Late Paleolithic sites. There is also no evidence of plant cultivation, so clearly in eastern Asia, the old view of pottery's emergence or dispersal as only coming within agricultural societies is no longer viable. Greater consideration needs to be given to the invention and spread of pottery in hunter-gatherer societies.*

*This paper first reviews recent finds of early pottery sites in South China and North China that now clearly show that the pottery first appears in otherwise Late Paleolithic contexts. Excavations and re-dating at Xianrendong Cave (Jiangxi) in South China show that pottery appears there in securely dated stratigraphic contexts dating to ca. 20,000 cal BP, during the Last Glacial Maximum, some ten millennia before sedentary, Early Neolithic villages first appear in China. Yuchanyan Cave (Hunan) has pottery dating to 18,300 cal BP, evidence for processing deer bones to extract marrow and grease, and perhaps evidence of seasonal visits to the site in annual rounds by mobile hunter-gatherer groups.*

*Sites with early pottery in North China, such as Yujiagou, Zhuannian, Donghulin, Lijiagou, and Nanzhuangtou, appear relatively late, from the climatic downturn of the Younger Dryas, some eight millennia after sites in South China and four millennia after early pottery in Japan and the Russian Far East. North China sites variously feature such adaptations as microblades and/or grinding stones, as well as evidence for the exploitation of wild grasses (including millets), acorns, and tubers. These sites might represent hunter-gatherers retreating to more favorable habitats during the Younger Dryas and indicate reduced mobility and semisedentary practices with more intensified exploitation of closer resources.*

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*Early pottery finds beginning from ca. 16,800 cal BP in Japan (Incipient Jōmon) and the Russian Far East (“Initial Neolithic”) are also reviewed. Incipient Jōmon sites occur contemporaneously with Final Upper Paleolithic sites, and are found from southern Kyūshū to Hokkaidō (Taishō 3 site). With over 80 known sites, Japan has a better evidence for changes in pottery distribution patterns and diverse adaptations to climatic changes from the time period of the earliest site, Ōdai Yamamoto I, to the Holocene. Molecular and stable isotope analyses of pottery adhesions provide valuable data on the use of early pottery in Japan lacking for all other regions: these indicate the widespread use of pottery for processing marine and freshwater animals.*

*Like Final Upper Paleolithic sites, Incipient Jōmon sites also may have microblades, edge polished stone axes, arrowheads, and bifacial spear points. Undecorated pottery with Mikoshiba-type lithics are found in the initial phase of pottery making (Ōdai Yamamoto I, Kitahara, and Maeda Kōji sites, dating ca. 16,500-13,500 BP). Decorated pottery (Phase 2) begins ca. 15,700 cal BP during the Bølling-Allerød warming period and rapidly disperses across the archipelago at a time when there may have been significant changes in subsistence and mobility patterns. Phase 1 pottery might occur during a time of intensive information flow and fluidity of social networks, while diversification of pottery in Phase 2 occurs when social networks were becoming more embedded in place.*

*Russian “Initial Neolithic” early pottery sites, such as Khummy, Gasya, and Goncharka 1 in the Lower Amur River basin, are transitional between Paleolithic traditions and typical Neolithic sites of the Holocene, with pottery and ground stone tools gradually appearing amongst Upper Paleolithic toolkits. As in China and Japan, early pottery production is at a very low scale, with only limited quantities of sherds being found at a few sites. Eastern Siberia early pottery is first present at the Ust'-Karenga 12 site ca. 13,000 cal BP. Pottery may have dispersed westerly across Siberia as forested areas expanded, perhaps resulting in the introduction of pottery into Europe by hunter-gatherer groups.*

*Across East Asia, early pottery appears only in small amounts and at a few sites, and it persists in this episodic, low scale usage from the Last Glacial Maximum until the Early Holocene. We still need to better understand why this is the case. Early pottery may have been invented and used for special purposes, such as in feasting that was carried out to achieve various socio-political goals. While pottery also offered utilitarian or economic value, its long-lasting, low-scale use, but widespread dispersal despite this, cannot be fully accounted for only in terms of it being an adaptation tied to subsistence and increasing energy yields. Questions still remain over whether pottery was the result of a single or multiple inventions in East Asia. South China sites are clearly earlier, and the contemporaneity of Japan and Russia does not rule out singular invention and spread, as sites of the same radiocarbon date in the Late Pleistocene actually fall within a real calendrical range on a centuries-long scale. We need to better understand the scale and patterns of hunter-gatherer mobility and the extent of information exchange networks through*

*which knowledge of pottery making could have spread widely in Late Pleistocene East Asia.*

**Key Words :** Early pottery, South China, Incipient Jōmon, Russian Far East

Since the earliest days of archaeological field research, pottery has provided archaeologists with the principal means for building cultural-chronological frameworks and reconstructing human behavior. The invention and use of pottery has long been tied to the advent of agriculture and the presence of Neolithic, farming populations and changes in subsistence systems and mobility, demographic change, increasing social status differentiation, and increases in symbolic behaviors and social signaling related to agricultural subsistence. Recent archaeological work, however, shows that pottery appears in South China ca. 20,000 cal BP in otherwise Late Paleolithic contexts during the Last Glacial Maximum, some ten millennia before the time when sedentary, Early Neolithic villages first appear in China (Cohen 2011; Wu, et al. 2012). With similar scenarios in Japan and the Russian Far East from ca. 16,800 cal BP, clearly in eastern Asia, a view of pottery's emergence or dispersal as only coming within agricultural societies, as was seen in southwestern Asia and southern and western Europe, is no longer viable, and the presence of pottery at sites needs to be decoupled from assumptions of Neolithic and agricultural contexts (Gibbs and Jordan 2013; Jordan and Zvelebil 2009a). East Asia, we now know, played a determinative role in the emergence of pottery, and greater consideration needs to be given to the invention and spread of pottery in hunter-gatherer societies there.

Although there is debate over whether pottery was invented in a single area of East Asia or independently invented in multiple regions, under either scenario, pottery still spread through hunter-gatherer groups over vast distances across Eurasia (Gibbs and Jordan 2013), but this also happened while it was being maintained at a very low scale of usage. Understanding the reasons for how and why pottery spread this way among hunter-gatherers and its roles in their lives may be more interesting in terms of human adaptations—technological, social, and ideological—than understanding where it was invented. Below we discuss recent data on the dating and function of early pottery and the patterns of its dispersal. We begin with two caves in South China, followed by the earliest known pottery in North China, Japan, and the Russian Far East and Eastern Siberia.

## THE WORLD'S EARLIEST POTTERY AT XIANRENDONG AND YUCHANYAN CAVES AND THE CHINESE LATE PALEOLITHIC

Two recently published series of systematic radiocarbon dates for the pottery at Xianrendong 仙人洞 Cave (Jiangxi Province) and Yuchanyan 玉蟾岩 Cave (Hunan Province) place the earliest pottery at these cave sites in South China in stratigraphic contexts as early as 20,000 cal BP and 18,300 cal BP respectively (Boaretto, et al. 2009; Wu, et al. 2012) (Figure 1). The pottery at Xianrendong Cave is not only the earliest in the history of ceramic technology in East Asia, but also the world, and contrary to previously available data, pottery at both of these caves predates the earliest pottery in Japan and the Russian Far East by well over a millennium or more. By the term pottery, we mean vessels or containers formed out of clay (possibly with other sediments and/or materials added for tempering) that was then purposefully fired to harden it and retain its form. Previously, the Xianrendong and Yuchanyan cave sites often had been described as “Early Neolithic” and were thought to have been inhabited by cultivators of perhaps domesticated rice (Yuan 2002; Zhang 2002b). Over the past decade, as more work was done on these caves and other Late Paleolithic sites as well as Early Neolithic village sites, and as Chinese scholars participated more in international dialogues, these cave sites are coming to be recognized as having belonged to mobile hunter-gatherers.

### Late Pleistocene climate change

Pottery first appears during the last glacial period and spreads during a time period of the Terminal Pleistocene that witnessed great climatic and environmental changes. The first question we must ask is what role did climate and local environmental change play in the invention and adoption of pottery? During the period under discussion here, from the Last Glacial Maximum (ca. 24,000-18,000 cal BP) through the onset of the Holocene (beginning 11,500 cal BP), East Asia witnessed significant climatic change and environmental stresses on human populations. The main factor affecting regional climate and environmental change across this broad region is the intensity and extent of the annual winter and summer monsoon systems (An 2000; Liu, et al. 2008; Morrill, et al. 2003; Yang and Ding 2008; Yi and Saito 2004; Yuan, et al. 2004). Changes in the monsoon systems impacted environmental systems in northern latitudes more dramatically (but less so in maritime areas).

In China, palaeoenvironmental data point to more severe and abrupt changes affecting plant and animal, and thus human, populations in the north than in the south (Harrison, et al. 2001; Qian and Ricklefs 2001; Yang and Ding 2008). North China during LGM was cold and arid, with desolate steppic-desertic environments. With post-glacial amelioration ca. 16,000 cal BP, forest habitats began to return, from the south slowly northward, as the summer monsoon system strengthened during the Bølling-Allerød (ca. 14,500–ca. 13,000/12,800 cal BP) (Bar-Yosef 2011; Liu, et al. 2008), allowing foragers to spread across the northern regions. These foragers again faced environmental stress with the quick onset of the colder, more arid conditions of the Younger Dryas (ca. 12,800-11,600 cal BP), which featured a greatly weakened summer monsoon system in East Asia and is the time period when we first see pottery, be it relatively late, in North China. Just after the Younger

Dryas, by the early Holocene, the first permanently settled, “Early Neolithic” villages are in place in northern and southern China (Cohen 2011; Lu 2005; Zhang and Hung 2010).

