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FRONT COVER: Sarah and Sally Beckmann among a collection of Roman portraits from the villa of Chiragan, kept in the Musée Saint-Raymond in Toulouse, France. Sarah’s article on several Late Antique sculptures from Chiragan appears in the January 2020 issue of the American Journal of Archaeology.

BACK COVER: Brittany Dolph Dinneen consolidates the surface of a cuneiform tablet in preparation for the reopening of the Morgens West Galleries of Ancient Near Eastern Art at the Michael C. Carlos Museum, Emory University. (Photograph courtesy of Emory Photo/Video).

ABOVE: Ruth Tringham, University of California–Berkeley, presents a Friday Seminar: Giving Voices—Without Words—To Prehistoric People, February 8, 2019.
In the United States we are surrounded by a variety of material-based technology, ranging from laptops and cell phones to clothing, bicycles, forks, spoons, chopsticks, and cooking pans. Archaeologists investigate technology to understand human behavior and society, and the ways they change. In the past, some technologies were invented, adopted, and eventually abandoned; others went through a series of changes and continued to be used for millennia. Ceramics are among the latter. The oldest ceramic technology dates to the Upper Paleolithic in Europe (32,000–27,000 cal BP) in the form of fired clay pellets and figurines (Farbstein and Davies 2017; Iizuka 2018:267; Svoboda et al. 2015). Current evidence indicates that the first ceramic vessels did not appear until the Late Pleistocene. The oldest pottery is found in eastern and northeastern Asia; this is suggested to be associated with hunting and gathering (Iizuka 2018:268). In this area, absolute dates for early pottery are between 20,000 and 17,000 years ago in South China (Boaretto et al. 2009; Cohen et al. 2017; Wu et al. 2012), between 16,000 and 14,000 years ago in the Russian Far East (Buvit and Terry 2011; Hashizume et al. 2016, 2017; Kuzmin 2002), around 14,000 cal BP in Trans-Baikal (Kuzmin 2017), and between 17,000 and 15,000 cal BP in Japan (Kudo 2012; Morisaki and Natsuki 2017).

I currently pursue the topic of the origins of pottery in East Asia and argue here that geochronology is unreliable in certain regions and that without more and more accurate dates, it will remain difficult to conduct interregional technological comparisons and to understand intraregional technological and behavioral variability. I also introduce my research on pottery from the southern area of Kyushu, the southernmost major island of Japan. In this region, pottery is associated with a firm geochronology within the Late Pleistocene. This article is an excerpt of my research review on the origins of pottery in East and Northeast Asia (Iizuka 2018), with some recent research updates. Calibrated radiocarbon dates provided here are based on the calibration in Iizuka (2018), unless noted.

**SOUTH CHINA**

In South China, archaeological sites with Late Pleistocene dates that are commonly discussed in English-language literature include Xianrendong (Cohen et al. 2016, 2017; Kuzmin 2002), around 14,000 cal BP in Trans-Baikal (Kuzmin 2017), and between 17,000 and 15,000 cal BP in Japan (Kudo 2012; Morisaki and Natsuki 2017).

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2017; MacNeish 1999; Wu et al. 2012), Diatonghuan (MacNeish 1999; Zhang 2002), and Yuchanyan (Boaretto et al. 2009; Lu 2010; Yuan 2002) (Figure 1). These sites are associated with limestone caves in the Yangtze River valley. The Xianrendong site was excavated by a group of Chinese scholars in the 1960s, by a Sino-American team in the 1990s, and again by a Chinese team in 1999 and 2000 (Cohen et al. 2017; Wu et al. 2012). The radiocarbon dates for the earliest ceramic phase, identified as the Xian Ren phase in the 1990s are between 17,625 and 16,775 cal BP (Sample UCR3440) and 15,225 and 14,165 cal BP (Sample BK95145) (MacNeish 1999). Zhang (2002) evaluated these early dates and suggests that the Xian Ren–phase materials are earlier than 14,992–14,164 cal BP. Environmental studies report both wild and domesticated rice (Oryza sativa) phytoliths in upper Xian Ren–phase pottery-yielding layers (Zhang 2002; Zhao 1996). Wu et al. (2012) revisited the site in 2009 and obtained sediment blocks and samples from profiles of previous excavations for micromorphology and accelerated mass spectrometry (AMS) radiocarbon dating. They concluded that post-depositional disturbances are minor. The AMS dates associated with the earliest pottery were between 21,435 and 20,660 cal BP (Sample AA15005) and between 17,540 and 17,115 cal BP (Sample BA09872). These dates range between the Last Glacial Maximum and the early half of the Oldest Dryas, currently the earliest time periods for pottery in the world, meaning that pottery must have been adopted by hunter-gatherers, prior to sedentism and the cultivation of wild rice (Iizuka 2018:279; Wu et al. 2012).

