



## Multiproxy evidence for abrupt climate change impacts on terrestrial and freshwater ecosystems in the Ol'khon region of Lake Baikal, central Asia

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### ARTICLE INFO

#### Article history:

Available online 4 October 2012

### ABSTRACT

A palaeolimnological study of Lake Khall was undertaken to reconstruct impacts from five thousand years of climate change and human activity in the Ol'khon region of Lake Baikal. Taiga biome dominated regional landscapes, although significant compositional turnover occurred due to the expansion of eurythermic and drought resistant Scots pine. Climate during the mid-Holocene was wetter than the present, and Lake Khall was fresh, with abundant molluscs. By 4.4 cal ka BP, sedimentary geochemistry indicated a gradual change in lake water chemistry with an increase in lake salinity up to the present day, most likely controlled by groundwater influences. Vegetation turnover rate was highest between 2.75 and 2.48 cal ka BP, with the onset of drier, more continental climate, which resulted in an influx of aeolian particles to the lake. This abrupt shift was coincident with ice rafted debris event (IRD-2) in North Atlantic sediments and an attenuation of the East Asian summer monsoon. A second arid period occurred shortly afterwards (2.12–1.87 cal ka BP) which resulted in the decline in ostracod numbers, especially *Candona* sp. A rather more quiescent, warmer period followed, between 1.9 and 0.7 cal ka BP, with very little change in vegetation composition, and low amounts of detrital transfer from catchment to the lake. Peak reconstructed temperatures (and low amounts of annual precipitation) were concurrent with the Medieval Climate Anomaly. Between 0.77 and 0.45 cal ka BP, climate in the Ol'khon region became colder and wetter, although Lake Khall did not become fresher. Cold, wet conditions are seen at other sites around Lake Baikal, and therefore represent a regional response to the period concurrent with the Little Ice Age and IRD-0. After AD 1845 the region warms, and *Pediastrum* appears in the lake in high abundances for the first time. This increase is ascribed to nutrient enrichment in the lake, linked to the rapid increase in regional pastoral farming.

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### 1. Introduction

Since 2001 a major interdisciplinary programme (Baikal Archaeology Project) has sought to characterise Holocene cultural dynamics among hunter-gatherer and pastoralist populations in central Asia (Weber et al., 2010). Results from this on-going research

have redefined our understanding of hunter-gatherer adaptive strategies during the Neolithic–Bronze Age, including aspects of culture, subsistence and diet, mobility patterns, genetic structure, and social and political relations. Most of these new archaeological data have been derived from numerous well-preserved formal cemetery contexts, which have allowed detailed analyses of human skeletal remains. Focus has especially centred on a distinct biocultural discontinuity during the Middle Neolithic (Weber et al., 2002), and more recently the expansion of pastoralist populations (Nomokonova et al., 2010).

One of the oldest records of human occupation in this region (ca. 9 ka BP) was recorded at the Sagan-Zaba cove, in the Ol'khon

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