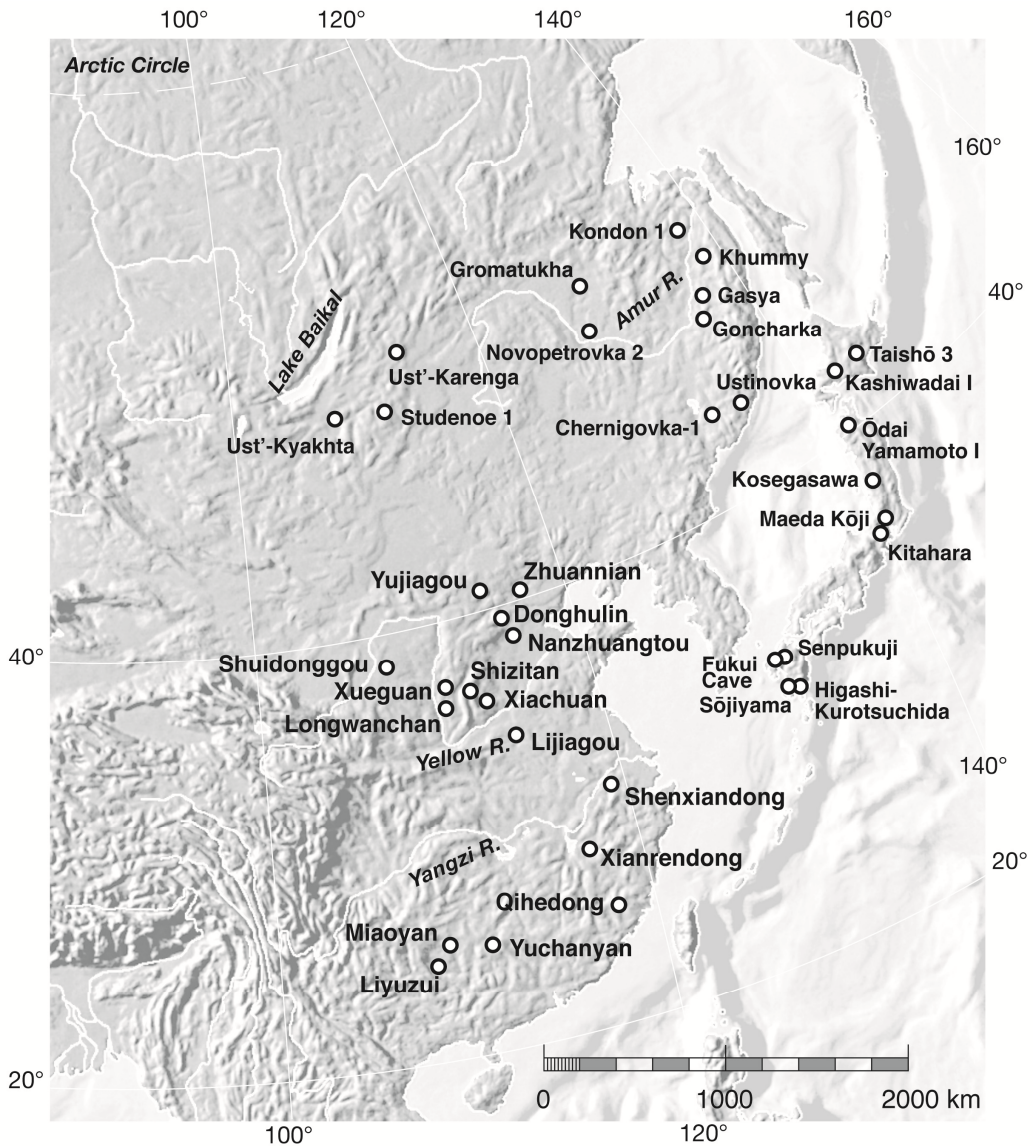


Fig. 1: Map showing the locations of early pottery sites mentioned in this paper.

Late Pleistocene climatic fluctuations correlate with a number of major cultural changes and introductions during the Late Paleolithic period, and their localized roles need to be considered for the advent or spread and increasing usage of certain technologies during this time period, such as grinding or milling stones, microblades, axes and adzes

(chipped or polished), and pottery, as well as perhaps shifts in subsistence patterns, including more specialized and focused exploitation of certain animal species such as deer, more fishing and shellfish gathering, and early experimentation with and manipulation of wild cereals, perhaps leading to cultivation (Bar-Yosef and Belfer-Cohen 2013; Bar-Yosef 2011; Cohen 2003; Lu 2006).

What impact did climate and environmental change have? We know from palaeoclimatic proxies such as speleothem records, marine, lake, and marsh pollen cores, loess profiles, and ice cores (Bar-Yosef 2011), that during the time period of the invention of pottery, human populations faced many stresses from changing environmental conditions, and their abilities to biologically sustain themselves and reproduce were tested, with some groups likely failing and dying off. Successful groups may have had to devise strategies to minimize the risks from these stresses (which could occur through slow or sudden climatic fluctuation), including, in addition to technological adaptations, social organization change, resource intensification, increased mobility, or migrating to new areas: any of these solutions could also affect a group's relationships with neighboring groups—friends or foes—in potentially negative ways, under conditions of increased competition. To mitigate potential disasters and dangers, both natural and inter-human, technological and social innovation would have been key to survival during the LGM and Late Pleistocene. Interactions and relationships (peaceful or antagonistic) with neighbors and distant groups had to be constantly negotiated as regional environments and the distribution of resources changed, and pottery may have played a role in this, such as in feasting (Hayden 2009a; Hayden and Villeneuve 2011; Rice 1999). The transmission of socio-economic information between small hunter-gatherer groups (information exchange networks) may have become increasingly important for survival, and symbolic systems would have played an important role in maintaining these networks. Other adaptations could include increasing the spectrum of exploited food resources by finding new plant and animal foods, or by developing the capability to increase the yields of known food resources, such as through intensification, tending and management, or intervening in the natural environment, as in low level food production. Technological changes and the introduction of new processing techniques could also increase energy yields (Bar-Yosef 2011). Pottery could have been involved in many of these types of adaptations, from increasing energy yields of food to negotiating relationships between people and groups (Hayden 1998). As outlined below, the scale of pottery production is very low until the Holocene, so it is difficult to say that pottery would have been key to survival during the LGM and Late Pleistocene simply in terms of energy yields, but it certainly would have been advantageous to those who had it. What is important here is that the origin and dispersal of pottery making occurs in an atmosphere of adaptive social and technological innovation. Recent analyses of pottery residues and sooting on recovered pottery clearly show that early pottery was used in cooking, but since early pottery's production is so low in scale (it is relatively rare until the Holocene) and yet it becomes dispersed over a broad geographic range, pottery's advantage to hunter-gatherers must certainly have extended beyond the realm of simply increasing nutritional yields of food to other areas, social and ideological: early pottery may have been something used for special but increasingly important purposes in hunter-gatherer groups.

## **Late Paleolithic South China and early pottery**

Archaeologically in China during the time period of the first appearance of pottery, we see a basic techno-typological division in the Upper (or Late) Paleolithic between North and South China, with lithic “core and flake tools” and the development of microblades in North China (see below) and core-chopper and flake industries in South China (Bar-Yosef and Wang 2012; Qu, et al. 2012). From the Lower Paleolithic through the Late Paleolithic, South China (the area south of the Qinling Mountains and Huai River) features relative stability in its lithic traditions, featuring core-chopper and flake tools frequently made on flat cobbles. By the Terminal Pleistocene, there are small numbers of “cup-holes” pecked into cobbles and perforated cobbles (each of uncertain function), as well as polished bone and antler tools, and perforated shell tools, too. One commonly cited reason for the continuation of simple lithic industries among hunter-gatherer populations in the south is the relatively greater environmental stability in this warmer, wetter, more resource-abundant region than in northern latitudes. A second reason is that perishable raw materials such as bamboo could have been formed into various tools such as knives and spears, as well as strips for basketry, matting, etc., using simple choppers and flakes, so new, complex chipped stone technologies were not required, as a recent experimental study of bamboo tool making involving this author has demonstrated (Bar-Yosef, et al. 2012). It is also in such Late Paleolithic hunter-gatherer contexts in South China that pottery vessels—the earliest in the world—first appear.

The evolutionary scenario in South China may be more complex, however, than Paleolithic period lithic typology reveals, because the core-chopper and flake industries persist despite possibly having multiple human migrant groups entering the region, as genetic studies indicate (The HUGO Pan-Asian SNP Consortium 2009; Zhong, et al. 2011). These migrant populations therefore would have had to acculturate with indigenous populations already there (Bar-Yosef and Belfer-Cohen 2013), as indigenous lithic technologies persisted even with these new populations entering the region and reproducing there with local populations. Thus, culture learning processes and the maintenance of “cultural templates”, as well as innovation occurring in perishable materials being used for new forms, could be responsible for this stability in lithics. Furthermore, it also was not a lack of suitable lithic raw materials that could be used to make more complex tools, as our study also demonstrated that more complex stone tool making, such as the Levallois reduction technique, can be readily accomplished on stone available in Hunan Province (Bar-Yosef, et al. 2012). It is in this sort of context of innovation and learning, still not highly visible archaeologically, that early pottery was invented.

## **Xianrendong Cave early pottery**

Xianrendong Cave is located about 100 km south of the Yangzi River in Wannian County, northern Jiangxi Province, in South China. Excavations in the 1960s and 1993-2000 uncovered a rich Late Paleolithic sequence with stone, bone, and shell tools and pottery, not yet fully described in a final excavation report (MacNeish, et al. 1998; Peng and Zhou 2006; Sun and Zhan 2004; Zhang 2002b). Although there were radiocarbon dates indicating that pottery in the cave might date as early as 15-20,000 cal BP, the dating of the earliest pottery was uncertain, and so a team, on which this author was a member, was

invited in 2009 to reopen two trenches from the earlier excavations to obtain a systematic series of radiocarbon samples for dating and to do soil micromorphological analysis to understand the complex formation processes of the deposits and ensure the contextual integrity of the early pottery sherds and the radiocarbon samples (Wu, et al. 2012). Results show that the earliest pottery sherds from layer 3C1B in the west trench and in layers 2B and 2B1 in the east trench date ca. 20,000 cal BP, during the LGM: these dates are reliable due to the internal consistency across a large, systematic series of radiocarbon dates done on samples from stable, stratigraphic contexts shown by micromorphology.

