Hunter-gatherer pottery production, use and exchange in the remote Kuril Islands

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Introduction

Archaeological research on the production of pottery in small-scale societies has traditionally emphasized the concepts of sedentism, population size and economy of scale to explain the manufacture and use of pottery (Eerkens et al. 2002). In contrast, recent research on pottery production in East Asia and circumpolar regions have provided clear evidence for the long-term production and use of pottery by a diverse range of small scale, semi-sedentary, hunter-gatherer communities (Jordan & Zvelebil 2009a). This research seeks to add to the growing knowledge of hunter-gatherer pottery production by investigating the manufacture, use and exchange of pottery among hunter-gatherers in the Kuril Islands of Northeast Asia. In the circumpolar Kuril Islands, foraging populations not only produced extensive pottery assemblages for nearly seven millennia (Yanshina and Kuzmin 2010) but did so in light of strong environmental constraints against pottery production such as short and wet summer seasons, patchy distributions of quality clay resources and the variable availability of firing fuel. Based upon this archaeological and environmental evidence, this research seeks to investigate a fairly simple question; why is there so much pottery in an environment where pottery is so difficult to produce?

The Kuril Islands: Biogeography, Climate and Culture-History

Biogeography of the Kuril Islands

The Kuril archipelago is located in Northeast Asia and includes 32 islands varying in size from 5 km^2 to 3,200 km^2 , stretching in line for almost 1,200 km from Hokkaido to Kamchatka. The most significant geographical feature in the Kuril Islands is the Bussol Strait which separates the southern three islands from the remote islands of the northern and central Kurils (see figure 1). The most defining feature of the remote Kuril Islands compared to the southern islands is their reduced biological diversity. The general pattern of biogegraphy (Pietsch et al. 2003; Fitzhugh et al. 2004) demonstrates higher biological diversity in the southern islands and significantly lower resource diversity in the remote central

and northern islands. This pattern is clearly observed in the flora of the archipelago with the southern islands maintaining a significantly higher diversity of trees and shrubs, including spruce, larch and oak as compared to the tundra-covered northern and central islands (Anderson et al. 2008). The fauna also clearly demonstrates this pattern with the southern islands containing much higher diversity and abundances of terrestrial mammals (Hoekstra and Fagan 1998), insects, freshwater and terrestrial mollusks and freshwater fish (Pietsch et al. 2001; Pietsch et al. 2003). The central islands, while ecologically less diverse compared to the southern and even northernmost islands, do contain high abundances of marine mammals, particularly sea lions, seals and sea otters, at least at present.

Climate of the Kuril Islands

The modern and paleo-climatic conditions of the remote Kuril Islands are characterized by wet summers and cold, harsh winters (Razzhigaeva et al. 2009). These climatic conditions are strongly influenced by the northwestern winds deriving from Siberia (Leonov 1990). The strong winds create large areas of sea ice which can cover up to one-third of the Sea of Okhotsk each winter. These winds help deliver nearly 138 snowstorm days per year and stable snow cover occurring from November until May (Ganzei et al. 2010). Summers are typically short and often characterized by dense fog and very high air humidity (Fitzhugh et al. 2002; Ganzei et al. 2010).

Culture-History of the Kuril Islands

The earliest archaeological remains in the Kuril archipelago are found in the southern islands at the sites of Yankito, Kuibyshevo and Sernovodskoe and date to around 7800 BP (Yanshina and Kuzmin 2010). Archaeological material from these early sites show the relationship between the southern Kurils and Hokkaido, with pottery from both regions demonstrating thick walls and cord-marked decoration which are both characteristic of the Early and Middle Jomon periods of Japan (Vasilevsky and Shubina 2006). However, it is not until just after 3000 BP that a consistent occupation north of the Bussol Strait is recognized (Fitzhugh et al. 2002; Niimi 1994), see figure 2. The first populations to substantially

colonize both the southern and remote regions of the archipelago likely originate from Hokkaido and are referred to as the Epi-Jomon. The Epi-Jomon cultural group is strongly characterized by cord-marked pottery decoration and this style of pottery has been identified at numerous archaeological sites throughout the island chain (Fitzhugh 2007). For reasons currently unknown, the Epi-Jomon populations experience a rapid decline around 2000 BP and are difficult to recognize archaeologically on the islands after 1500 BP.