The research history and new AMS dates are problematic given the wide range of dates associated with early pottery, the environment, and evidence for subsistence practices. In South China, the process of rice cultivation and domestication seems to have started in the Holocene (Higham and Lu 1998; Zuo et al. 2017). The limestone geology in South China has been shown to yield inaccurately old radiocarbon dates, with discrepancies as large as 2,000 years (An 1991; Lu 2010). I therefore suggest that the dates provided for Xianrendong may have errors of up to
10,000 years and that the available materials and data need to be reevaluated.

Diatonghuan is a site near Xianrendong and seems to have similar problems (Iizuka 2018). It was excavated by a Sino-American team in the 1990s (MacNeish 1999; Zhang 2002). The radiocarbon dates for the earliest pottery are thought to be from the Xian Ren phase, 14,060–13,390 cal BP (Sample BK95138) (MacNeish 1999), or at least from 12,430 ± 80 BP (14,992–14,164 cal BP) (Zhang 2002) or 18,780–17,875 cal BP (Sample BA00014) (Wu and Zhao 2003; Iizuka 2018:279). This site yielded wild rice (MacNeish 1999), and domesticated rice phytoliths associated with early pottery (Zhao 1998), which Zhao (1998) estimated to be from the Early Holocene.

Yuchanyan was excavated by Jiarong Yuan in the 1990s and the Boaretto group in 2004 and 2005 (Boaretto et al. 2009; Yuan 2002). Boaretto et al. (2009) provided AMS dates from their excavation in a range between 18,300 and 15,000 cal BP for early pottery. The excavation and dating seem rigorous and reliable. However, sherd clusters from earlier excavations, probably associated with much younger dates—13,770–13,560 cal BP (Sample BA05420)—were found in relative close proximity to a sherd excavated in 2004 (Boaretto et al. 2009), should also be taken into consideration (Iizuka 2018). Whereas Boaretto et al. (2009) suggest that the site was used by hunter-gatherers, an earlier report by Yuan (2002) suggests that husks of wild and semi-domesticated rice were uncovered near the bottom layer, similar to contexts in which pottery was encountered (Iizuka 2018; Yuan 2002). Therefore Yuchanyan also suffers from discrepancies between the antiquity of the radiocarbon dates and the timing of the process of rice domestication.

TRANS-BAIKAL

In Trans-Baikal, early pottery-yielding sites associated with mobile foraging include Studenoe 1 (Figure 1). This site was investigated starting in 1975 (Konstantinov 1994). Buvit et al. (2003) conducted geoarchaeological studies at the site in 1998. The earliest pottery was encountered in Cultural Horizons 9 and 8 of Unit VI (Buvit et al. 2003; Khlobystin and Konstantinov 1996; Kuzmin and Vetrov 2007). Radiocarbon dates of Cultural Horizon 9G range between 14,025
and 13,305 cal BP (Kuzmin 2017; Razgildeeva et al. 2013). However, Buvit et al. (2003) demonstrated inconsistencies in radiocarbon dates of 10,000 years or more at this site in both Paleolithic and Neolithic contexts (Buvit and Terry 2011). Konstantinov (2016) suggests that Humic Layers 9 and 8, from which early pottery was recovered, developed during the climatic optimum of 7,000–6,000 cal BP (Iizuka 2018). The cause of the discrepancy between the radiocarbon chronology and the stratigraphic data is yet to be determined. In a poster presented at the 2019 conference of the International Union for Quaternary Research (INQUA), we hypothesize that among the causes may be old carbon originating from Lake Baikal (Konstantinov et al. 2019).