Recently, Kuzmin (2013) critiqued and rejected the 20,000 cal BP date for the earliest pottery levels and the early pottery in them, instead choosing to accept a “short” chronology in an informal report self-published by MacNeish (MacNeish, et al. 1998). MacNeish had 34 radiocarbon determinations available and rejected all but 7. He did this in order to maintain his proposed seriation of pottery and lithics across several sites, and he believed, based on cross-dating to what he saw as similar pottery in distant sites in Japan and the Russian Far East, that the early pottery layer in Xianrendong should be later than what most of the dates for samples in the same layer indicated. He thus selected the date of  $12,530 \pm 140$  uncal BP (BA95145) as representing the time period of the earliest pottery but had to reject 8-10 other samples that are older but relatively consistent (with a few problems) in the same layer and layers above and below in order to do this. Although Kuzmin writes that BA95145 had a direct association with the pottery, all of the other, rejected samples had equivalently direct associations, which means simply that they came from the same layer: MacNeish made no other stratigraphic or behavioral links between the samples and the pottery sherds, and the stratigraphic integrity of the samples was never tested. MacNeish appears to have rejected 27 of 34 radiocarbon dates primarily because they did not tally with his guess for what the date of the early pottery should be. Although MacNeish argues they were not “reliable” dates, their “reliability” was never tested in terms of the preservation and quality of the samples themselves or the integrity of their stratigraphic contexts: they simply did not fit his expectations. MacNeish wrote, “This brings us to the first pottery horizon, the Xian Ren phase. We tried over and over again (6 or 7 dates) to get reliable dates, yet all but one turned out too old or in reverse of the order of the stratigraphy. Only the one date of  $12,530 \pm 140$  BP (BA95145), from charcoal from zone 3C1a of Xian Ren Dong, seems reliable. Presently, there is no site with similar pottery in China to cross-date this phase [author’s note: actually, Yuchanyan pottery was already excavated and known to have earlier dates (Yuan 2013)]. The only sites with similar pottery are Ust’novka 3 and Khummy ( $13,260 \pm 100$  BP) from far to the north on the Amur River of Siberia and Miyagase in Japan with three or four dates in 13,000 BP. Thus the estimate that the Xian Ren phase lasted from  $13,500 \pm 500$  BP to  $11,800 \pm 400$  BP is not very reliable” (MacNeish, et al. 1998).

While Kuzmin (2013) cites MacNeish’s choices of these 7 dates over the 27 others as being indicative of better “reliability”, they clearly are not more reliable, and MacNeish was contorting even the then available dating to fit in one outlier determination that he thought should be correct. The re-dating of Xianrendong by Wu, et al. (2012) offers a systematic series of radiocarbon dates with stratigraphic integrity demonstrated by microscopic examination of their surrounding matrix. The new dates for the layers with the earliest pottery are strongly supported by internal consistency among the new and the old



samples within and between layers, plus this consistency is repeated in two separate areas of the cave. It is this consistency amongst a large number of samples that allows for the rejection of a few samples as outliers—cave stratigraphy and formation processes are complex and samples can never all be “perfect” because of this: only a large number of stratigraphically stable radiocarbon samples such as available at Xianrendong and Yuchanyan allow us to more clearly recognize which are likely outliers. Coupled with understanding of the formation processes through micromorphology, a strong archaeological case can be made for supporting the 20,000 cal. BP dates.

While Kuzmin argues that MacNeish’s dating samples are better because they were obtained in “direct association with the pottery,” “direct association” in this case simply means that the samples and the pottery came from the same gross stratigraphic layers or “zones” as MacNeish called them, so, in fact, his rejected samples and the new samples have equally “direct association with the pottery” as the one MacNeish chose. How good is this association? Layer 3C1A was 30 cm thick and 3C1B was 10 cm thick, and they were dug in “natural levels” according to MacNeish, and the varied formation processes of the layers, now shown by the micromorphology, were never considered. In fact, the term “layer” is somewhat a misnomer for the complex depositional and post-depositional processes of what are actually lenses and microstrata in Xianrendong (and Yuchanyan), as micromorphological analysis in the new dating study reveals. The new study’s samples were recorded by identifying the same layers from the previous excavations by reopening these same profiles, plus the stratigraphic integrity of the samples—meaning that post depositional processes did not alter their stratigraphic position—was demonstrated by the micromorphology. In short, the “reliability” of the samples is best determined systematically, i.e., by looking at how all of the radiocarbon determinations best fit together in two related sequences in the cave, and by rejecting samples that are seen to be outliers within and between strata or that come from unsecure contexts as seen by the micromorphology. The 20,000 cal BP dates for the early pottery layers in both trenches, in following such an approach, are thus secure and reliable and associated with the time period of the deposition of the pottery.

In looking at the description of the micromorphology, Kuzmin (2013) also argues that dates from the East Section should also be rejected because he believes they are unrelated to “human occupation” of the cave. However, Kuzmin is confusing the term “occupation” with “activity.” In fact, these deposits are directly the result of human action and not of natural depositional processes, so the pottery and radiocarbon samples within these strata—shown to have stable post-depositional associations by micromorphology—were placed there together at the same time by human action. Wu, et al. (2012) write (emphasis added), “The sediments in the East Trench, on the other hand, are much richer in bones and ashes, and some charcoal, which all point to *anthropogenic inputs* and not alluvial ones... In other words, it seems that most of the accumulation of the deposits in the Eastern Profile of the site do not represent in place human occupations or even occupation in this space.” The point being made here was simply that the living areas of the site—those locations in the site where humans were performing most of their regular activities related to daily living and thus have greater behavioral significance to archaeologists—were not in this part of the cave, so the excavations had actually missed the most informative areas of the site. However, these deposits in the East Trench are still directly the result of human actions (they are

anthropogenic), they still have behavioral significance as artifacts themselves of human activity, and the stratigraphy is stable. Thus, the sequence and dates in the East Trench are valid.

Wu, et al. (2012) incorporated 45 radiocarbon determinations from Xianrendong in their study. These indicate that the cave was first used ca. 29,000 cal BP and continued to be used until ca. 17,500 cal BP. It was then abandoned for 3,000 years, with human groups returning again from ca. 14,500-12,000 cal BP. With a large series of radiocarbon determinations, the dated samples can serve as proxies for human activity in the cave. Thus, the absence of radiocarbon dates for a time period can be indicative of a gap in the occupation history of the cave (the same occurs at Yuchanyan Cave) (although sampling, of course, can also be a factor). Before systematic dating at Yuchanyan (below) and Xianrendong, it was unclear that there were periods of abandonment and then re-use of the caves, and it was commonly assumed that the caves were continuously occupied, especially when all strata have cultural material. However, since the deposits in the caves can be primarily anthropogenic—as can be seen by soil micromorphology at Yuchanyan—gaps in the occupation are stratigraphically invisible because they are not represented by geological strata devoid of cultural remains. These periods of occupation and abandonment now have to be considered when modeling human activities related to these cave sites.

Not including the mixed uppermost layer, ca. 282 pottery sherds were found at Xianrendong during the 1990s excavations (mostly from later layers) (MacNeish, et al. 1998), but except for one rounded bottom vessel excavated in 1962 of uncertain stratigraphic provenience, no vessel forms could be reconstructed, although others had rounded bottoms, too. Many sherds reportedly have scorch marks on the exterior, indicating that the vessels were possibly used in cooking. The vessel walls are thick, ranging 0.7-1.2 cm (thicker than Incipient Jōmon and Amur River early pottery, below, and counter to MacNeish's cross-dating), and the early pottery is crudely made and fired at low temperature, which may also be indicated by black cores in the sherds from incomplete oxidation during firing. All the pottery was tempered with large (1-5 mm and greater) sized pieces of crushed quartzite or occasionally feldspar, and the earliest sherds commonly had ferric oxide nodules perhaps indicating the clay-containing sediments for the pottery fabric came from flood deposits and were not cleaned (MacNeish, et al. 1998; Wu, et al. 2012; Zhang 2002a; Zhang 2002b).

The sample size for the earliest pottery is small, but the stratified deposits at Xianrendong give some indication of a developmental sequence for pottery manufacture, although it has been described in slightly different ways (MacNeish, et al. 1998; Wu, et al. 2012; Zhang 2002a; Zhang 2002b). Here we follow Zhang Chi's (2002a; 2002b) descriptions. The pottery is formed in two ways. The first is by laminating—joining sheets of clay together in layers upward to form the vessel walls. Laminated pottery is either “stripe-marked”—decorated with parallel striations formed by scraping a tooth-edged tool across the interior and exterior surfaces—or plain surfaced, resulting from hand smoothing after scraping in the same way. Stripe-marked, laminated pottery is the earliest (found in layers 3C1B and 3C1A). Rims of both plain (found in layer 3C1A) and stripe-marked early pottery could be decorated with regularly spaced U- or V-shaped notches, and several rows of irregularly spaced punctates appear under some rims formed by punching a stylus into

the exterior surface, which causes raised dots on the interiors, as well (Figure 2). The second manufacturing technique, appearing after laminated pottery, was by coiling and paddling. Coiled pottery was tempered with quartzite or even crushed pottery sherds, and the exterior surfaces (and sometimes the interior as well) are covered by impressions similar to cord-marking (but not clear) formed by the paddle having been wrapped in cordage or fibers; this cord- or fiber-marked pottery is found in layer 3B2 and upward. Some of the coil-made pottery also has impressions of straw- and/or cord matting on the exterior: this is the latest pottery in the sequence (MacNeish, et al. 1998; Wu, et al. 2012; Zhang 2002a; Zhang 2002b).

We still have no clear data as to how pottery at Xianrendong (or Yuchanyan) was used. There have been no residue, starch, or other physiochemical analyses done on the pottery. With evidence for sooting and the vessels having rounded bottoms, the pottery at Xianrendong may have been used for cooking (Hayden 2009a). Carmody, et al. (2011) have shown that cooking not only increases the energy yield of starchy foods, it also increases the energy gained from meat, and the energy yield increases more by cooking than by preparing meat or starchy tubers (a likely food resource in South China) by pounding. The Xianrendong faunal assemblage has been described as over 90% deer bone, and a large number of the bones are fragmented (Wu, et al. 2012). Thus, another use of the pottery may have been for grease and marrow extraction from bones, and deer bones at Yuchanyan have been processed in such a way that this would have been a likely use of the bones there (Prendergast, et al. 2009).