Immediately following the Epi-Jomon cultural tradition, the Okhotsk culture flourished under a time of significant social and economic change throughout East Asia from 1500 to 800 BP (Hudson 2004). The development of this culture is argued to have occurred in three distinctive stages (Amano 1979 in Hudson 2004). The first stage is the initial eastern expansion from south Sakhalin Island into the Japanese archipelago including the islands of Rishiri, Rebun and northern Hokkaido. This is followed by a second stage of movement of the Okhotsk culture to the northeastern corner of Hokkaido and into the Kuril Islands (Hudson 2004). Similar to the Epi-Jomon, the Okhotsk culture is recognized throughout the entire island chain with the highest density of settlements in the central and northern Kurils. During the later stages of the Okhotsk period in northeastern Hokkaido and the southern Kurils, the remaining Okhotsk people are believed to have been assimilated by proto-Ainu populations associated with the Satsumon culture (Deryugin 2008). The Okhotsk culture also experiences a rapid decline in the island chain and is difficult to identify archaeologically after 700 BP.

Ethnographically, the Kuril Ainu lived throughout the island chain in relatively large pit house villages as well as smaller seasonal camps (Fitzhugh et al. 2002; Kono and Fitzhugh 1999). Kikuchi (1999) suggests that the Ainu movement from Hokkaido into the Kuril Islands would have likely taken place during the fourteenth or fifteenth centuries AD following abandonment by the Okhotsk culture. During the early eighteenth century and nineteenth centuries the Russian-American Company settled the Kurils with transplanted Alaskan and Siberian sea mammal hunters (Shubin 1994). The Japanese occupation of the Kurils during the twentieth century forcefully displaced many Ainu populations and World War II saw the occupation and fortification of the islands by the Russian military.

Pottery Production in the remote Kuril Islands

The remote Kuril Islands provide a number of challenges in the production of pottery with the most prominent difficulties being small population sizes and restrictive environmental conditions. Based upon preliminary radiocarbon dates developed by the Kuril Biocomplexity Project, the remote regions of the island chain never developed substantial population sizes. Since pottery production is often conceptualized as an economy of scale, where due to the time, resources and energy required for pottery production, the benefits to production are not recognized unless demand for pottery is high and large quantities can be produced in a single production event (Eerkens et al. 2002). In theory, given the small population sizes of nomadic and semi-sedentary hunter-gatherer communities in the Kuril Islands, a high demand for pottery in these regions is unlikely. In addition to the challenges of small population sizes, maritime hunter-gatherers in the Kuril Islands encountered restrictive environmental conditions. Most notable is the shortened and wet summer season when the production process of raw material gathering, vessel formation, drying and firing likely occurred. In addition, the remote Kuril Islands contain a patchy distribution of key production resources, namely quality raw clay and wood firing fuel. The patchy distribution of raw clay is due to the steepness profiles of the central and northern islands which limits secondary clay formation. The variable availability of wood can be attributed to the tundra climate conditions of the central and northern islands with driftwood likely being the major source of fuel in these remote regions. While extensive amounts of driftwood currently exist on specific beaches, the sustainability of driftwood resources in the past is currently unknown.

