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NORTH EURASIAN HUNTER-GATHERER CERAMICS AS AN ARCHAEOLOGICAL SOURCE: REPLY TO KUZMIN (2013)

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In his comment, "The Patterns of Neolithization in the North Eurasian Forest Zone: A Comment on Hartz et al. (2012)," Y Kuzmin has raised a number of questions concerning the paper "Hunter-Gatherer Pottery and Charred Residue Dating: New Results on Early Ceramics in the North Eurasian Forest Zone" by Hartz et al. (2012). The following remarks aim to clarify some of these issues.

Concerning the allegation of a diffusionist paradigm in Hartz et al. (2012), we do not accept Kuzmin's criticism as we think it necessary to keep an open mind regarding the processes behind the development of the earliest ceramics in Eurasia. Two general scenarios are possible: a) pottery was invented independently in various places; b) pottery production spread from regions where pottery was already known to areas where previously no pottery had been produced. We do not regard the dispersal of pottery innovation as the only possible scenario behind the appearance of the technology in new regions, and we are aware that ceramic containers have been invented in several parts of the world independently (Gronenborn 2011). However, we also consider a dispersal of the new technology over smaller and also larger distances possible.

In their critique of a diffusionist approach for understanding early pottery dispersals, Kuzmin et al. (2009) focus on evidence from East Asia and Siberia, namely from the regions that have so far produced the oldest dates for ceramics (East Asia: ~13,700–13,300 BP; Transbaikal: ~12,200–10,500 BP; southern West Siberian Plain: possibly ~9900–9100 BP): "As for the vast terrain between these territories (several thousand kilometers), the earliest well-documented pottery assemblages are dated only to ~8000 BP" (Kuzmin et al. 2009:894). We think that this observation alone is not sufficient to conclude that "Therefore, the diffusionist approach […] seems to be unproductive in understanding the spread of pottery from (presumably) East Asia to other parts of Eurasia" (Kuzmin et al. 2009:894). The state of research in the areas between the mentioned early focal points is extremely poor in some areas with just a few radiocarbon dates from early pottery contexts (e.g. McKenzie 2009). Thus, before such far-reaching conclusions can be made, it is necessary to work out a better basis of investigated sites from the period in question and to build an absolute chronology based on reliable ^{14}C dates.

In Hartz et al. (2012), the focus of the discussion is eastern Europe, and here, the research situation is much better than east of the Urals. Already, currently there is enough archaeological evidence to trace the dispersal of pottery innovation across the region, starting in the 7th millennium in the southern steppes north of the Black and Caspian seas and ultimately reaching the Baltic coast and the Kola Peninsula in the 5th millennium cal BC (Piezonka 2012:41–7).

A related problem is posed by the term "genetic relationship" as it is used by Kuzmin in his comment. Which are the reliable archaeological criteria that do allow us to identify or reject a "genetic relationship" between pottery complexes? In our opinion, influences and mutual interferences between pottery traditions, and among those the special case of spreading of the knowledge of the

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technology into new areas, do not mean that the respective wares have to be identical. Typological differences, on the other hand, do not *per se* indicate that pottery has been invented in hundreds of neighboring places again and again. In better-investigated areas, it has been demonstrated that pottery production was just realized differently on a regional and even local scale (e.g. slightly different vessel shapes and proportions, different temper, decorative preferences) (e.g. German 2002; Klassen 2004:148–206).

In contrast to Kuzmin's opinion that an assumed spread of the pottery-making technology in eastern Europe contradicts archaeological data, evidence has been put forward by various authors suggesting the dispersal of ceramic production. This also concerns the so-called notched wares of European Russia. Vasileva and Vybornov (2012), for example, conclude on the basis of technological analysis that the notched complex of the Middle Volga culture has developed from an intermixture of Elshan and Lower Volga components. In his comprehensive study on the Early Neolithic of the Mari Volga region in the Middle Volga region, VV Nikitin suggests on typological and technological grounds that the early Neolithic pottery in the forest zone of the Middle Volga region has its origins further south in the Volga steppes and that elements of the Elshan culture can be found in the ceramics of the steppe, forest steppe, and forest zones of the Volga region (Nikitin 2011:150). The earliest pottery of the Middle Volga region, in turn, has been regarded as the possible origin of the early Upper Volga wares further west (Engovatova 2008).