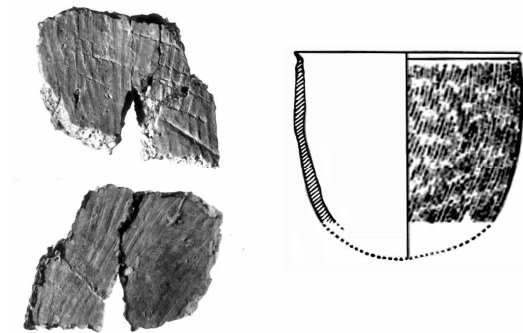


Fig. 2: Left: “Stripe-marked” pottery sherd from Xianrendong Cave Layer 3C1b dating to ca. 20,000 cal. BP. Right: A reconstruction of the possible appearance of an early pottery vessel based on sherds from the earliest pottery containing layers. No scale available. Images courtesy of the *Origins of Rice Cultivation in the Yangzi River Basin Project*; after Wu, et al. (2012: Supplement).

### Yuchanyan Cave early pottery

The second well-dated early pottery site in South China is Yuchanyan Cave, located in Daoxian County, Hunan, 450 km south of the Yangzi River. Like Xianrendong, Yuchanyan is also located in a karst hillside, and the site features a rich assemblage of Late Paleolithic stone, bone, and shell tools, as well as early pottery. Excavations were carried out in 1993

and 1995, and again by a Sino-American collaborative team, on which this author was a member, in 2004 and 2005 (Yuan 2002; Yuan 2000; Yuan 2013). The 1990s excavations recovered two clusters of sherds from which a conical-shaped pottery cauldron (Figure 3) and a large fragment of a second vessel could be reconstructed. The later excavations were aimed at clarifying the stratigraphy, recovering more pottery and rice remains, and collecting and analyzing systematic radiocarbon, micromorphological, and mineralogical samples to understand the complex formation processes of the cave's deposits and securely date the pottery. This resulted in secure dates for the earliest pottery in the cave of 18,300-17,500 cal BP (Boaretto, et al. 2009). Although not discussed in the dating study of Yuchanyan, the systematic series of radiocarbon dates (Boaretto, et al. 2009) may also give indications of gaps in the human usage of the cave, with an initial occupation ca. 21,000 cal BP followed by a gap, and then a return to the cave at the time of the earliest pottery. There may also be a gap following this, and then another occupation of the cave from ca. 16,000-13,800 cal BP.

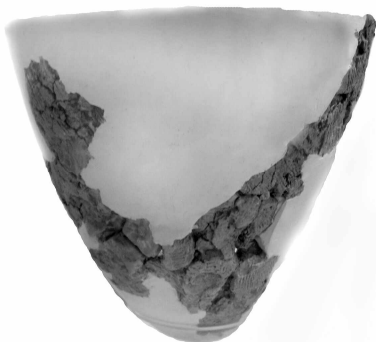


Fig. 3: The reconstructed pottery vessel from Yuchanyan Cave. This cauldron-shaped vessel stands 29 cm tall and has a mouth diameter of 31 cm. Image courtesy of the *Origins of Rice Cultivation in the Yangzi River Basin Project*.

The micromorphology and mineralogy of the Yuchanyan deposits show that they are mainly anthropogenic, resultant from people building many wood fires in the cave. There is also evidence of humans purposefully bringing red, kaolinite-containing clays into the cave from sources outside to make surfaces of still unknown function: these are represented in the deposits by discontinuous, massive lenticular bands of red clay that are ca. 1-3 cm thick and 30-50 cm long. Lenses of ash from wood fires overlies these clay surfaces. Infrared spectra show that some of these clay bands had reached temperatures between 400 and 500 °C (Boaretto, et al. 2009). This knowledge of and exploitation of local clay sources and prominent use of fire in the cave, including controlled fire in hearths, also relate to the capability to make early pottery.

In addition to the two refitted clusters of pottery sherds found near each other in the 1990s, two more sherds were found in 2004 and 2005. The pottery is crumbly and coarsely made. It has thick, uneven walls up to 2 cm thick, and the clay has inclusions of charcoal, crushed quartz, and water-polished pebbles up to 5 mm in size. The pottery was fired at

low temperature, perhaps 600 °C. The one reconstructed vessel is in the shape of a *fu* 釜 cauldron and was formed by attaching slabs of clay together. It is conical in shape with a pointed base, stands 29 cm high, and opens to a mouth diameter of 31 cm. The interior and exterior surfaces of this vessel and the pottery fragment appear to be impressed with cordage (Boaretto, et al. 2009; Yuan 2002; Yuan 2013).

In the 1990s, some five grains of rice were recovered in the excavations, and so Yuchanyan in earlier literature is often called “Neolithic” and was seen as giving evidence for early rice cultivation (Yuan 2013; Zhang 2002c). The later excavations with finer spatial controls for provenience, screening, and flotation did not recover any more rice macroremains at the site, so at present, to this author, the site appears to be a Late Paleolithic hunter-gatherer site with typical core-choppers and retouched flakes with the addition of small amounts of early pottery and not agricultural. The rice phytoliths identified from the cave could possibly be from gathering in the abundant natural wetlands that surrounded the site (Bar-Yosef 2011), and further studies of the rice phytoliths are needed, as these may give evidence for changes in exploitation patterns of this cereal.

We still have little understanding of the seasonality of these cave sites in China and the degree and patterns of mobility of the people who used the caves. Yuchanyan has some indications of being a seasonally occupied site used ephemerally by small groups of hunter-gatherers, and this, too, is important for understanding the use of early pottery. Rice harvesting may be an indication of fall visits to the cave by mobile bands of hunter-gatherers. Faunal remains, particularly of migratory birds, also indicate fall to early spring visits to the site. Over 30% of the Yuchanyan faunal assemblage was bird, with 27 species of birds identified. This number of bird species and amount of bones is a rare discovery in China, and it is also indicative of a new subsistence practice in the Late Paleolithic of specialized bird hunting not seen before. 17 of the bird species were migratory and are mostly waterfowl, with migratory cycles of moving to South China in early fall and returning north during the early spring. There are also 35 species of mammals (with a focus on deer), 18 species of freshwater and terrestrial snails, and fish remains (including various cyprinids and carp, catfish, and perch) (Gu and Yuan 2006; Prendergast, et al. 2009; Yuan 2013). The fish, too, are among the earliest evidence in China for regular exploitation of fresh water fish and another new subsistence practice that might have arisen during this time period. Thus, at the time of the first use of pottery, hunter-gatherer groups have also begun to bring birds and fish as a larger component into their diets: there appears to be dietary expansion.

In addition to the introduction of fish and birds, an array of taphonomic analyses applied to the mammalian faunal assemblage at Yuchanyan, for the first time in China, gives evidence of resource intensification, and particularly a focus on deer (43% of mammalian MNI). Yuchanyan hunters harvested primarily prime-aged deer, and processing of the bones is indicative of marrow and grease extraction (Prendergast, et al. 2009). This type of processing—fragmenting the limb bones—is one way by which to maximize the nutritional potential of a single animal. As mentioned above, cooking in pottery also increases the energy yield of meats. Since similar faunal studies have yet to be done at other sites, it is difficult to ascertain if this type of processing of bone is a new practice in this time period or if it is widespread or not. Also, we must consider if the use of

pottery somehow relates to grease and marrow extraction or the entry of fish (possibly for oils, too) and birds into the diet.

There are a few additional Late Pleistocene sites in South China with pottery, but they are not fully reported and their dating is considered problematic or not well reported yet. The date of the earliest pottery at Miaoyan 廟岩 (Guangxi) is bracketed between two radiocarbon determinations of ca. 21,600 to 16,400 cal BP (Yuan 2006). Shenxiandong 神仙洞 (Jiangsu) only has one date, with unclear associations with the pottery, of ca. 12,600 cal BP. Dalongtan 大龍潭 (or Liyuzui 鯉魚嘴) has a date of ca. 13,000 cal BP from human bone and shell in the lowest layer with pottery (Yuan 2006). Qihedong 奇和洞 Cave (Fujian) has pottery and ground stone tools from strata reportedly dating 12-10,000 years ago (unclear if calibrated or not) (Fan 2014).

### Northern China early pottery

The earliest pottery known in North China appears eight millennia later than in South China. At one of these early sites, Yujiagou 于家沟 (Hebei; ca. 11,600-11,100 BP [TL date]), dating to the end of the Younger Dryas, the pottery is found within a typical Late Paleolithic microblade assemblage on the cold arid grasslands northwest of the Taihang Mountains. In the Late Paleolithic in North China from the LGM to the Holocene, we see the continuation of core and flake tools in primarily short-term sites, with the addition of new forms and techniques, such as microblades, that might reflect a broader range of technological strategies than lithics alone do in southern China. In South China, however, as mentioned above, tools on organic materials, such as ones made from bamboo, may have mitigated the need for more specialized lithic toolkits (Bar-Yosef, et al. 2012). In North China, microblade production appears beginning ca. 25,000 cal BP (before or during the LGM), as seen earliest at Longwangchan 龍王辿 (Shaanxi) and Xiachuan 下川 (Shanxi), and continues into the early Holocene. These microblade industries might derive from Upper Paleolithic blade industries of the Altai region (Bar-Yosef and Wang 2012; Derevianko 2010), but there are rare examples of blade tools in North China appearing as early as 40,000 BP, such as at Shuidonggou 水洞沟 (Madsen, et al. 2014). It must be emphasized that the Late Pleistocene microblade sites in North China are part of an extensive microblade cultural sphere with several hundred known sites that reaches down to the Yellow River region in China (but not into South China), across southern Siberia and the Russian Far East, into Korea, and into Japan, and microblades even reach Alaska in the Late Pleistocene migrations from northeastern Asia into the Americas. Early pottery appears in microblade sites, too, in North China, Siberia, the Russian Far East, and Japan (below) (Bar-Yosef and Belfer-Cohen 2013; Cohen 2003; Kajiwar 2008; Kuzmin, et al. 2007).

The mechanisms by which microblade technology reached across such a wide area need to be better understood. These mechanisms could relate to broad-ranging information exchange networks and interactions among mobile, small-sized bands of hunter-gatherers that might have been needed in order to maintain biologically viable population pools incorporating small groups over long distances from each other. It would also be within such networks—in South China as well—that knowledge of pottery making and use (and

even the need to make pottery, such as for feasting) could spread over large distances but pottery production could still be low scale. Scenarios of migration and exchange remain cloudy, but growing genetic evidence points to much greater human biological variability in eastern Eurasia than understood before, with multiple modern human populations moving into East and Southeast Asia along northern and southern routes, with the presence of earlier Neanderthal and Denisovan DNA in modern populations, and with some genetic contributions from the north being present in the southern populations that had reached East and Southeast Asia by a southern route. These could indicate that down-the-line information exchange between human groups was extensive, with complex movement and interaction between populations and no regions remaining purely isolated. While there is genetic mixture across geographic boundaries indicative of long-ranging if not direct contact between groups, the lack of microblades in South China, despite the availability of suitable raw material there, means that a “cultural boundary” was reached (Bar-Yosef and Belfer-Cohen 2013; Bar-Yosef, et al. 2012), yet with some genetic exchange across it.