Investigating pottery production, use and exchange in the remote Kuril Islands

While it is clear that the remote Kuril Islands do not offer a favorable environment for pottery production, the reality of the archaeological record is that pottery remains are spatially and temporally ubiquitous in the central and northern Kurils. This research seeks to investigate the contradiction between the theoretical expectation of limited pottery production due to mobile foragers, small population sizes and a restrictive production environment and the reality of fairly extensive pottery production for over

2,000 years in the remote Kuril Islands. As a starting point in this investigation, I will evaluate three hypotheses concerning the motivation behind pottery production in the remote Kuril Islands. It is important to note that these hypotheses are not mutually exclusive and aspects of each hypothesis may play a greater or lesser role in the development and maintenance of a pottery industry.

H_1: Pottery is produced in the remote Kuril Islands due to a strong cultural connection between pottery and ritual activities.

H_2: Pottery is produced in the remote Kuril Islands for use in everyday subsistence practices.

H_3: Pottery is produced in the remote Kuril Islands for use in the storage, transport and exchange of resources and/or prestige goods (which may or may not include the pottery vessel itself).

H_1: Pottery for ritual activities

This hypothesis suggests that hunter-gatherer populations inhabiting the remote Kuril Islands develop pottery for use in ritual activities. The ritual connection to pottery is likely to have originated within ancestral populations with established and diverse pottery industries, such as those identified on Hokkaido and Honshu (Habu 2004). The archaeological expectation is that if some pottery was produced for ritual contexts, a proportion of the ceramic assemblage from each site would demonstrate "fine-ware" characteristics such as more elaborate manufacturing technology, developed shapes and complicated geometric decorations (Zhushchikhovskaya 2009). In order to evaluate this hypothesis, manufacturing, form and decorative attributes of pottery from the remote Kuril Islands are compared to similar attributes in pottery from the southern island region that occurred within the same temporal period of 1900-2100 BP (see table 1). The time frame is chosen as it represents the height of occupation in the southern and remote Kuril Islands.

The comparison of pottery attributes from archaeological sites in the remote Kuril Islands and the southern Kuril Islands demonstrates similarity in manufacturing and form attributes but differences in decorative styles. The most notable difference in decorative elements is the presence of elaborate

geometric designs (see figure 3) on Epi-Jomon pottery from sites in the southern region as opposed to the ordinary cord-marked decoration found at sites in the remote islands. In my opinion, the similarity in technology and form highlight the shared pottery tradition between the remote Kurils and the southern islands but the differences in decoration between the two regions suggest the pottery in the remote Kuril Islands was not intentionally produced for use in ritual activities.

H_2: Pottery for everyday subsistence practices

The use of pottery in everyday subsistence practices among hunter-gatherers has been established throughout the world, with an emerging association in East Asia between pottery use and the processing of aquatic resources (see Jordan and Zvelbil 2009). The archaeological expectation of this hypothesis in the remote Kuril Islands is that lipid residue analysis on pottery remains will reveal the presence of marine resources. Specifically, residue analysis is expected to exhibit the presence of ω-(o-alkaphenyl) alkanoic acids that are associated with the repeated heating (>270 C) of saturated marine fatty acids and one of three isoprenoid acids (4,8,12 TMTD, Phytanic, Pristanic) common to marine resources (Craig et al. 2011; Evershed et al. 2008).

In order to this evaluate this hypothesis, lipid residue analysis of extracted fatty acids was performed at the Sachs Lab at the University of Washington on 17 ceramic sherds from four archaeological sites in the Kuril Islands (Ainu Creek (south), Vodopodnaya (central), Rasshua (central) and Ainu Bay (central)). The lipid analysis followed established laboratory protocols with the pulverizing of the pottery sherds and extraction of lipid by accelerated solvent extraction in a dicholormethane: methanol solvent. The solvent extract was evaporated under N_2 to obtain a total lipid extraction. The total lipid extract was silylated and analyzed by gas chromatography-mass spectrometry (GC-MS).

