

Introduction to the Special Issue: Correlating changes for environmental, technological and societal transformation in prehistoric eastern Asia

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Abstract

Identifying and explaining changes in the prehistoric material and social world is one of the greatest research interests in archaeology, palaeoclimate and environmental science. In the last two decades or so, a considerable number of studies have made significant contributions to the associated disciplines in eastern Asian archaeology. However, due to the more specialized scientific approaches and the rapid accumulation of new excavation materials, it becomes increasingly difficult for scholars to examine and correlate research outputs from different areas and achieve a holistic picture of the past. Using eastern Asian archaeology as an example, this Special Issue aims to break down the disciplinary boundaries and present the current research debate on how to correlate different climate, environmental and social changes and explain human past. One of the fundamental issues is the lack of adequate chronological resolution to order various archaeological events. To tackle this, a large number of radiocarbon dates, primarily derived from short lived materials, are provided in the Special Issue. A great variety of changes in local environment, agricultural practice, animal husbandry, technologies, migration, demography and social organizations are revealed in the following papers but there are two profound drivers to all of these changes. One is the broad climate change since the start of the Holocene and the other is the communication between the West and the East.

Key words: Eastern Asian archaeology; prehistoric Silk Road; early agriculture; animal domestication; radiocarbon chronology; climate and environmental changes

Rationale of the Special Issue

Changes related to palaeoclimate and other aspects of the environment, subsistence strategies, ceramic and metal technologies, demographic variations and human migrations have been

constantly attracting scholarly attention in the recent decades in eastern Asian archaeology. The climatic and environmental conditions since the start of the Holocene have provided a more suitable context for human activities in many regions such as the Yellow River in eastern Asia and facilitated settlement expansion, long-distance travelling and large-scale agricultural practice and domestication. A good example might be the so-called prehistoric Silk Road, along which a variety of archaeological elements were transmitted between the East and the West, including different crops (e.g., millet, rice, wheat and barley), domesticated animals (e.g., sheep, goat, horses, cattle, pig, dog, chicken), painted pottery, chariots and metallurgy. Thanks to the ever-increasing contacts between different groups of people, early societies were enabled to explore wider physical landscapes and natural resources. In return, more natural materials such as clay, precious stones (e.g., nephrite, obsidians or agates) and particularly metallic minerals (e.g., copper, tin, lead, arsenic, gold, silver or iron) were either directly utilized by local groups of people or transported to other places by trade, exchange, gift exchange or warfare. Exotic materials and gift exchanges started to perform a crucial role in the political and ritual system and soon found their places in the increasing complexity and inequality of the prehistoric societies in eastern Asia. As a result of more complex social organization, one can see a rapid expansion of cultivated land and habitation with a network of communication being constantly extended. Illustrated by the most recent studies, permanent settlement was finally achieved on the Tibetan Plateau around 3600 cal BP, underpinned by the year-round subsistence provided by millet, barley, yak, sheep and goat, many of which were introduced to the local societies through the long-term communication between the East and the West (Chen et al., 2015).

Whilst the overall body of knowledge and data on these profound social and technological changes is now far greater than twenty years ago, each of them becomes simultaneously more specialized, therefore more challenging for scholars to evaluate and incorporate into their own research. One of the major barriers is the lack of adequate chronological resolution. It has been a routine exercise to correlate the spikes in various climate or environmental records (e.g., oxygen stable isotopes) with the variation in, for example, the spatial and temporal distribution of one or several archaeological cultures, in order to identify movement or collapse of particular cultures driven by climate changes. However, one has to bear in mind that many climate change events or archaeological cultures are poorly dated and, in many cases, boxed into a period of several hundred years. Without a robust chronological sequence to order these changes, we simply cannot equate these seemingly correlated spikes to the underlying causality. Secondly, regardless of the underlying reason and mechanisms, direct human migrations or intermittent ‘cultural creep’ often brought about multiple changes at the same time, or a package of change (e.g. a combination of language, crops, animals or technologies). So far, these ‘packages’ of change have not yet been systematically identified or investigated in eastern Asia archaeology. A potentially much bigger picture is missing. Thirdly, due to the nature of archaeological records, it is sometimes difficult to recognize widespread changes based on an individual site. Scholars often need to scale up and combine data from a number of sites belonging to a broader time and space to attest these changes. An increasing number of studies have followed this framework. Facilitated by this ‘big data’ approach and powerful statistical analysis, overarching changes of great archaeological interests begin to emerge.

The central objective of this special issue is to present the current state of debate on several major changes identified for prehistoric eastern Asia. They are a reflection of the current research effort and are primarily focused on climate and other environmental changes, the development of agriculture, animal domestication, material culture and East-West communications. A large amount of new data on radiocarbon dating, stable isotopic analysis, flotation, zoology and environmental changes can be found in the following papers, which not only contribute to the existing knowledge and patterns of many well-studied areas (e.g., central China), but also promote our understanding of some new regions such as the Tibetan Plateau and Xinjiang. The focus of discussion is no longer limited to any individual site but is more often on the regional or even continental scale, across a large span of time. Clearly, scholars are endeavouring to answer the questions of not only what, when, or how, but also, more importantly, why.