With the more extreme, negative climatic (and subsequently biotic) shifts occurring in northern latitudes, the more diversified toolkits there perhaps reflect specialized adaptations and risk reduction strategies that were needed to survive during the Last Glacial Maximum and Terminal Pleistocene (Elston and Brantingham 2002). Elston, et al. (2011) argue that the appearance of microlithic and microblade technologies reflects an animal-oriented intensification strategy used by mobile forager groups who have a subsistence focus on hunting. In addition to microblades, these small, ephemeral sites also feature larger tools on quartz and quartzite or other local raw materials. Grinding stones are also found in North China during the Late Paleolithic, but just in a few sites—and these also have microblades: the earliest are found at localities at Longwangchan ca. 25,000 cal BP, Xiachuan between 28,000-19,700 cal BP, Shizitan 柿子灘 (Shanxi; 23,000-11,800 cal BP), and at Nanzhuangtou 南庄頭 (Hebei; 12,400-11,400 cal BP), which also has pottery (Elston, et al. 2011; Lu 2010; Zhang, et al. 2011). A recent residue and use wear analysis of Shizitan Locality 14 grinding stones dating to LGM (ca. 23,000-19,500 cal BP) shows they were likely used in processing a range of wild grasses, beans, and even tubers, *Dioscorea opposita* yam and *Trichosanthes kirilowii* snakegourd roots (Liu, et al. 2013). The grinding stones at Xiachuan and Shizitan may have been used in preparing red ochre pigment for symbolic activities, as well (Cohen 2003).

Chipped stone axes and adzes are also found at Xiachuan, at Xueguan 薛關 (Shanxi; ca. 16,200 cal BP); and at Yujiagou, which also had pottery. Body ornamentation, such as ostrich eggshell, stone, shell, and bone beads—“global” Upper Paleolithic practices—though rare, are also found in North China (Cohen 2011; Elston, et al. 2011; Qu, et al. 2012; Wu and Zhao 2003; Zhao, et al. 2006) and could possibly be related to the incoming western Eurasian migrant populations, who are now being seen genetically, but who otherwise acculturated to East Asian conditions (Bar-Yosef and Belfer-Cohen 2013). The Ust-Kyakhta site (ca. 13,400 cal BP), in southern Transbaikal, Siberia, near the Mongolian border, also has microblades, pottery, and ostrich shell beads (see below).

During or following the Younger Dryas, new cultural developments appear in North China that may be direct precursors to the Early Neolithic: the few sites dating to this time period are beginning to fill a critical gap when the transition to cereal cultivation and the

first permanent settlements occur. There is evidence of millet and acorn exploitation at these larger sites, and they also have burials, ditches, stone-lined hearths, more grinding stones, and more pottery, all of which are generally indicative of greater sedentism, and there is more broad spectrum resource exploitation (Cohen 2011; Lu 2006). These sites, including Nanzhuangtou 南庄頭, Zhuannian 轉年, Donghulin 東湖林, and Lijiagou 李家溝, are different in character from the above North China Late Paleolithic sites and the earliest pottery sites in South China and the Russian Far East. They and Yujiagou date three to four millennia later than the earliest pottery sites in the Russian Far East and in Japan (below). Nanzhuangtou (Hebei; 12,400-11,400 cal BP or later), on the eastern warmer and wetter side of the Taihang range, has only flake tools and no microblades. Along with pottery, it has polished stone axes, bone and antler tools, and 5 grinding stones and rollers; millet starches were recovered from a grinding stone and a roller. The site features human-made ditches (landscape alteration), pits, hearths, and the earliest domesticated dog in China (Yang, et al. 2012; Yuan 2010). The pottery is more decorated than earlier pottery, perhaps indicating increased social signaling using ceramics, and sooting may be indicative of its use in cooking over fire.

Donghulin (Beijing; 11,000-9,500 cal BP) features microblades and many grinding slabs and rollers, pit hearths lined with cobbles (improved pyrotechnological control), and two small pit burials. One burial had a stone axe placed at the head and the body was surrounded by perforated shells (Beijing da xue kao gu wen bo xue yuan, et al. 2006). The pottery at the site is low fired at an estimated 450-550 °C (Zhu, et al. 2013). Evidence of millet and acorn processing was identified on the grinding stones (Liu, et al. 2010; Yang, et al. 2012). Zhuannian (Beijing; 11,300-10,300 cal BP) is a larger site (0.5 ha), with pottery, microblades, grinding stones and rollers, small stone axes, and fragments of stone vessels that might be mortars, as well as pottery (Zhao et al. 2006). Lijiagou (Henan, ca. 10,500 - 8600 cal BP), is a deeply stratified site with a sequence of three cultural levels from the Late Paleolithic (with microblades and small amounts of pottery), to a new transitional culture (with microblades, ground stone adzes, a grinding stone, and much more low fired plain pottery), to an Early Neolithic Peiligang 裴李崗 Culture level (Zhengzhou shi wen wu kao gu yan jiu suo and Beijing da xue kao gu wen bo xue yuan 2011). Lijiagou is also important as a rare microblade site found to the south of the Yellow River and might provide important clues to the origins of the Early Neolithic Peiligang Culture.

While the function of the pottery is still unknown, all of these North China pottery sites appear late compared to South China, Japan, and the Russian Far East, and they might represent hunter-gatherers retreating to more favorable habitats during the Younger Dryas, which had a larger impact in this inland, more cold and arid region. These sites indicate a reduction in mobility and the establishment of semisedentary practices with more intensified exploitation of closer resources, as well as their inhabitants likely facing new security and defense needs caused by increasing competition between groups. These processes increase going into the Holocene resulting in the large, fully sedentary villages of the Early Neolithic Peiligang and related cultures (Bar-Yosef 2011; Cohen 2011).



## EARLY POTTERY IN JAPAN: THE INCIPIENT JŌMON

Pottery first appears in Japan by ca. 16,800 cal BP, marking the beginning of the Incipient Jōmon period (縄文草創期), which is defined by the occurrence of early pottery at sites, as opposed to contemporaneous sites without pottery of the Final Upper Paleolithic period. The Incipient Jōmon continues until the beginning of the Holocene, followed by the Initial and then Early Jōmon. Incipient Jōmon sites are found across the extent of the Japanese archipelago, from southern Kyūshū to Hokkaidō, with over 80 known sites (and there are even more Final Upper Paleolithic sites): thus, Terminal Pleistocene archaeological data are much richer in Japan than other areas of eastern Asia. Although there are other schema for periodization (Kobayashi and Kaner 2004; Kuzmin 2006; Taniguchi 2005; Tsutsumi 2002; Yoshida, et al. 2013), the Incipient Jōmon period can be divided into four chronological phases and subphases based primarily on pottery surface decoration from radiocarbon dated sites:

Phase 1: 16,800–15,300 cal BP, non-decorated pottery

Phase 2: 15,700–13,500 cal BP (Bølling-Allerød warming), linear-relief or slender clay ridge decorated (*ryūkisenmon* 隆起線紋)

Phase 3a: 14,800–12,000 cal BP, pitted or punctate decoration (*enkōmon* 円孔紋), nail-impressed or decorated with crescent-impressed patterns (*tsumegatamon* 爪形紋), and impressed cord-marking (*oatsu jōmon* 押圧縄紋)

Phase 3b: 12,000–11,200 cal BP (Younger Dryas), rolled cord-marking *kaiten jōmon* 回転縄紋 and other decorations (Taniguchi 2005).

Phase 1 pottery, including the earliest known in Japan, from Ōdai Yamamoto I 大平山元 I (Aomori Prefecture) in northernmost Honshū, dates to a time period at the end of LGM when subarctic vegetation still extended across central and northern Honshū (Kudo and Kumon 2012). Vegetation changes to cool-temperate deciduous broadleaf trees around 15-14,000 cal BP during the Bølling-Allerød and Incipient Jōmon Phases 2 and 3a. During this warming period, there appears to be diverse adaptations to more favorable conditions (Yasuda and Catto 2004). In southern Kyūshū, for example, larger quantities of pottery, grinding stones, and hand stones appear (Pearson 2006). New storage features appear there, too: the Higashi-Kurotsuchida 東黒土田 site (Kagoshima Prefecture) features the earliest acorn storage pit in Japan, dated to 13,400 cal BP. The use of pottery expands geographically and the amounts of pottery sherds found at sites increase during post-glacial amelioration; although more acorns and nuts are available and pottery could have been useful for boiling or leaching them to remove toxins, residue analyses discussed below do not support its widespread use in this way. Furthermore, the earliest pottery appears before this warming period, under harsher subarctic conditions, so its initial role needs to be considered within this environmental setting (Kudo 2012; Kuzmin 2010). Unlike China, in Japan there have been analyses of pottery residues that provide valuable data on the use of early pottery: these indicate a widespread use of pottery for processing marine and freshwater animals (Craig, et al. 2013; Kaner 2013)(see below).

At the earliest site, Ōdai Yamamoto I, 46 Incipient Jōmon pottery sherds were recovered from Strata III and IV, thought by the excavators to be from the same pot despite differences in radiocarbon dates and strata (Figure 4). The vessel shape features a flat base and deep sides with a straight rim. Most of the sherds are plain surface, but nine have incised lines; they are ca. 7.6 mm thick and do not have fiber tempering (plant fiber is found in later pottery at other sites in Japan, and it is used as tempering in the Russian Far East). 30 of the sherds had adhesions on the interior side thought by the excavators to be from boiling. Radiocarbon determinations on the adhesions range 16,500-15,000 cal BP in the report, and Kuzmin (2013) provides an average age for the radiocarbon samples from the earliest component as 16,800 cal BP. 91% of the lithics are on shale, and 5% are on obsidian sourced 70 km away. Two arrowheads were also found in these layers and provide the earliest evidence for bow and arrow usage in Japan. Other lithics include blade tools, with blade blanks being used for scrapers and graters. There are also two chipped, edge-polished stone axes of the Mikoshiha-type 神子柴 (Kaner 2009; Kuzmin 2013; Ōdai Yamamoto I iseki hakkutsu chōsadan 1999). The Mikoshiha type lithic assemblage, found in Hokkaidō and northern and central Japan, is seen by some as an horizon that begins in the Amur River Region of eastern Siberia and that enters Japan and spreads rapidly from the north to the south (Tsutsumi 2002), but the chronology and dispersal pattern are not straightforward. Mikoshiha-like small tanged or stemmed arrowheads have been found at the Ustinovka-6 site in Primorye, which dates just before the Younger Dryas, and are like others in the lower Amur River at Goncharka-1 and Gasya (Buvit and Terry 2011) (below).