Results of residue analysis strongly suggest the use of marine resources in Epi-Jomon pottery from the southern archaeological site of Ainu Creek (see table 2) with an overwhelming presence of aquatic biomarkers (ω-(o-alkaphenyl) alkanoic acids and one of three isoprenoid acids). Interestingly,

pottery remains with Okhotsk cultural associations, which are most commonly found in the remote region of the Kuril Islands, do not demonstrate the same aquatic biomarkers. One possible explanation for the lack of aquatic biomarkers in Okhotsk pottery is the use of terrestrial resources with pottery. However, given the complete lack of terrestrial resources in the remote Kuril Islands, this explanation seems improbable. A second, and more likely explanation, is the use of pottery for subsistence activities that are not directly related to cooking food. Specifically, the rendering of marine oils from fish or marine mammals do not require the higher temperatures (>270 C) (Reid 1989) that would transform portions of marine fatty acids into their aquatic biomarker form (ω-(o-alkaphenyl) alkanoic acids) .

H_3: Pottery for exchange of resources and/or prestige goods

Previous archaeological and ethnographic research in the Kuril Islands has identified an active exchange network existing within the archipelago. Archaeological evidence shows the long-distance movement of obsidian from Hokkaido and Kamchatka into remote areas of the island chain (Phillips 201; Phillips and Speakman 2009). Additionally, ethnographic evidence from the island chain demonstrates a tradition of small "treasure" exchange such as beads, earrings, bird feathers and hides (Ohnuki-Tierney 1976; Tezuka 1998). The archaeological expectation of this hypothesis is that pottery either directly or indirectly (as a storage vessel) participated in the exchange of prestige goods between inhabitants of the remote Kuril Islands and the southern Kuril Islands and/or Hokkaido. Therefore, assuming reciprocal exchange of pottery vessels between populations, pottery assemblages from archaeological sites in the remote Kuril Island should demonstrate fairly high proportion of "imported" ceramic artifacts.

In order to test this hypothesis, trace element analysis was performed on 315 pottery sherds from 19 archaeological sites. Analysis was performed using a Bruker III-V+ portable X-ray fluorescence (pXRF) instrument at a setting of 40 KeV and 26 µ-amps. It is important to note pXRF can only reliably measure a limited range of around ten elements (Fe^{26}-Zn^{30} and Rb^{37}-Nb^{41}) (Forster et al. 2011) and therefore results from pXRF anaylsis should always be considered preliminary until compared with analytical methods that measure a wider range of trace elements such as inductively coupled plasma-mass

spectrometry (ICP-MS) or instrumental neutron activation analysis (INAA). Currently, all 315 pottery sherds analyzed by pXRF are undergoing ICP-MS analysis at the Institute of the Earth's Crust, Russian Academy of Sciences-Irktusk.

Using a combination of principal component analysis and an iterative regression method (Malmqvist 1978), geochemical data developed through pXRF analysis was analyzed to determine the proportion of ceramic artifacts that can be identified as local (<150 km / 93.75 miles) to each of the 19 archaeological sites in this analysis. Results of this analysis show that archaeological sites in the central region of the archipelago average a higher proportion (83%) of pottery that is produced, used and discarded within the local area of each archaeological site, or conversely a very low proportion (17%) of "imported" pottery (see figure 3). In contrast, pottery remains from the northern and southern regions of the island chain show a greater propensity to have been imported to archaeological sites through exchange or movement of the pottery vessel.

What does this all mean? Conclusions about pottery production in the remote Kuril Islands

As is the case in many archaeological investigations, the hypotheses developed in this research are unable to be definitively confirmed or rejected; however, a number of important conclusions can be drawn from the data. Perhaps the most apparent conclusion is that pottery production in the remote Kuril Islands differs from pottery production in the southern Kuril Islands. Key differences in pottery production of the remote Kuril Islands include:

