



Research Highlight

Megadrought and cultural exchange along the proto-silk road, in the context of debate over human-environment interactions

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There is a growing volume of literature on the relationship between climate variability and the fate of cultures. This is particularly important because of the looming threat of human induced climate change and the resilience of societies in managing it. Since human nature has probably changed little over the millennia it is interesting to investigate the past, in order to understand the relationship between humans and their environmental settings, and on how humans adapted to new conditions. Much of the published literature falls into two main camps. There are those that argue that climate change was a significant trigger in the fate of some cultures e.g. [1]. Others argue that while climate change may have been a factor, it was social factors that ultimately led to changes. These may have been wars, famine, disease or the collapse of government structures e.g., [2]. In reality, individual cultures probably had their fates driven by a combination of factors.

Even in the face of mounting evidence of a warming world today, there is debate on this topic. Humans have a tendency to feel that there is a norm about the climate they live in. Our way of life depends on a relatively stable climate. A warmer, wetter, colder or drier year is to be expected, but there is an overriding expectation that things will return to normal in a short period. Most societies have the resilience to ride out one or two “aberrant” years. But what happens when the change lingers for a decade or more? At this point resilience breaks down and social and cultural practices are placed under huge stress e.g. [3]. The details of how this played out in the past are beset by a number of technical problems. The big changes in climate and culture may be evident, but the onset, development and variability of climate can be difficult to pin-down due to the time resolution of the available palaeoenvironmental records [4]. Additionally, the material remains of cultures, at best, provide little more than a basis to assess how societies may have been adjusting, and just what social factors may have come into play. In many cases the dating results may allude to an association between climate and cultural changes, but they are rarely precise, and then we see assumptions of cause and effect appearing in arguments.

The Silk Road and its predecessors are one of the earliest examples of globalisation in trade, in this case between the East and

West of Eurasia [5]. The Silk Road is in fact several roads, and they crossed Central Asia which includes arid lands over vast areas. Societies there lived in challenging environments with scarce water resources. Thus, many were living on the edge which made them particularly vulnerable to drought. Nevertheless, their presence made East-West trade in commodities and ideas possible and contributed to the well-being of societies at either end.

The project directed by Tan et al. [6] has used a multi-proxy and rigorous dating program to identify an intense and long-lasting drought in the middle part of the region in the Fergana Valley of Kyrgyzstan. The Fergana Plain is enclosed by mountains and is famous as a site for production of gold and silver artefacts, and later iron, and these were exported widely across Eurasia. It was a very important centre for East-West trade. The identification of a major and long-lasting drought is supported by precisely dated speleothem records. They use isotopes and geochemical parameters which can be related to the rainfall patterns that occurred while speleothems grew in Talisman Cave (Fig. 1). Regional records from past water-level studies from Lake Song-Kol [7] and Lake Balkhash [8] which show a fall of many metres in the water level, and the occurrence of gypsum and nitrogen isotope values which indicate dryness are present. Several other records from Central Asia also record a drought at about this time and there is evidence of a pulse of eolian dust from Asia into the North Pacific Ocean [9]. A key strength of the key paper here is that the ages pin-down the timing of the drought precisely. And the record shows that it was not just a simple plunge into a uniformly harsh drought but it showed some variation within the period.

The cause of this change is not yet clear but a prime candidate seems to be a shift in the westerly jet. Increased storminess at that time in the North Atlantic supports this hypothesis. The north-shifted westerlies would reduce the intensity of storms in the Mediterranean and thus a decrease in moisture delivery into central and southern Europe [10]. Since the arid region of central Asia is downstream from there, this means there is a reduction in delivery of moisture into the region via the westerlies. It is also possible that high evaporation under warm conditions was a principle cause of drought [11].