Similarities between the early ceramics of the Middle and Upper Volga regions are extensive and include shape (bucket-like bodies and flat bases), decoration (ornaments concentrating below the rim and above as well as on the base, elements consisting of small oval, round, or triangular notches, large proportion of undecorated vessels), and technology (Nikitin 2011:134–5). Nikitin even suggests to summarize the Upper Volga and the Volga-Kama cultures as a single cultural entity (Nikitin 2009:184), thus seizing a hypothesis by Krainov who had proposed the existence of a single entity of notched pottery in the Russian plain (see Tsvetkova 2011:176). These examples illustrate that many researchers involved in the study of the materials in question do see evidence for typological links among the earliest ceramic wares in eastern Europe.

Altogether, the emergence and development of early pottery traditions in the Volga region and adjacent territories was a complicated process, which at the moment is only partly understood (Nikitin 2009; Tsvetkova 2011; Vasileva and Vybornov 2012), and further research is needed to draw a more coherent and detailed picture of the early pottery phase. In our opinion, an important line of research involves the construction of a reliable chronological framework, and with our AMS dating program, part of which was presented in Hartz et al. (2012), we are striving to contribute to this task. The existing sets of dates are often problematic, be it because they are not numerous enough to create a comprehensive picture, the related information is not documented sufficiently, or methodological challenges still have to be addressed (e.g. the disputed method of ^{14}C dating entire pottery sherds). In our studies on the absolute chronology of early Eurasian ceramics, we aim to present the new data as comprehensible and retraceable as possible, including information on context and sample material as well as images of the dated specimen. The current discussion shows that we already reached methodological advances in the dating but that problems have not yet been entirely solved.

A second promising line of research into the development of early Eurasian ceramics involves the application of multivariate statistical analysis such as correspondence analysis. This approach is suited to overcome the problem that often single criteria such as raw material and tempering or particularities of the decoration are being used to draw far-reaching conclusions on cultural connections and even migrations of populations. The main advantage of multivariate analysis in pottery studies

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is the possibility to investigate the complex interrelation of a multitude of characteristics for a large set of specimens (i.e. vessel units). The approach enables the mathematical identification of organizing principles within the data set that cannot be recognized by a mere impressionist consideration or by statistical analyses of single characteristics. The characteristics to be analyzed include technological traits such as temper, moulding technique, and surface treatment, formal criteria such as mouth diameter, wall thickness, and rim shape, and particularities in the execution and design of decoration. As a result, structuring factors in the data set such as chronological developments and regional stylistic and technological traditions can be identified. A recent application of multivariate statistics to early hunter-gatherer ceramics in the eastern and northern Baltic was able to confirm mutual interferences and interdependencies between several pottery traditions, and over large distances of several thousand kilometers (Piezonka 2012). The fact that in principle, long-range influences and interconnections can be expected among early ceramic traditions was thereby convincingly demonstrated for the Baltic region. It will be an important task for future research to investigate on a more objective basis whether such spaces of communication and influences have also connected early pottery traditions along the Volga River and in further regions such as the Volga-Kama and the Transurals.

A clarification is necessary concerning Kuzmin's critique of culture names used in Hartz et al. (2012). The Volga-Oka culture is a disputed concept in the scientific community. This culture has recently been defined by Y B Tsetlin on the basis of ceramic typology and encompasses a part of the archaeological record that is characteristic for the early phase of the Upper Volga culture according to most other authors (Tsetlin 2008:37). Most Stone Age experts working in the Upper Volga region reject the concept of a Volga-Oka culture (e.g. Tsvetkova 2011:176). The main criticism centers on the fact that, apart from pottery ornamentation, no other specifics of the supposed Volga-Oka culture such as lithics, bone, and antler inventory, settlement, etc. have been considered by Tsetlin. This fundamental methodological problem was also criticized by Dolukhanov (2009:1193) in his review of Tsetlin's monograph.