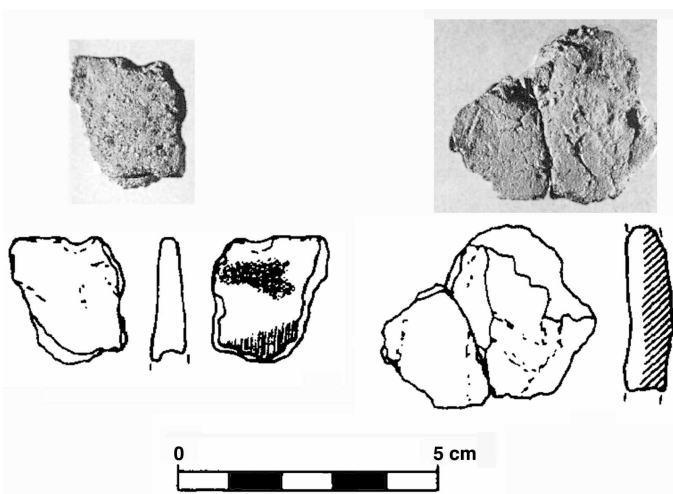


Fig. 4: Two of the 46 Incipient Jōmon pottery sherds recovered at the Ōdai Yamamoto I site. After Ōdai Yamamoto I iseki hakkutsu chōsadan (1999).

Since the Incipient Jōmon is defined by the presence of pottery, there is chronological overlap with contemporaneous Final Upper Paleolithic sites (radiocarbon dating plots of early pottery sites and backed blade, microblade, and point industry sites of the Upper Paleolithic by Kudo and Kumon 2012 clearly show this; see their fig. 7). The Final Upper Paleolithic is defined primarily by the presence of microblade industries. These appear

earliest in Hokkaidō during the LGM at the same time as Xiachuan, ca. 25,000-24,000 cal BP, at the Kashiwadai 1 柏台 1 site (Chitose City), when Hokkaidō was connected to Sakhalin (Hokkaidō island was never connected to Honshū). A few thousand years later, microblade assemblages reach central Honshū. By 18,200 cal BP, microblades (which are differentiated into multiple types based on core reduction patterns) are present in southern Kyūshū and continue there until ca. 14,000 cal BP, which overlaps with the Incipient Jōmon sites of Fukui 福井 Cave Layer II and Senpukuji 泉福寺 Cave (14,810-13,820 cal BP) (both near Nagasaki): these sites also have microblades, which are common in Incipient Jōmon sites in Kyūshū and western Honshū. Incipient Jōmon sites are thus differentiated by the presence of ceramics possibly along with edge polished stone axes, arrowheads, and bifacial spear points (Hagiwara 2001; Kuzmin 2013; Nakazawa, et al. 2005; Ono, et al. 2002). It should be noted that there already prolific production of edge-polished stone axes much earlier in Japan, ca. 38-32,000 cal BP (MIS3), in the early Upper Paleolithic period, with 896 known examples of chipped or edge-ground axes from 224 sites in Honshū and Kyūshū but none in Hokkaidō (Tsutsumi 2012). Use of axes is then abandoned until it starts again in the Incipient Jōmon time period.

Undecorated pottery with Mikoshiba-type lithics are also found in central Honshū during the same initial phase of pottery making as Ōdai Yamamoto I. Dates for the Kitahara 北原 site (Kanagawa; ca. 16,200-14,600 cal BP) and Maeda Kōji 前田耕地 (Tokyo; 16,150-14,600 cal BP) (Nakazawa, et al. 2011) overlap with Ōdai Yamamoto I, and Keally, et al. (2004) list 10 sites with reliable dating falling in the range 16,500-13,500 cal BP. Decorated pottery (Phase 2) begins ca.15,700 cal BP (Kaner 2009). Taniguchi (2005) lists 13 radiocarbon dated sites from Phase 2, by which time pottery making has spread throughout Japan.

Although until recently it was thought that the Incipient Jōmon did not reach the northern island of Hokkaidō, pottery dated to 15,300 cal BP has been found there at the Taishō 3 大正 3 site (Obihiro City) (Craig, et al. 2013; Kuzmin 2010). At Taishō 3, ca. 400 potsherds were recovered, and five reconstructed vessels all feature bottoms with nipple-like projections (Figure 5). Vessel surfaces were decorated with cord-marking, punctates, *tsumegatamon*, and linear relief (Bunkachō 2006; Yamahara 2006).

Pottery is present in the south, in Kyūshū, by 15,000 cal BP, such as at Fukui Cave Layer 2 (Nakazawa, et al. 2011) and at open air sites there by 13,500 cal BP, such as Sōjiyama 掃除山 (Kagoshima), thought to be a winter camp, which also has grinding stones, stone arrowheads, chipped adzes, and scrapers, and boat-shaped, stone-lined hearths: such hearths are only found at linear-relief pottery sites (Pearson 2006), and perhaps indicate advances in pyrotechnology tied to the ability to make this pottery as well as changes in cooking techniques and fuel usage and heat yield.

Thus, the earliest *decorated* pottery occurs during the Bølling-Allerød warming period, and it rapidly disperses across the archipelago at a time when there may have been significant changes in subsistence and mobility patterns (an overview of can be found in Tsutsumi 2002). There is also great diversification in pottery decoration coupled with intensification of lithic production seen at sites. For example, the assemblage at

Kosegasawa 小瀬ヶ沢 cave (Niigata; ca. 12,500 cal BP) varies remarkably from Phase 1 sites, with over 1000 sherds divided into 22 styles recovered along with 500 large bifacial projectile points, 500 arrowheads, 100 adzes, various blades, awls, scrapers, etc., including early tanged scrapers that become common later in the Jōmon (Kaner 2009; Yoshida, et al. 2013). This change occurs during the Younger Dryas, but Yasuda, et al. (2004) believe the Younger Dryas's impact on maritime Japan was much less than on inland continental areas of the rest of East Asia: Japan's climate became colder and snow accumulation increased, but stands of forest still remained.

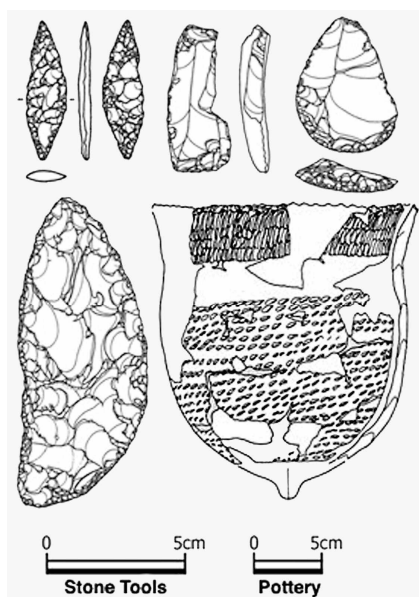


Fig. 5: Examples of lithic artifacts and a reconstructed pottery vessel from the Taishō 3 site. After Nakazawa, et al. (2011).

### Changing mobility and identity

Sites of the Incipient Jōmon are small, most likely seasonal camps inhabited by pottery-making hunter-gatherers, as were early pottery sites in China. Kaner (2009) describes that during Phase 1, as seen in the intensively investigated southern Kantō region, hunter-gatherers were highly mobile, moving around throughout large territories. During this time period, microblade sites contain lithic raw materials from up to 200 km away, while bifacial point industry sites have raw materials from up to 100 km away; Sano (2011) sees these distances as evidence of the hunter-gatherer groups' total range sizes. In Phase 2, still-mobile groups now circled annually through smaller ranges than before, with more developed and intensive utilization of plant and animal resources (such as fish, perhaps, as seen in pottery residues) within these areas. Kaner (2009) thus sees the first use of pottery in central Honshū during Phase 1 as occurring during a time of intensive information flow (with both Mikoshiba-type assemblage- and microblade assemblage sites in the same region) and fluidity and instability of social networks. Diversification of pottery in Phase 2 occurs

when social networks were becoming more embedded in place, and the new, decorated pottery could serve in newly necessary expressions of identity. Mizoguchi (2002), notes a shift in mobility during the Incipient Jōmon to “radiating mobility” with rounds between fixed locales, and sees this as also a shift to higher predictability of resource availability that can be based in a group’s past experience; it thus also marks new senses of territoriality and attachment to place, and therefore new types of relationships between groups and new notions of identity, or what he calls “topographies of identity” (Kaner 2009).

### Pottery residues

In contrast to our lack of knowledge concerning the use of early pottery in China, recently published data from chemical analyses of carbonized adhesions on Incipient Jōmon pottery give direct indications of how the pottery was used. Craig, et al. (2013) carried out molecular and stable isotope analyses of adhesions on 101 sherds from 13 sites throughout Japan dating 15,300-11,200 cal BP. They found that most had lipids from the oils of high-trophic-level freshwater and marine organisms: these vessels were most likely used for processing various kinds of fish, shellfish, or possibly marine mammals. They conclude that, “aquatic products were the most frequently processed products in Incipient Jōmon pottery.... Whether ceramic vessels were integral to the processing of aquatic resources or, as is suggested by their rarity, were used only occasionally, perhaps ceremonially or as a prestige technology, remains debatable. The appearance of pottery at Late Pleistocene sites located on narrowing coastal plains and along rivers where there was an abundance of terrestrial game, aquatic resources and fresh water might have led to decreased mobility permitting a greater investment in pottery production for either purpose” (Craig, et al. 2013). Stable isotope analyses on charred adhesions on pottery from 8 Incipient Jōmon sites in Niigata by Yoshida, et al. (2013) show similar results as well as indications that a small portion of the early pottery was used for separately cooking nuts. The Niigata sites, and Taishō 3 in Hokkaidō analyzed by Craig, et al. (2013), though distant from the sea, still had signatures of marine resources, so people probably fished anadromous salmon and trout from nearby rivers (Kunikita, et al. 2013).