Overview of the Special Issue

This special issue opens with an insightful critique by [Jaffe and Hein \(2021\)](#). Using the archaeological cultures of Xindian and Siwa in the Hexi Corridor of western China as a vivid example, they very well explain the current issues of correlating climate changes with the local social economic transformations. Given the vast geographical area covered by these two archaeological cultures, the basic data on chronology, climate, environment, subsistence strategies and local field surveys are rather patchy. Although a large number of publications have attempted to associate various local changes with the well-known 4.2 ka climate event, there is little robust evidence to support such causality. Meanwhile, their research reminds us that the local archaeological research is heavily oriented by ceramic typology as well as transmitted texts, which leads to potentially bigger chronological error bars if one attempts to correlate the variation of archaeological cultures with climate change. Dealing with an extremely large region such as the Hexi Corridor, as Jaffe and Hein have argued, requires many more thorough investigations on a local level.

New regions, new data and new discoveries

It is very exciting to see that many scholars have already carried out detailed research at key individual sites and often linked their data and interpretation to the broader picture. The next three papers have clearly exemplified such effort. Based on the new radiocarbon dates and flotation results, [Ren et al. \(2021\)](#) have successfully established the chronological sequence for the site of Jinchankou in the Hexi Corridor, which further enables them to illustrate diachronic changes of local crop cultivation. The broader Hexi Corridor (or Gansu-Qinghai region) witnessed a crucial change around 4000 cal BP, when wheat and barley were introduced to the local agricultural system which was previously dominated by millet. In particular, barley acquired the same importance as millet in this region from 3600 cal BP. Meanwhile, the level of field management appeared much lower than before, which was arguably due to the local development of animal husbandry. The variation of these crops was clearly related to multiple factors. The interaction between West (wheat and barley) and East (foxtail and broomcorn millet) brought new species to the Hexi Corridor. Given the drier

climate, increasing population and social pressure, local societies decided to adopt these changes in their subsistence strategies.

Three other case studies can be found for the eastern Xinjiang region. [Dong W et al. \(2021\)](#) have produced an impressive number of carbon and nitrogen stable isotopic analyses of human and animal remains at the site of Liushugou. Their research demonstrates that local diet was heavily dependent on C₃ food and animal protein around 3500-2900 cal BP. Compared to other sites, it is interesting to note that consumption of millet was largely absent at Liushugou. What is also worth highlighting are the paired radiocarbon dates and stable isotopic analysis of the human bones in the fourteen tombs at Liushugou, allowing scholars to connect a fine-grained chronology with dietary changes and other archaeological information (e.g., tomb structure or contents). A rather different subsistence strategy is discovered at the site of Wupu by [Wang L et al. \(2021\)](#). Located in an oasis area, local people were able to take advantage of the riverine system and develop more flexible multi-crop farming (millet, wheat and barley) and herding practice around 3000-2400 cal BP. The sharp comparison between Liushugou and Wupu underpins the vital importance of water supply to the local life style in the arid regions such as eastern Xinjiang.

The Andronovo culture was a widespread archaeological phenomenon between the Caspian Sea and western China and it is often cited by scholars to explain the changes observed in the material record or socio-economic changes. However, it is still unclear by what mechanism the Andronovo culture archived such a continental scale. [Zhu et al. \(2021\)](#) fill an important gap in the English literature by offering a detailed summary of the Andronovo culture in Xinjiang. Their radiocarbon chronology and genetic data reveal that a small group of people might have migrated from the middle Tianshan or further west into the east Tianshan area around 3600 cal BP, which was presumably facilitated by drier and warmer climate. This makes important contributions to the long-term question of how to correlate the spread of the markers of archaeological cultures (e.g., ceramics, bronzes or burial structures) in eastern Xinjiang with the movement of people or ideas from central Asia or the Hexi Corridor and the broader climate and environmental changes.

In addition to the Hexi Corridor and Xinjiang, another region of considerable research interest in recent years is the Tibetan Plateau (TP). Given the unique geographical characteristics of the Tibetan Plateau, the leading question is how people established permanent settlement there. The two studies focused on the central and southeast TP have provided extremely important data and the results of detailed investigation. Radiocarbon dating shows that Qugong, so far the only systematically excavated site in central TP, can be traced back to around 3750-3500 cal BP. Even more intriguing is that both millet from the East and wheat/barley from the West made their way to the heart of the Tibetan Plateau around 3400 cal BP ([Gao et al., 2021](#)). More new radiocarbon dates are published for southeast TP, showing that human activities started around the fifth millennium BP and peaked at cal 2700-2000 cal BP ([Wang Y et al., 2021](#)). Both papers point out that agriculture performed a pivotal role in peopling the different parts of the Tibetan Plateau and this could not be achieved without the rise of the prehistoric Silk Road which cemented the East and the West.