1) A lack of "fine" wares production

2) Limited evidence for repeated, direct cooking of marine resources

3) Higher proportion of locally made and discarded pottery vessels

The combination of these characteristics preliminarily suggests that the motivation to produce pottery in the remote islands is not heavily influenced by ritual activities or exchange of prestige goods. One potential explanation for the abundance of this "coarse" pottery in the remote Kuril Island is the use of pottery in the fairly common, but intensive practice of producing and storing marine or fish oils. It is

important to note that fish and marine mammal oil was a valued commodity among foraging groups (Jordan and Zvelebil 2009b) and may have been prepared for feasting or ritual activities. In contrast, the presence of fine wares and the high proportion of imported pottery in consort with evidence of direct cooking of marine resources promote the perception of a more diverse pottery industry in the southern islands that produced pottery vessels for ritual activities and exchanges as well as pottery used in everyday cooking practices. Regardless of the exact motivation for pottery production in the Kuril Islands, it is clear that the pottery produced in this region participates in a complex system of social obligations and subsistence needs within various cultural groups, and while sometimes crude-looking, the diverse information extracted from pottery of circumpolar populations should never be underestimated.

Figures

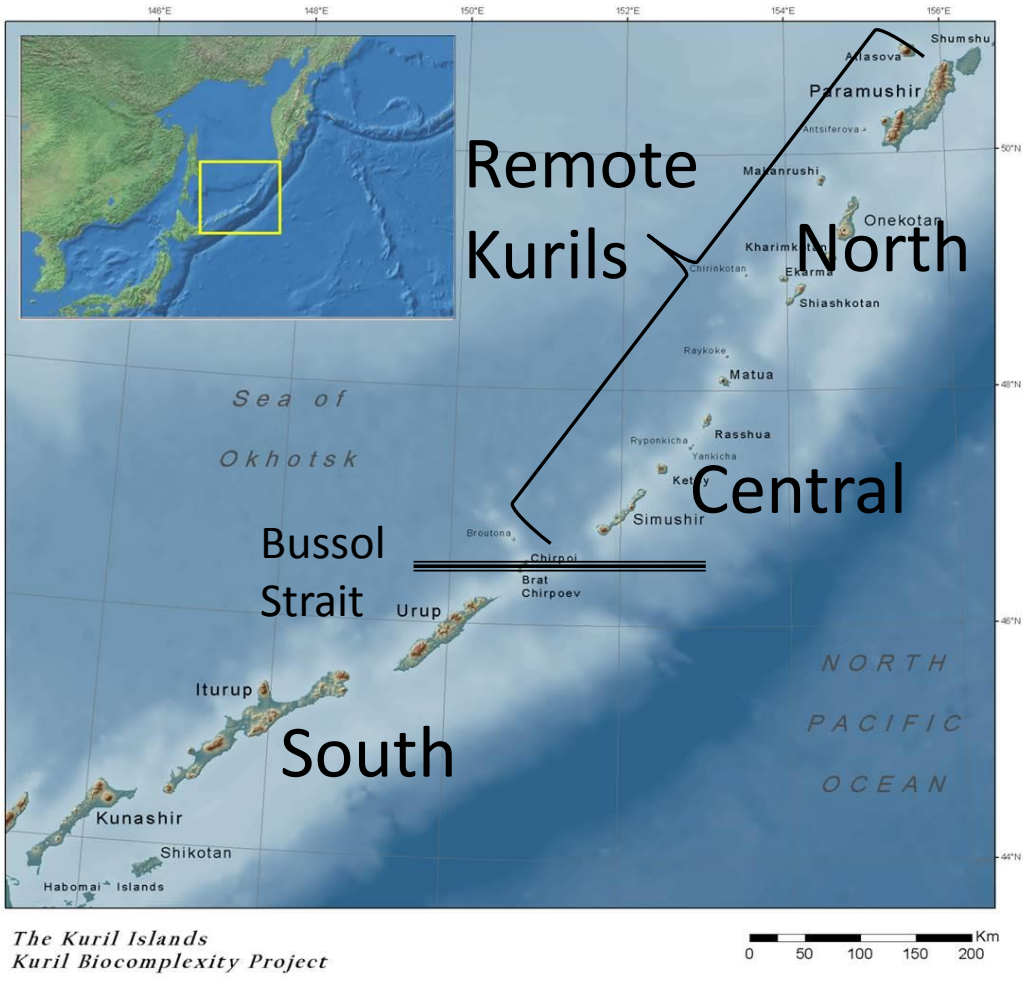

Figure 1. Map of the Kuril Islands showing major geographic regions. (Map by A. Freeburg)

