



Contents lists available at ScienceDirect

Quaternary International

journal homepage: [www.elsevier.com/locate/quaint](http://www.elsevier.com/locate/quaint)

## Evaluating the biological discontinuity hypothesis of Cis-Baikal Early versus Late Neolithic–Early Bronze Age populations using dental non-metric traits

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### ARTICLE INFO

#### Article history:

Available online xxx

#### Keywords:

Dental non-metric traits  
Population continuity  
Genetic admixture  
Lake Baikal  
Central Asia  
Hunter–gatherers

### ABSTRACT

The aim of this study is to assess dental non-metric trait frequencies of Middle Holocene hunter–gatherer populations from the western Lake Baikal region of Siberia, the Russian Federation, for evidence of population discontinuity. Mortuary practices, cranial morphology, and mitochondrial DNA data have led to the hypothesis of a discontinuity event between the Early Neolithic (EN; ~7500–7025 *cal BP*) and Late Neolithic–Early Bronze Age (LN–EBA; ~5500–3700 *cal BP*) populations. Dental non-metric traits are highly heritable and can be used to infer biological affinity between populations. Mean measure of divergence results find that dental non-metric trait frequencies vary between archaeological periods in statistical terms, but the extent of difference is minor. In the LN–EBA sample, several, but not all, trait frequencies shift towards the range characteristic of populations with Western European genetic admixture. Gene flow from a population to the south of the Baikal region is the most likely explanation for this shift, although the role of genetic drift and the impact of small sample sizes cannot be discounted. Two cemeteries along the Angara River on either side of the discontinuity event have the most similar dental non-metric trait patterns. The similarity of traits between the EN site of Lokomotiv and the LN component of the site of Ust'-Ida I could suggest population continuity or genetic admixture between groups in this area. Dental non-metric trait data are shown to be an informative avenue for assessing past population events, revealing trends not detected by other data types, and directing research into our reconstruction of the history of these groups away from the shores of Lake Baikal to along the Angara River.

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### 1. Introduction

Dental non-metric traits are heritable variants in tooth form and structure, scorable in a non- or quasi-continuous manner, that are used by biological anthropologists to estimate the genetic similarity of past human populations (i.e. Greene, 1982; Sofaer et al., 1986; Turner, 1985a, 1987). Biological distance (also known as bio-distance) is calculated by the multivariate statistical comparison of trait frequencies between groups. An understanding of population continuity or discontinuity is important for interpreting trends in activity patterns, diet, and disease (Larsen, 1997).

In the western region of Lake Baikal, Siberia, Russia, known as the Cis-Baikal, previous research has found evidence for

biological and cultural discontinuity of the human populations on either side of the Middle Neolithic (MN) (~7000–5575 *cal BP*) (Weber et al. in press). Specifically, Early Neolithic (EN) peoples (~7500–7025 *cal BP*) from the region differ from Late Neolithic (~5550–4675 *cal BP*) and Early Bronze Age (4675–3700 *cal BP*) (LN–EBA) peoples (Weber et al. in press) according to several lines of evidence, including ancient mitochondrial DNA (mtDNA) (Mooder et al., 2006, 2010), cranial morphometry (Gerasimov, 1955; Mamonova, 1983; Gerasimova, 1991), and material culture complexes and mortuary practices (Weber, 1995; Weber et al., 2002; Bazaliiskii, 2010). These lines of evidence have culminated into the rather well-accepted idea that the EN and LN–EBA peoples were genetically discontinuous. However, a recent examination of cranial non-metric traits found that while some EN compared to LN–EBA spatial groups differed significantly, the EN skeletons from the cemetery of Lokomotiv along the upper Angara River (Fig. 1)

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Fig. 1. Map of Lake Baikal showing the location of the five cemeteries.

bore affinity to later LN–EBA skeletons from the same region, which the authors argue suggests genetic continuity between periods (Movsesian et al., 2014). Until now, no systematic comparison of tooth morphology has been conducted to see, firstly, if there is a difference in dental non-metric trait frequencies between the EN and LN–EBA populations, overall and between different spatial regions, and secondly, if such a difference can shed light on the existence and nature of possible genetic continuity or discontinuity. Haeussler examined some Cis-Baikal skeletons for dental non-metric traits in the late 1980s (Haeussler and Turner, 1989, 1992; Haeussler, 1996). Sample sizes were small, and the time-period of many burials unknown or problematic, such that a comparison between time-periods was not possible. Haeussler (1993) did note, however, that the EN (Kitoi) had an unambiguous ‘Mongoloid’ (broadly Asian) pattern. Based on additional sites outside the Cis-Baikal, Haeussler (1996) observed a shift in dental non-metric frequencies at some point during the Neolithic, and suggested that the settlement of Southern Siberia was complicated.

The purported biological discontinuity between the Cis-Baikal EN, on the one hand, and LN–EBA, on the other, has been proposed to be due to the latter group containing more typically Western European genes (i.e. Gerasimov, 1955; Gerasimov and Chernykh, 1975; Mamonova, 1983; Gerasimova, 1991; Mooder et al., 2006, 2010). There are quite well-documented differences in the occurrence and frequency of many dental non-metric traits between Western European and Central Asian (more broadly Sinodont) populations (see Scott and Turner, 1997 for an overview), such that genetic admixture can usually be detected in a shift in trait frequencies. Sinodont refers to the dental non-metric trait complex of many ancient and modern populations from North and East Asia and many New World descendants; it is contrasted with Sundadont, which characterizes most prehistoric and modern populations of

mainland or insular Southeast Asia (Turner, 1987, 1990; Hanihara, 1992; Matsumura, 1995). As an example, most Western European populations have higher frequencies of traits such as Carabelli, hypoconulid absence, and 2-rooted upper first premolars, while Central Asian populations typically have higher frequencies of shoveling, upper central incisor winging, and enamel extension (Scott and Turner, 1997). Based upon their own extensive research and compilations of data from many other researchers, Scott and Turner (1997: 178–235) list and discuss the global frequency of many crown and root traits. Cis-Baikal data are in high concordance with the frequencies listed for Sinodont Southern Siberian populations. Subsequent research has shown that Sinodont Asian dental non-metric variation is best categorized into three geographic groups: Central Asian, Northern Asian, and East Asian (Hanihara, 2008), as will be used in this research, with the Cis-Baikal populations corresponding most closely to the Central Asian group.

In this study, the dental non-metric traits of 194 individuals from five cemeteries (Fig. 1), 106 from the EN, 38 from the LN, and 50 from the EBA, are compared with the first aim to determine if there is a significant difference between the EN and LN–EBA that supports a model of genetic discontinuity. Discontinuity is defined herein as a difference in trait frequencies that is greater than expected based on the continuous development of a population that experienced no external gene flow. An evaluation of this will be based upon bio-distance statistics and the qualitative examination of non-metric trait frequencies that differ between time periods. In the LN–EBA is there an increase in the frequency of dental non-metric traits characteristic of Western European-derived populations? If there is a significant shift in non-metric trait frequency, is it possible to pinpoint the population(s) or region(s) that were the source of external genetic admixture? Finally, the four larger cemeteries are also analyzed to assess the presence of spatial patterning, possibly

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