Aside from the poor preservation of bone and plant remains due to its volcanic soils, Japan has the richest excavated material culture record in eastern Asia for the Late Pleistocene period, so we can better assess patterns of pottery and lithic distribution than in China. Nakazawa, et al. (2011) looked at pottery distribution at sites through the Incipient and Initial Jōmon periods, till 8500 cal BP. Using 332 published radiocarbon dates to understand the impact of the sudden climatic downturn of the Younger Dryas on pottery sites, they found 3 sites dated before 14,700 cal BP, 21 sites from the Bølling-Allerød, 7 sites from the Younger Dryas, and 36 Preboreal sites. The size of pottery assemblages at sites significantly decreases in the Younger Dryas: the median size of Bølling-Allerød assemblages are 50% larger than Younger Dryas assemblages, and the median size of early Holocene (Preboreal) assemblages is 400% larger, with the largest number of sherds at a Preboreal site being 66 times more than the largest number at a Younger Dryas site (Preboreal sites are more sedentary, too). Keally, et al. (2003) quantify a similar increase in raw sherd counts. This pattern for the early Holocene probably holds in China, too, where, though not yet quantified, the amount of pottery found at sites increases dramatically

compared to earlier sites, as the use of pottery becomes more imbedded and regularized in daily and special activities across more sedentary human groups inhabiting Early Neolithic villages (Cohen 2011).

Despite decreases in site numbers and amounts of pottery in Japan during the Younger Dryas, Nakazawa, et al. (2011) show that foraging patterns remained the same, as sites continued in the same latitudes and altitudes during the Younger Dryas. Thus, population sizes might have contracted but groups were never isolated and knowledge of pottery making could continue. Perhaps this was accomplished through the maintenance of broad-scale hunter-gatherer social networks at the same time as they were exploiting in new or more intensive ways smaller resource patches, including marine and freshwater resources, acorns and nuts, and geophytes, in what was still a more forested environment than during the glacial period (Yasuda, et al. 2004). Adaptations in this period also set the stage for the great changes in pottery production, sedentism and settlements, toolkits, and subsistence systems at the onset of the Holocene and the Initial and Early Jōmon periods (Kobayashi and Kaner 2004).

## **EARLY POTTERY IN THE RUSSIAN FAR EAST AND SIBERIA**

Early pottery first appears ca. 16,800 cal BP among Late Pleistocene hunter-gatherer groups in the conifer and birch-alder forests of the Amur River basin of the Russian Far East: it thus appears later than in South China by at least several millennia but roughly contemporaneously with the earliest pottery in the Incipient Jōmon in Japan (Kunikita, et al. 2013; Kuzmin 2006; Kuzmin 2010), and some five millennia earlier than in North China. The Russian sites have been called “Initial Neolithic,” with “Neolithic” simply being defined by the presence of pottery (Jordan and Zvelebil 2009b; Kuzmin 2006). Initial Neolithic sites include, in the Lower Amur River basin, sites of the Osipovka cultural complex such as Khummy (16,780-15,450 cal BP), Gasya (16,390-15,070 cal BP), Goncharka 1 (15,070-14,200 cal BP; 13,300-13,000 cal BP on pottery adhesions), Novotroitskoe 10 (13,500 cal BP on pottery adhesions), and Gosyan; and in the Middle Amur (Zeya River) region, Gromatukha (14,950-14,060 cal BP) and Novopetrovka 2 (no dates available). Early pottery is found later in Western Primorye at Chernigovka-1 (12,800-8300 cal BP), and in Eastern Primorye at Ustinovka-3 (10,600 cal BP), roughly at the same time as the transition to the Early Neolithic in the Lower Amur as seen at the Kondon 1 site (11,000-9900 cal BP) (Kunikita, et al. 2013; Kuzmin 2006; Kuzmin 2013; Zhushchikhovskaya 2009).

Initial Neolithic sites are transitional between older Paleolithic traditions and typical Neolithic sites of the Holocene, with pottery and ground stone tools gradually appearing amongst Upper Paleolithic toolkits. Fishing, and particularly salmon fishing, likely was added to the subsistence system, perhaps allowing previously mobile Paleolithic hunter-gatherer groups to become more sedentary where these resources were more abundant (Zhushchikhovskaya 2009); fishing is indicated by the presence of net-sinkers at the Amur sites (Kuzmin and Rakov 2011). As in China and Japan, early pottery production is at a very low scale, with only limited quantities of sherds being found at sites. Pottery at Gasya,

Khummy, Gosyan, Gromatukha, Chernigovka-1, and Gorny Khutor has plant fiber tempering. The reconstructed vessel from Gasya and the four from Goncharka have a flat base (Figure 6). Firing temperature was low, perhaps 450-600 °C. Gasya and Khummy pottery has vertical grooves 1 mm deep and 2-3 mm wide. Zigzag or net impressions on the exterior and sometimes interior surfaces, such as from Khummy, may have been from baskets or cord bags being used in shaping the pots (Gibbs and Jordan 2013; Zhushchikhovskaya 2009), leading Zhushchikhovskaya (2009) to surmise that early pottery might have been modeled upon basketry.

To the west, data for Eastern Siberia show pottery present at the Ust'-Karenga 12 site in northern Trans-Baikal in a conifer forest biome ca. 13,310-12,900 cal BP, making it the earliest pottery west of the Amur (Kuzmin 2013; Kuzmin and Vetrov 2007; McKenzie 2009). The site belongs to a cluster of over 30 sites at the confluence of the Vitim and Karenga Rivers. The pottery differs from the earliest of the Amur region, with pointed bases and comb-pattern, cog-stamped, herringbone, and zigzag decorations, but it, too, is plant fiber tempered; grooves from smoothing with grass bundles or comb tools are found on the interior and exterior surfaces. Associated lithics number in the thousands and are typical of the final Upper Paleolithic, including wedge-shaped and other microblade cores, burins, scrapers, knives on blades, chisels, points, and bifaces, primarily on flint. Two other sites in Transbaikal may have Terminal Pleistocene pottery, as well. In the south, near Mongolia, the Ust-Kyakhta site (ca. 13,610-13,160 cal BP) has wedge-shaped microblade cores, ostrich shell beads, and 10 small sherds tempered with crushed minerals and ostrich shell, and the Studenoe 1 site (14,230-13,420 cal BP), in western Transbaikal, has thin-walled (ca. 0.3 cm), pointed bottom vessels with string impressions, but its dating is debated: however, the string and cord-marked pottery first seen at Studenoe 1 contains the decorations that subsequently become the earliest found across other parts of Eastern Siberia (Gibbs and Jordan 2013; Kuzmin 2013; Kuzmin and Vetrov 2007; McKenzie 2009).

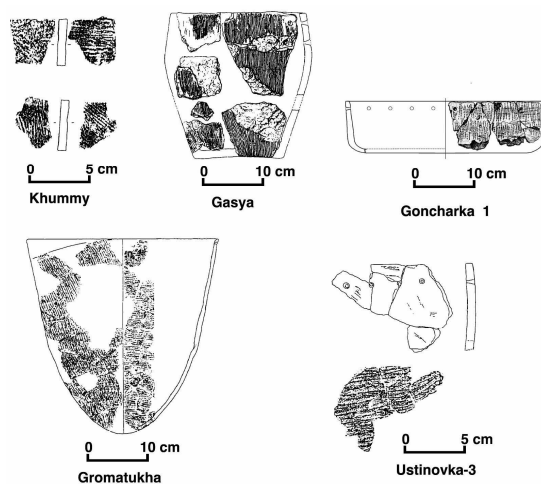


Fig. 6: Examples of early pottery from Initial Neolithic sites in the Lower Amur River basin (Khummy, Gasya, Goncharka 1), the Middle Amur region (Gromatukha), and Eastern Primorye (Ustinovka-3). After Ōdai Yamamoto *I seki hakkutsu chōsadan* (1999) and Buvit and Terry (2011).

## **An hypothesized hunter-gatherer dispersal of pottery across Eurasia**

A series of Early Holocene Neolithic sites, such as the Sumpanya complex, with pointed-bottom vessels with incised and combed decoration, also are known on the central West Siberian Plain (Kuzmin and Vetrov 2007). Pottery may also have been present in West Siberia as early as 10,000 cal BP at Yurtobor 3 (Tobol-Ishim region) and Lake Andreevskoe site YAO-18 (Gibbs and Jordan 2013). These sites now raise questions about the dispersal of pottery technology from eastern Asia into Europe, but there are still very few sites found across the vast extent of Siberia and a large geographic gap between West Siberian sites and those above. Jordan and Zvebil (2009b) propose a model of the dispersal of pottery among hunter-gatherer groups from East Asia through southern Siberia and into Northern and Eastern Europe, and then a southward spread might have brought pottery into Pre-Pottery Neolithic agricultural communities in the Near East, from which pottery and agriculture as a package then spread into southern and western Europe. Others, particularly Kuzmin, argue that data are too limited to make such claims (Kuzmin and Vetrov 2007). Within Siberia, Gibbs and Jordan (2013) hypothesize an “Hyperborean stream” of dispersal for pottery—this is an environmentally based argument in which pottery may have dispersed in the Early Holocene because the expansion of forests along river valleys and the formation of shallow lakes created a string of new biomes favorable for the exploitation of new pottery technology to its full potential: pottery technology spread, they argue, because pottery use would have been readily adaptable to the variety of economic, social, and technological traditions of groups across this vast Siberian expanse who were connected by new riverine and lacustrine ecological corridors.

## **CONCLUSIONS AND CONSIDERATIONS**

New East Asian data on early pottery challenge older narratives of cultural progress, in which pottery is an element appearing among a Neolithic “package” of cultural features and processes tied to sedentism and farming that inevitably comes to replace hunter-gatherer subsistence patterns (Jordan and Zvebil 2009b). As shown above, in China, Japan, and the Russian Far East, early pottery is found only in limited amounts in a small number of archaeological assemblages belonging to mobile or semi-mobile hunter-gatherer populations beginning in the Last Glacial Maximum, and it persists in episodic, low scale usage until the Early Holocene, when a new phase of pottery use is signaled by widespread appearance of pottery across many or all sites in a region, exponentially greater amounts of pottery found at sites (such as Early Neolithic villages in China and Early Jōmon settlements in Japan), and the much greater diversity of pottery forms and decorative styles. At this point, with larger, sedentary social groups, early food production, and the beginnings of social differentiation, the extensive use of pottery shows that it has become completely embedded in daily subsistence practices for the entire population, as well as in ritual practices and in social signaling.