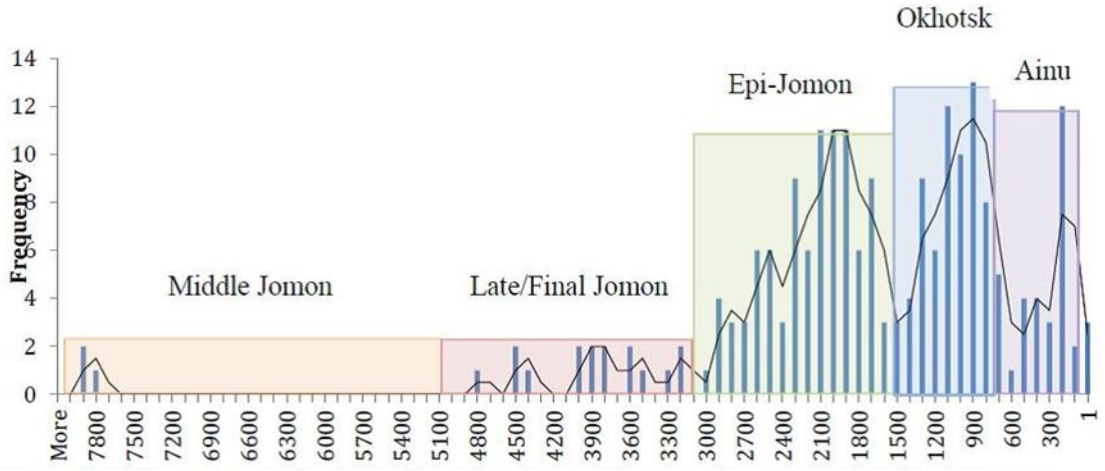

Figure 2. Histogram of calibrated radiocarbon dates using central weighted mean estimates with occupation periods labeled (dates are used with permission from the Kuril Biocomplexity Project)

