Quaternary International xxx (2016) 1–19

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

The impact of the LGM on the development of the Upper Paleolithic in Mongolia

Evgeny P. Rybin [a, b, *], Arina M. Khatsenovich [a], Byambaa Gunchinsuren [c], John W. Olsen [d], Nicolas Zwyns [e]

[a] Institute of Archaeology and Ethnography, SB RAS, Novosibirsk, Russia
[b] Altai State University, Barnaul, Russia
[c] Institute of History and Archaeology, MAS, Ulaanbaatar, Mongolia
[d] The University of Arizona, Tucson, USA
[e] University of California, Davis, USA

ARTICLE INFO

Article history:
Available online xxx

Keywords:
Central Asia
Mongolia
Siberia
Last Glacial Maximum
Chronology
Paleolithic

ABSTRACT

In the Northern Hemisphere, the Last Glacial Maximum (LGM) is recognized as a cold and dry period that marks the maximum southward extension of the Scandinavian Inlands in Europe. In Asia, the ice sheet did not expand from the Arctic into Siberia, yet the LGM had a significant impact at high latitudes and elevations, as well as in regions with a continental climate. How much these changes affected the human occupation of Siberia and Mongolia is still a matter of debate and various models dealing with continuity, discontinuity, demographic movement and adaptation have been put forth. The present paper is a critical review of available empirical data regarding the impact of the LGM on landscapes and human settlements in Mongolia. This review underscores the caveats in the data collected and further analyses are proposed to test several basic hypotheses. The results obtained suggest that during Marine Isotope Stages (MIS) 3 and MIS 2, there were hiatuses in the human occupation of Mongolia. These gaps are potentially linked with significant changes in climate. It is recognized that one of the main breaks in the cultural sequence is associated with the LGM, suggesting that Mongolia experienced periods of depopulation associated with this dramatic climatic change.

1. Introduction

Defining the geographic center of Asia, Mongolia can be divided into two large and distinct physiographic provinces. A closed drainage area covers two thirds of the country and geographically belongs to Central Asia. The rest of the country falls within the borders of northern Asia. Landscapes vary with elevation and include mountainous areas, peneplains (between 1000 and 3000 m.a.s.l.) and plains (Deviatkin et al., 1982). When variables such as moisture and precipitation are taken into account, mountainous regions (e.g., the Khangai–Khentii and Altai Ranges) have a higher water input than do the drier steppe regions (e.g., the Gobi Desert and eastern Mongolia) (Dorofeyuk, 2008: 13) (Fig. 1). Changes in vegetation are consistent with the physical border delineated by the Khangai mountain range. The latter separates the mountain-taiga (boreal forest) and steppe-taiga environments from the southern part of the country that is dominated by semi-arid and arid extremely continental biomes. Although the northern territories are still challenging for most modern herders, the extensive deserts and semi-arid areas combined with even sharper seasonal and diurnal–nocturnal temperature variations are no less demanding (Golubeva, 1976). These apparent difficulties notwithstanding, migratory movements of species such as *Capra sibirica*, *Cervus e. sibiricus*, *Capreolus p. pygargus*, and *Alces alces* (as well as, potentially, human beings) exist along intermountain depressions and low passes with moderate slopes (Savchenko, 2009).

When vegetation cover and water resources are available at elevations below 2000 m.a.s.l., a passage from the Russian Altai through the mountains of the Mongolian Altai, Dzungaria (Xinjiang, in northwestern China), the eastern Sayan, Khangai, and Khentii Ranges is possible (Mongolskaya Narodnaya Respublica, 1990). The Selenga and Orkhon river systems represent other possible lower

* Corresponding author. Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Lavrentieva Ave., 17, Novosibirsk 630090, Russia.
E-mail address: rybep@yandex.ru (E.P. Rybin).