THE JAPANESE ARCHIPELAGO

Inferences based on sites in the Japanese Archipelago with absolute dates for Late Pleistocene pottery generally tend to be accepted in the English-language literature (Kudo 2012; Keally et al. 2003; Kuzmin 2013, 2017). Nevertheless, caution is required here as well. For example, the Odaiyamamoto I site in the Aomori Prefecture of northern Japan (Figure 1) has been dated between 17,200 and 14,500 cal BP (Iizuka 2018; Kudo 2012; Nakamura et al. 2001; Odai Yamamoto I Site Excavation Team 1999). The first problem is that the date of the site is partly based on the presence of stone tools belonging to the Chojakubo-Mikoshiba lithic assemblage, associated with the late Upper Paleolithic and Incipient Jomon (Sotogahamamachi Board of Education 2011). These tools, however, were dated by tephrochronology at another site without pottery, but containing similar stone tools, in the Aomori Prefecture. Another issue is the presence of anomalous radiocarbon dates, as early as 8,000–7,800 cal BP, which are not explained by a careful evaluation of the site formation processes (Iizuka 2018; Odai Yamamoto I Site Excavation Team 1999). A recent re-exca-vation in Fukui Cave, in the Nagasaki Prefecture on Kyushu Island in southern Japan, is detailed and has yielded abundant radiocarbon dates (Sasebo City Board of Education 2016). The timing of micro-level technological changes, however, appears difficult to discern.

My colleagues and I have chosen southern Kyushu as the focus of our research. With tephrochronology, this place has produced some of the most reliable dates for Late Pleistocene pottery in eastern and northeastern Asia (Iizuka 2018; Iizuka and Izuho 2017). Materials from the earliest pottery period, the Incipient Jomon (14,000–13,500/12,800 BCE), associated with foraging, are commonly encountered below Satsuma tephra, dated to 12,800 cal BP. Because of this, it is possible to conduct intraregional studies of technologies and reconstruct human behavior. We are interested in understanding intraregional behavioral variability and changes from the Upper Paleolithic to the Incipient and Initial Jomon periods, around 38,000–7,300 cal BP. We study stone tools and pottery technology, features, and site locations. We place these in the larger context of environmental changes such as global climatic fluctuations, local volcanic eruptions, biomes, and sea level changes (Iizuka and Izuho 2017; lizuka et al. 2019a). Reconstruction of pottery technology such as production processes, uses, distribution, and post-depositional alterations is our core research purpose. With reconstruction of the technical process, we evaluate possible performance characteristics and intended functions of the recovered ceramic fragments (Iizuka 2013; Schiffer 1995, 2011; Skibo 2012). My colleagues and I have conducted visual analyses of Incipient Jomon pottery excavated at more than 10 sites (Iizuka and Izuho 2017; lizuka et al. 2016, 2018, 2019a, 2019b). Parameters such as vessel forms, inclusion types, thickness, manufacturing techniques, Mohs hardness, reduction and oxidation patterns, and decorative techniques have been examined. The sites of Kenshojo-Ato and the Soujiyama on Kagoshima are presented here as a case study (Figure 1; Iizuka et al. 2018).

There are more than 50 Incipient Jomon sites within the Kagoshima Prefecture (Iizuka and Izuho 2017; Kagoshima Prefectural Archaeological Center 2019). In southern Kyushu, features and artifacts of the Incipient Jomon include indicators of increased sedentism, with pit houses, game pits, possible smoking pits, grinding stones, and stone plates, but
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with significant intersite variability (Iizuka 2018; Iizuka and Izuho 2017; Morisaki and Sato 2014). We have been studying sites on Tanegashima Island, off the southern coast of Kagoshima, as well as sites on mainland Kyushu. Pottery production likely began around 16,000–15,000 cal BP on mainland southern Kyushu. There are, however, only a small number of sites with both pottery and absolute dates from this context, and a further evaluation of the geochronology is necessary (Iizuka 2018).