As the amounts of pottery produced, the diversity of its forms, and its dispersal patterns change through time, so, too, perhaps, did the roles of pottery. Therefore, to understand the invention of pottery and its dispersal and adoption, we must consider its



contexts and scales of use across not only different time periods and regions at the site level, but also on an inter-site, local scale, for while early pottery was made or used at one site, there were other, contemporary sites within the local region without pottery. We still need to better understand why only a few sites have pottery (and only in very small numbers) while others in the same region and time period have none.

Because of its low scale of production and use and crudeness in manufacture (unprocessed clay, thick, uneven walls, unsorted inclusions, simple or no decoration, and low firing temperature), early pottery must have had different roles than it came to have in the Holocene. The contrast in the scale of early pottery production has led scholars to hypothesize that early pottery may have mainly been invented and used for special purposes—in ritual or other special activities or for processing or cooking special foods—and not for every-day purposes by all members of the social group (Craig, et al. 2013). This point has been emphasized by Hayden (1998; 2009a; 2009b), who argues that early pottery was a “prestige technology”—a functional item with special symbolic or socio-political value—used for preparing or serving food for special events—feasting—that allowed certain individuals, through offering special foods to others, to achieve socio-political goals such as building or strengthening kinship bonds and long-distance networks, creating ritual ties with others, and promoting exchange. Hayden models this in terms of self-aggrandizing individuals in transegalitarian hunter-gatherer groups being the main agents, with these individuals using pottery in feasts to build debt relationships in promotion of their own self-interests, such as to mobilize others or to build alliances for times of conflict or resource stress (Hayden and Villeneuve 2011). Pearson (2005), contrary to Hayden, in looking at the early pottery in South China but seeing no evidence of social differentiation, argues that pottery could be used for feasting, but rather as a collective event used in building social cohesion.

Whether used for feasting or not, pottery still offered utilitarian or economic value in subsistence, but we still have limited understanding of its economic roles and usages, except from the residue analyses done on Incipient Jōmon pottery discussed above that indicated most pottery was used in processing aquatic resources. Elston, et al. (2011), following the results of the faunal study by Prendergast, et al. (2009) in South China, see North China early pottery as an “intensification technology” tied to bone grease production among hunter-gatherers with a focus on hunting (indicated by microblade technologies): this is an optimization/efficiency model. They also point out that the early pottery in South China, Japan, and the Russian Far East appears with lithics they identify as hunting gear and not with grinding stones for plant processing. While pottery certainly could play an economic role and make for more efficient processing and cooking, and increase energy yields of meat, fish, shellfish, nuts, and other plant foods, we still have no data available from residue analyses and other direct analyses as to exactly how the pottery was being used in North China, South China, or Russia. Whatever its exact usages, the long-lasting rarity and episodic appearance of early pottery—and its widespread dispersal despite this rarity—cannot be fully accounted for only in terms of it being a utilitarian adaptation tied to subsistence.

Lastly, questions still remain concerning the nature of the origins of pottery, and particularly if it was invented in one place in East Asia and then spread throughout Eurasia

from there, or if it was the result of multiple inventions in different regions. Due to what was previously seen as contemporaneity for early pottery sites in South China, Japan, and the Russian Far East, and to the typological differences of the pottery and the paleoenvironmental differences between these areas, Kuzmin and others have argued that there were probably multiple independent inventions of pottery in these regions (Keally, et al. 2004; Kuzmin 2013; Kuzmin, et al. 2009). However, more sites are being found and old sites are being better dated, and we now know that Xianrendong and Yuchanyan pottery is clearly earlier by at least several millennia than other regions. Second, archaeological contemporaneity does not rule out a single origin and dispersal, as sites of the same archaeological phase or with the same radiocarbon date in the Late Pleistocene actually fall within a real calendrical range on a centuries to millennium scale due to probability of the determinations. Thus, depending on the extent of hunter-gatherer information exchange networks, the speed at which information flows through them, and the scale and patterns of mobility of all the groups tied together through the long chains of inter-linked networks, knowledge of pottery making could have spread rapidly and widely. Therefore, we now need to consider the possible areal scope of hunter-gatherer information networks and social organization. These can be inferred by looking at other materials, such as shared lithic technologies, which in the case of both microblade technology and core-chopper industries, have much greater distribution areas than early pottery itself does. Archaeological remains and genetic studies, as we have noted above, too, give indications of broad, complex population movements and interaction in eastern Asia during the Late Pleistocene among mobile populations. The possible extent of these is exemplified by the peopling of the New World from Asia during this same time period and open-water navigation into Japan, Sahul, and Australia. Independent invention of pottery should imply relatively isolated groups and regions, and although early pottery is produced at a low scale and is found at only a few sites, other cultural materials and technologies present in all of these pottery sites give indications of the hunter-gatherers that produced them being tied into larger, trans-regional networks. More physical and chemical analyses of the early pottery itself, better dating of sites, and increased attention to the nature of hunter-gatherer interactions and mobility in Late Pleistocene East Asia are all required for better understanding of the origins and dispersal of early pottery.

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## 東亞早期陶器的出現與散布： 關於世界最早陶器的新年代與新思考

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### 摘要

本文欲討論近來在華北、華南、日本、俄羅斯遠東地區與西伯利亞東部等地區所發現，年代屬於更新世晚期的早期陶器的年代與功能，並對它們出現和散布的模式與緣由提出新的思考。早期陶器所出現的情境，除了出現少數的陶器之外，基本上皆與更新世晚期的遺址相似。在東亞地區，最顯著的就是沒有植物栽培的證據，這無疑使得過去認為陶器的出現與擴散經常與農業相伴的看法受到了挑戰。因之，我們需要對於狩獵採集社會中陶器的發明與散布給予慎重的思考。

本文首先檢視出現於華北與華南舊石器脈絡中的早期陶器。華南仙人洞遺址的發掘及測定年代顯示，該遺址的陶器出現在校正年代距今大約 20,000 年前的地層中，正當末次冰期盛期的期間，比過去所知早期新石器時代定居村落在中國初次出現的年代早了一萬年。湖南玉蟾岩遺址出土了校正年代距今 18,300 年的陶器，同時出現了從鹿骨中擷取骨髓及油脂的證據，可能代表狩獵採集遊群年度性地光顧這個遺址。

在華北，出現早期陶器的遺址，例如于家溝、轉年、東湖林、李家溝及南庄頭，年代相對較晚，大約是在新仙女木事件氣溫下降的時候，晚於華南早期陶器的年代約 8,000 年，也晚於日本及俄羅斯遠東約 4,000 年。華北的遺址呈現出使用細石瓣及（或）磨石的多樣性適應，以及採集禾本類（如小米）、橡子和根莖類等野生植物的證據。這些遺址也許代表狩獵採集者在仙女木事件時期退居到比較適於居住的環境，減少遊居，成為半定居，並密集開採居住地周邊的資源。

日本早期陶器開始於大約年代距今 16,800 年，相當於繩紋草創期。而俄羅斯遠東是出現於新石器初期。繩紋草創期的遺址大約與晚舊石器時代末期的遺址同時，分布在從九州南部到北海道（大正 3 號遺址）。80 處已知遺址，提供了有關於陶器分布類型與從最早的遺址（大平山元 I 遺址）到全新世期間關於各種氣候變遷適應的良好證據。關於陶器附著物的分子生物與穩定同位素分析，提供了關於日本早期陶器使用的重要資料：陶器被廣泛的使用在處理海洋與淡水動物。這些資料完全不見於東亞其它地方。

如同晚舊石器時代末期遺址，繩紋草創時期也可能擁有細石瓣、磨刃石斧、箭頭、雙面矛頭。素面陶器與神子柴形石器同時出現在陶器製作早期階段（大平山元 I 遺址、北原遺址與前田耕地遺址，距今約 16,500—13,500）。有裝飾的陶器（階段二）約出現在

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15,700 年前開始的博令—阿勒羅德 (*Bølling-Allerød*) 暖化階段，並且迅速地擴散到整個群島，在這個階段產生了生計與移動性重大的改變。階段一的陶器可以發生在密集資訊流動的社會網絡中，階段二陶器的變異性則發生在社會網絡變得與地點更加嵌合的情況。

俄羅斯新石器早期陶器的遺址，如 *Khummy*, *Gasya*, 以及在 *Amur* 河下游河谷的 *Goncharka 1*，是舊石器傳統與全新世典型新石器的轉換期，陶器與研磨石器逐漸在舊石器晚期的工具組中出現。如同在中國與日本，早期陶器的製作規模甚小，僅有數量極少的陶片在少數遺址中被發現。西伯利亞東部的早期陶器首次在 *Ust-Karenga 12* 遺址出現，大約距今 13,000 年前，陶器可能越過西伯利亞向西邊擴散，狩獵採集群體可能即是將陶器帶入歐洲的人。

在整個東亞，早期陶器出現的數量很少，同時只出現在少數幾個遺址中，持續低頻度地使用於末次冰期盛期到全新世早期之間。我們有必要去理解何以會產生這種現象。早期陶器或許是為了某種用途而被發明與使用，例如用於飲宴中來達成多種社會政治的目地。然而，陶器雖然同時提供了實用性與經濟性的價值、所具有之耐久與小規模的使用性，以及大規模的擴散性，但是不能僅僅解釋為一種對生計及持續增加能量產出的適應。關於東亞陶器是否為單一起源或多個起源的問題仍舊存在。中國南部的遺址明顯是更為早期的，然而與之同期的日本與俄羅斯，並不能排除單一起源與擴散的可能性。因為在更新世晚期具有相同放射性碳素年代的遺址，在曆年上實際是落入數世紀之久的年代尺度內。我們仍有必要對狩獵採集社會移動性之規模與形態，以及東亞更新世晚期陶器製作訊息擴散的交換網絡範圍有更多理解。

**關鍵詞：**早期陶器、中國南部、繩紋草創期、俄羅斯遠東