http://dx.doi.org/10.1016/j.quaint.2016.05.001

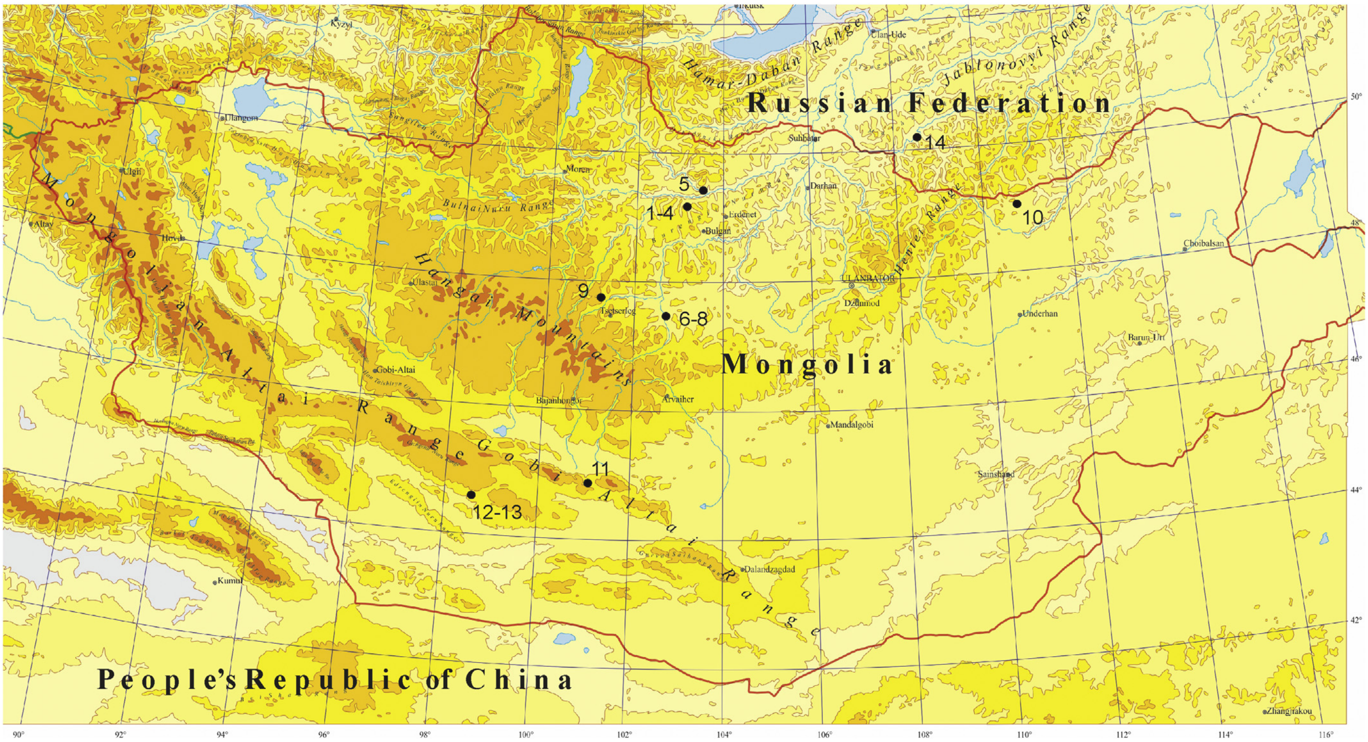

Fig. 1. Location of sites mentioned in text. 1. Tolbor 4; 2. Tolbor 15; 3. Tolbor 16; 4. Kharganyn Gol 5; 5. Dorolj 1; 6. Orkhon 1; 7. Orkhon 7; 8. Moil'tyn-am; 9. Tsatsyn-Ereg 2; 10. Rashaan Khad; 11. Tsagaan Agui Cave; 12. Chikhen Agui Cave; 13. Chikhen 2; 14. Studenoe 2.

altitude links between the Lake Baikal region of southern Siberia and northern Mongolia; similar corridors may have linked the Gobi Altai Mountains with the Valley of Great Lakes in south-central Mongolia.

Although Pleistocene living conditions in these areas were likely challenging from a human perspective, Mongolia displays a diversity of landscapes and occupies a central location at the crossroads of potential migration routes of humans and many animals. Perhaps this is why throughout various historical periods, the territory of Mongolia has been considered an important source of innovation and a contact zone. Although the neighboring region of Siberia probably experienced several depopulation events as a result of extremely harsh climatic oscillations, scholars have discussed the possibility of continuity of human occupation across the Last Glacial Maximum (LGM).

In the Northern Hemisphere, the LGM, *sensu lato*, was characterized by climatic degradation and the gradual emergence of a cool and arid climatic regime between 26 and 19 ka cal BP. Archaeologists also commonly use LGM to refer to the maximum extent of the Scandinavian Inlands in Europe, or to the peak of cold, arid conditions elsewhere between ca. 24–22 ka BP (Clark et al., 2009; Kuzmin and Keates, 2013). In both cases, it is difficult to test whether humans were able to successfully adapt to such challenges based solely on radiocarbon dates obtained from archaeological sites (e.g., Graf, 2009; Kuzmin, 2009). The sequencing of a DNA from the Mal'ta and Afontova Gora sites in Siberia established that the two individuals sampled were related closely enough to belong to the same population that recolonized the region after supposed post-LGM recolonization (Raghavan et al., 2014). Even if the archaeological meaning of such results is yet to be fully understood, the fact that demographic continuity is possible in south-central Siberia marks a significant advance in this long-standing debate. How populations responded to the LGM in Mongolia is still unclear and for this region, the question is still open.

Based upon his work in Mongolia during the 1940s–1960s, A. P. Okladnikov (1981) suggested that this region, located at the crossroads of Siberia and China, was a potential seedbed for behavioral innovations and that these innovations may have influenced the cultural development of neighboring regions. Okladnikov's views are particularly salient when one examines the LGM, a period during which subsistence strategies of Paleolithic populations in northern Asia underwent significant changes. These changes may have contributed to the success of concomitant technological changes, as illustrated by the bifacial shaping of wedge-shaped cores, and the spread of that technology into Siberia (Tashak, 2000). Such technical changes may indirectly point out that increased mobility, new settlement patterns and extended raw material networks were possible responses to this specific cold and dry climatic event. In this context, Mongolia has been regarded as a possible refugium mostly due to its geographic setting situated between northern and Central Asian topographic and biotic zones.

According to these hypotheses, the re-population of southern Siberia could have originated in Mongolia, at least in part. Human groups could have carried innovations such as microlithic technology (Goebel et al., 2000; Goebel, 2002), bifacially-prepared wedge-shaped cores (Tashak, 2000) and the earliest documented pressure flaking in the region, supporting such a model (Gladyshev et al., 2010, 2012b). In accord with Okladnikov's suggestion, the complex transformation of Upper Paleolithic behaviors could have originated in Mongolia and later, influenced the development of Upper Paleolithic assemblages in southern Siberia and Central Asia.

Until recently, Mongolia was still a Paleolithic *terra incognita*; stimulating expectations to find answers to questions regarding the development of Paleolithic assemblages in northern and Central Asia. Luckily, the last two decades of international archaeological collaborations with colleagues from Mongolia have generated significant new data relevant to the human occupation of Mongolia before, during and following the LGM. Based on critical review, a