Within the context of 14,000-13,500/12,800 cal BP, pottery at Kenshojo-Ato comprises deep bowls and cylindrical vessels that can have raised bases (Aira City Board of Education 2005), while Soujiyama yields deep and shallow bowls with open to somewhat closed mouths and with raised, rounded, or pointed bases (Kagoshima City Board of Education 1992) (Figure 1). Body sherds from Kenshojo-Ato are thicker than those from Soujiyama. All pottery has sandy inclusions and was likely produced using raw materials available within a 10-km (6-mile) radius (Iizuka et al. 2018). Vessels were mainly made by the layering of slabs. Their Mohs hardness was below 2, with an average of about 1.5 at both sites. Vessels from Soujiyama had more variable reduction and oxidation patterns than those from Kenshojo-Ato. Whereas the majority of the material from Kenshojo-Ato is plain, sherds from Soujiyama tend to preserve appliques on the exterior.

Given these results, we assume that Soujiyama had more varied redox conditions and that pottery was produced and used for a wider variety of purposes than at Kenshojo-Ato. Both sites had raw materials readily available, and the relatively soft pottery was not suitable for long-distance transportation. Vessels were thus likely made and used locally. Pottery at both sites has sandy inclusions, indicating that producers prioritized heating effectiveness (Schiffer and Skibo 1997; Skibo et al. 1989). The thicker walls at Kenshojo-Ato, however, may demonstrate that this was less of a concern here than it was at Soujiyama, where walls were thinner (Braun 1983; Eerkens 2005). The common slab technique may indicate the prioritization of the ease of manufacture (Skibo et al. 1989) or that users belonged to the same linguistic group (Gosse-lain 1998; Reina and Hill 1978). If the application of exterior decoration had implications for the display characteristics of the vessels (Mills 2007), Soujiyama potters found this more important than those at Kenshojo-Ato (Iizuka et al. 2018).

Building on our visual analytical results, we are currently conducting instrumental analyses of pottery samples. Pottery sourcing is often done by adopting petrographic and geochemical methods (Iizuka 2017). Pottery thin-section analysis is among the most effec-

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tive ways to evaluate sources of raw materials. For this, pottery is sectioned, mounted on a glass slide, and ground to a 50-micron thickness. The result is studied using a petrographic microscope in cross-polarized light. With this method, mineral and rock types, as well as organic inclusions, can be identified and quantified, and their size, form, and texture can be described. The results can be compared with geological maps of the locations of archaeological sites and areas with raw materials (clayey soils, rocks, and sand). If pottery displays the characteristics of raw materials available near an archaeological site, then the pottery is interpreted to be a local product. However, it is difficult to make such assumptions if the archaeological site is in a geologically homogeneous area. If there are inclusions of non-local origin that are also not introduced by river or sea currents, the pottery may have been transported from elsewhere.

The use of the polarizing microscope at the Cotsen Institute of Archaeology helped us obtain the petrographic results presented at the 2019 INQUA Congress (Iizuka et al. 2019a). Based on our hypothesis that most pottery was produced locally but that some vessels may have been transported from a long distance, we examined 58 thin sections of Incipient Jomon pottery from Sankakuyama I on Tanegashima Island (Figures 1 and 2). We compared these with thin sections of sediments gathered on Tanegashima (with predominantly sedimentary geology; Figure 3),
Yakushima Island (about 17 km or 11 miles away, with mainly granite and sedimentary geology), and southern Kyushu Island (about 33 km or 21 miles away, with some granitic but mostly volcanic geology). The majority of the samples had signatures of local sedimentary geology (Figure 4), at times combined with tephra and minor amounts of naturally transported sediment from Yakushima. A few samples contained non-local granitic materials, likely derived from Yakushima or the Osumi Peninsula of Kagoshima. Our results were concurrent with the conclusions of our visual inspection (Iizuka and Izuho 2017) suggests that pottery was mainly produced by foragers with high degrees of sedentism during the Bølling-Allerød but with significant investments in the long-distance transportation of minor amounts of pottery. Details of this study will be submitted soon to an English-language peer-reviewed journal, so stay tuned for more.

In summary, early ceramic research at regional and interregional levels from the Late Pleistocene requires careful assessments of geochronology. Only with the proper understanding of it can we begin to compare materials from the same time ranges. The Satsuma tephra of southern Kyushu, where we run the project on the origins of pottery, is dated around the onset of the Younger Dryas. Satsuma tephra is found above the Incipient Jomon phase. This place, hence, is an ideal area to begin to reconstruct human behaviors involving early pottery production, uses, circulation, and post-depositional changes.

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