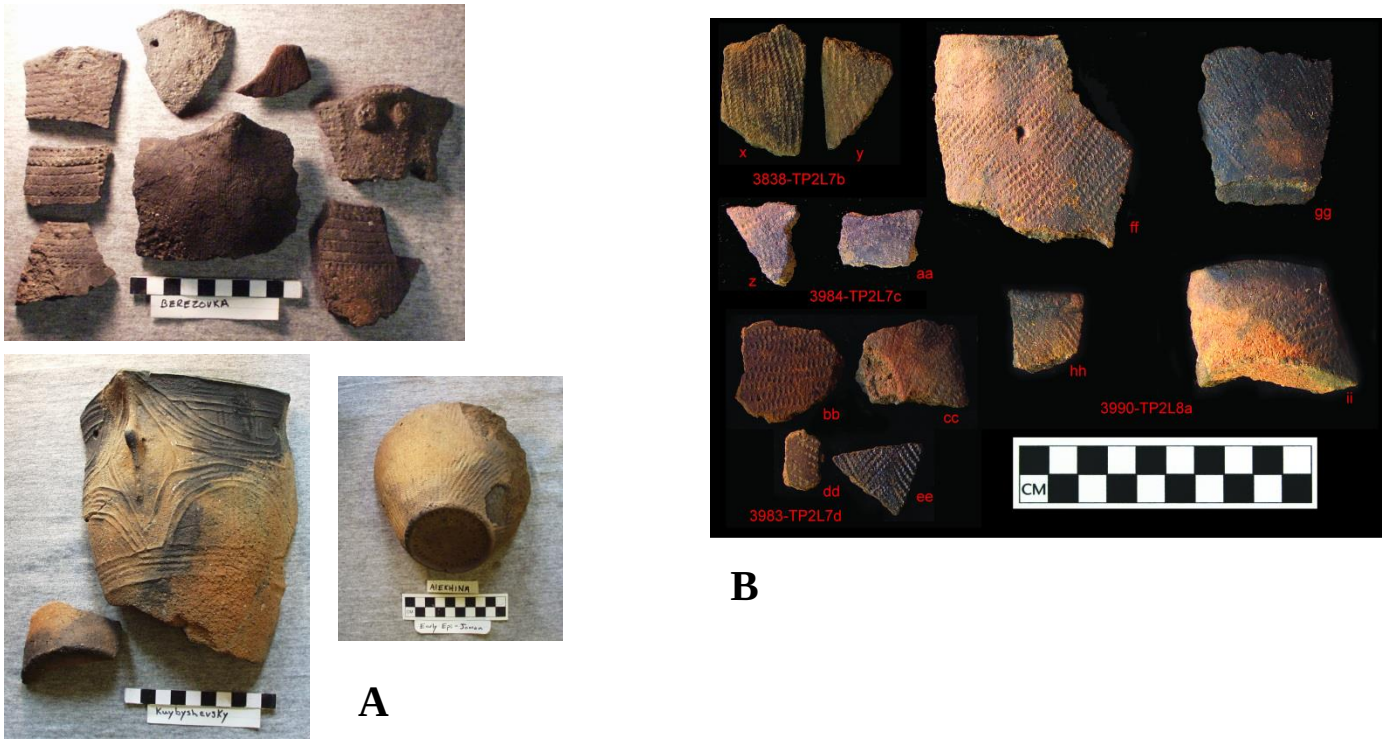

Figure 3. Selected images of pottery remains from archaeological sites dated between 1900-2100 in the southern (A) and central (B) regions of the Kuril Islands.