Old regions but new data, new methods and new thinking

While the Central Plains have been the centre of debate since the beginning of Chinese archaeology in 1920s, new excavations and data are constantly reshaping our understanding (Zhang et al., 2019). Three papers in this special issue choose to revisit the dietary practice in the Central Plains from the Neolithic to Bronze Age. [Yang et al. \(2021\)](#) report new radiocarbon data and flotation results for twenty-five sites in the modern Sanmenxia region. 4000 cal BP was a crucial turning point of local agricultural practice because wheat and barley replaced millet and became the most important crop then. This discovery distinguishes the Sanmenxia region from other parts of the Central Plains where the dominance of millet certainly continued after 4000 cal BP. The primary questions in the other two papers are both related to the dietary complexity within a unified archaeological culture. Carbon and nitrogen stable isotopic analyses of human bones at Wadian and Haojiatai, the two critical sites of the well-known Longshan culture, illustrate a diversified dietary practice, suggesting that local groups consisted of not only millet/rice farmers but also hunter-gathers. This is also reflected by the different stone toolkits used for agriculture and hunter-gathering at both sites. The fact that millet became the major source of fodder for sheep and cattle, as suggested by the stable isotopic data of the faunal remains, means that these two imported animal species were successfully assimilated into the local subsistence strategy ([Li et al., 2021](#)). [Dong Y et al. \(2021\)](#) discovered significant synchronic and diachronic variation in the foodways of the Dawenkou culture in Shandong. This calls for reconsideration of how to understand the relationship between an archaeological culture defined essentially by ceramic assemblages and the evidence for diversified subsistence strategies. Dong Y and her colleagues have also made an important exploration of using Bayesian modelling to estimate the mixing of different food sources in the local diets. Such methods are still rarely encountered in the literature dealing with the Chinese stable isotopic data.

Another methodological paper in this Special Issue is published by [Zhou et al. \(2021\)](#). Based on the carbon stable isotopic fractionation over the photosynthetic process, it is expected to see a correlation between water supply and the carbon isotope discrimination ($\Delta^{13}\text{C}$) values. Zhou et al. examined carbonized wheat from a considerable number of archaeological sites in northern China dated from the Neolithic to historical periods. A clear difference can be illustrated for water supply in different times and places, which appears also consistent with the climate and historical records.

Broad patterns across regions

Two papers choose to focus on much broader patterns. [Dong G et al. \(2021\)](#) noted that animal utilization in northern China was fundamentally changed between 4300 – 3500 cal BP, when a number of new species were introduced to the Central Plains, including cattle, sheep/goat and horse. During this process, the region called the ‘Arc’ played a crucial part. The Arc was a vast geographical area surrounding the Central Plains from northeast to southwest China.

Various parts of Arc share broadly similar environmental settings, social-economy and lifestyle (e.g., a combination of pastoralism and agriculture). It was firstly proposed by the Chinese scholar Tong Enzheng but significantly developed by Jessica Rawson in recent years (Rawson, 2017). The importance of the Arc is reflected not only by the introduction of new animal species into China but also the exchange of different crops and steppe-derived technologies (e.g., metallurgy and chariots). [Liu R et al.](#) has synthesized probably the largest carbon and nitrogen stable isotopic database of ancient Chinese human bones. Compared to the macroscopic plant remains, the stable isotopic data is a reflection of foods which were not only available to but actually consumed by the ancient societies. A variety of major dietary changes have been captured across Chinese history, which is primarily due to the rise of fall of the C₄ crop millet. What is equally important is the strong cultural resistance to wheat during the Chinese Bronze Age. It was not until the Han dynasty that wheat was widely adopted in the Central Plains.

This special issue is heavily focused on China, but we are fortunate to have an excellent review paper by [Amano et al.](#) (2021). They provide an excellent summary of the prehistoric and historic evidence on the introduction of new plants and animals into the Philippine Islands and their potential ecological impacts on local land-use. This study offers a crucial model of how to systematically reconstruct the interaction between human societies and tropical environment for future comparative studies.

Conclusions and future perspectives

There is certainly no doubt that prehistoric eastern Asia experienced a variety of changes over several millennia. Amongst them, the changes in agricultural practices, animal husbandry and technologies performed vital roles in many important archaeological narratives and have helped scholars to reconstruct the past trajectory towards complex societies and networks in various times and places. As demonstrated in the present Special Issue of Holocene, scholars working on east Asian archaeology have accumulated a remarkable amount of new data in recent years. Many crucial gaps, such as the creation of high-resolution chronologies, are beginning to be bridged, which will enable us to rule out some spurious correlations and make a step further to the true causality among different archaeological events. At least two fundamental drivers underlying all these changes can be suggested. One is the broadly more suitable climate conditions for human activities during the Holocene and the other is the rise of East-West communications along the prehistoric Silk Road. None of the changes that happened to prehistoric eastern Asia existed in a vacuum. They were all part of the overall Eurasian unity. Answers to many of the questions raised in this Special Issue might be buried outside east Asia and still await future research (Tan et al. accepted).

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