Another point of critique concerns chronology: Almost all pottery identified by Tsetlin as belonging to the Volga-Oka culture stems from mixed layers also containing Upper Volga (according to Tsetlin's definition) materials (Tsetlin 2008:217–8, Table 53a), and the association of absolute dates from these layers with the Volga-Oka culture (Tsetlin 2008:234, Table 66) is therefore at best speculative. Other specialists attribute these same dates to the Upper Volga culture (e.g. Zaretskaya and Kostyleva 2008; Tsvetkova 2011:160–1, Table 2). The internal division of the Volga-Oka culture into 4 periods as suggested by Tsetlin likewise poses methodological problems as it solely rests on an analysis of pottery decoration (Tsetlin 2008:50, 224–7). We favor a more complex concept of archaeological cultures based on Clarke's polythetic model (Clarke 1968; see also Furholt 2008; Gramsch 2009). We therefore agree with the methodological criticism directed at Tsetlin's definition of a Volga-Oka culture and, for the time being, prefer to employ the better-founded concept of the Upper Volga culture to describe the earliest pottery-producing groups of the central Russian Plain.

Concerning Kuzmin's opinion that some of the references are not appropriate for the line of discussion followed in Hartz et al. (2012), we would like to point out the following: In addition to what the title of the mentioned article by Philippsen et al. (2010) spells out and contrary to what Kuzmin states, the paper does at length deal with aquatic resources such as fish and water snails and their being affected by freshwater reservoir effects (of which the hardwater effect is 1 type). A special focus of the study is placed on the influence fish processing (cooking, charring in a ceramic vessel to the state of food crust) might have on reservoir ages. The modern as well as archaeological samples dated are presented with their respective $\delta^{13}C$ values. The experimentally produced food crusts

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have yielded interesting results that are clearly in accordance with arguments put forward in Hartz et al. (2012): food crust consisting of fish showed a reservoir age of 756 ± 41 yr and gave very low $\delta^{13}C$ values of –28.14‰ (elemental analyzer) and –30.47‰ (dual inlet) (AAR-11414, 371 ± 23 BP), while food crust made from boar meat showed no reservoir effect and gave much higher $\delta^{13}C$ values of –17.84‰ (elemental analyzer) and –18.03‰ (dual inlet) (AAR-11411, –537 ± 34 BP) (Philippsen et al. 2010: Table 1). We regard the information presented in this article altogether as very relevant to the questions dealt within Hartz et al. (2012).

We completely agree with Kuzmin that caution has to be employed when interpreting isotopic data from food crusts in connection with possible reservoir effects and that further research is necessary to better understand the processes involved and the associated analytical results. We prefer, however, a less pessimistic perspective and think that $\delta^{13}C$ and $\delta^{15}N$ isotopic values measured in ^{14}C samples could potentially help to elaborate the absolute chronology and to investigate culture-historical questions of economy, social sphere, etc. Possible interrelations between freshwater organisms and reservoir effects in pottery food crusts have become a focus of research only relatively recently (e.g. Fischer and Heinemeier 2003). Especially promising for a better understanding of the relationship between vessel contents, components in the charred crusts, and influences on dating results and for possibilities to identify them is the experimental approach followed by B Philippsen and her colleagues (Philippsen 2010; Philippsen et al. 2010). To be able to more reliably investigate archaeological crusts, it is also necessary to measure the isotopic values in contemporary materials (bones of terrestrial animals, fish bones, mussel shells, plant remains, etc.) from the same region, or, if possible, even from the same context as the charred crust samples because modern samples, especially from distant regions, are not necessarily comparable due to environmental variations in space and time. This was rightfully pointed out by Kuzmin on the basis of Fischer et al. (2007). Pair dates of food crusts and terrestrial material associated with the same vessel can also help to shed more light on reservoir effects and their relationship to the information provided by isotopic values.

In conclusion, we think it legitimate not to regard opinions such as the one by Boudin et al. (2010: 704), which was quoted Kuzmin, as eternal truths but to test and, if necessary, modify them should new evidence be found or new methods provide new perspectives. Even though a lot of methodological problems still have to be accommodated when employing new techniques such as AMS direct dating, isotopic analyses, and lipid analyses, the study of early pottery shows immense potential for understanding both the chronology and the socioeconomic conditions of the late hunter-gatherers in Eurasia. This potential needs to be further developed by a systematic approach and by interdisciplinary cooperation across the borders.

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