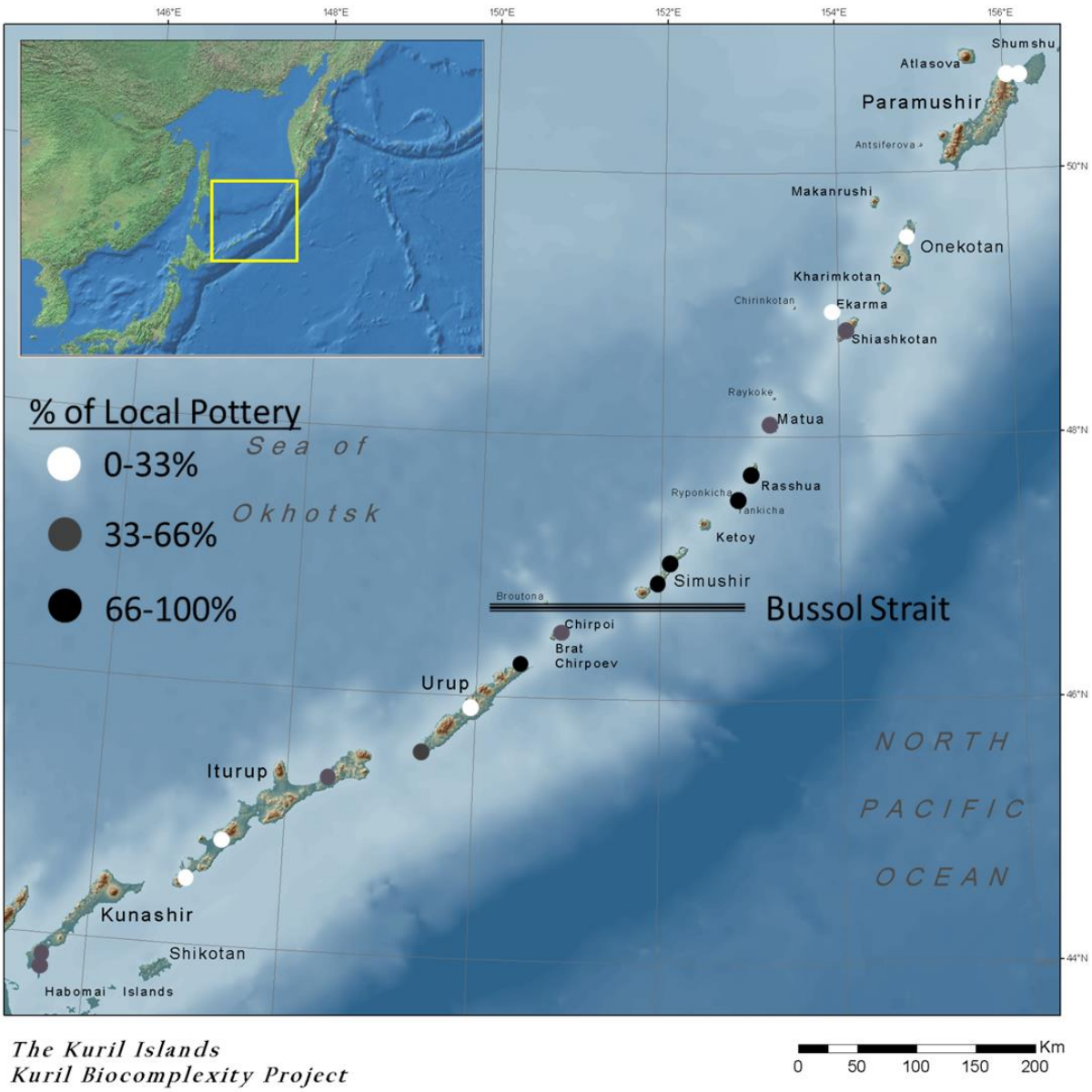

Figure 4. Map of Kuril Islands showing the percent of "locally" produced at each of the 19 archaeological sites (as determined by pXRF analysis).

Tables

Sites dated to 1900-2100 BP		Manufacturing		
Site	**Region**	**Porosity %**	**Temper %**	**Wall Thickness**
Kuybshevskaya	South	32	Low	7.4 mm
Berezovka	South	23	Medium	8.8 mm
Ainu Creek	South	33	Medium	8.2 mm
Kompanisky	South	34	Low	7.7 mm
Rasshua	Central	32	Low	8.0 mm
Drobnye	North	40	Low	7.7 mm

Shape			Decoration		
Form	**Vessel Orifice**	**Basal Shape**	**Decoration Style**	**Main Decoration**	**Ware Type**
Conical Bowl	Unrestricted	Flat	Elaborate	Cord, Geometric	Fine
Conical Bowl	Unrestricted	Flat	Elaborate	Cord, Geometric	Fine / Coarse
Conical Bowl	Unrestricted	Flat	Ordinary	Cord	Fine / Coarse
Conical Bowl	Unrestricted	Flat	Ordinary	Cord, Linear	Fine / Coarse
Conical Bowl	Unrestricted	Flat	Ordinary	Cord	Coarse
Conical Bowl	Unrestricted	Flat	Ordinary	Cord	Coarse

Table 1. Manufacturing, form and decorative attributes of ceramic artifacts from archaeological levels dated between 1900-2100 BP.

Period and Site

Epi-Jomon	Region	Vessels	Aquatic Biomarkers %
Ainu Creek	South	5	100%
Rasshua	Central	1	0%

Okhotsk	Region	Vessels	Aquatic Biomarkers %
Ainu Creek	South	4	25%
Vodpodnaya	Central	6	0%
Ainu Bay	Central	1	0%

Table 2. Summary of lipid residue data from four archaeological sites in the Kuril Islands.

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