The drought lasted for 640 years. This was no ordinary drought, and the researchers used the term Megadrought. Its scale is unprecedented in the perspective of the last 8000 years. The peak

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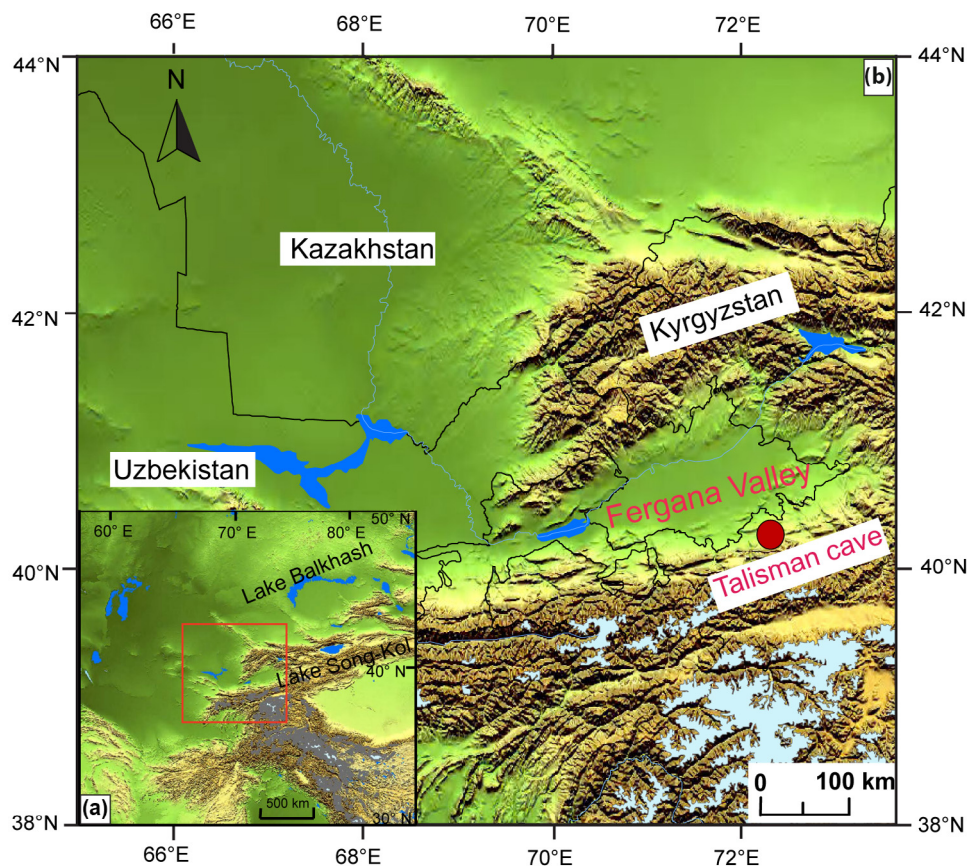


Fig. 1. Map showing locations mentioned in the text (a) and the Inset (b) shows location in Central Asia. Figure drawn by Dr. Fengyan Lu.

of the drought was between 5820 and 5180 years before present. It coincided with the time that Neolithic societies were beginning to exchange ideas and technology in metallurgy and farming. The diversity and precise timing that the records provide, and the fact that the drought had a broad geographical coverage, means that the impact on societies can be addressed directly. No society could overcome the severity of the conditions over such a long period and the archaeological record of the area falls largely silent during this period. This suggests societies in Arid Central Asia had to abandon life around oases and relocate to areas with mountains and run-off to the north and south for reliable supplies of water.

From about 5180 years before present there was a gradual weakening of the drought and increasing precipitation enabled settlements and oasis life, and hence opening-up of exchange routes through Arid Central Asia, to resume. The archaeological record of settlements then expanded and shows that the oasis routes become key elements of the early Silk Roads. While the research shows there was continuing variability there was no return to prolonged megadrought conditions. This is also the approximate period when new crops and animals were apparently introduced into central and eastern Asia, and some Asian crops such as rice and millets spread westward [12–14]. East-West exchanges probably began from about 5200 years ago once the drought had ameliorated. After such a long drought people may have been more predisposed to be accepting of new technologies and agricultural methods from both East and West, as this is about the time that the use of these became more widespread.

One of the justifications of studying past climates is that the instrumental record is too short to reveal the full range of climate variability. This is needed, for example, to constrain climate model simulations. Studies of past climates have revealed many abrupt

and high magnitude events, that can last decades or centuries. The largest of these, like the megadrought of Central Asia is beyond the capacity of societies to ride them out. The adjustments that people need to make alter the very nature of social structures and drive the need to do things differently. Abrupt, less severe or where the change is gradual or of short duration can allow societies to adapt. But this needs testing with high resolution records. Many abrupt changes have their impact on vegetation, soils, hydrology and resources, and thus on societies. However, we need well-dated archaeological records to help understand the full range of climate variability that societies have coped with. Where these studies are coupled with detailed archaeological records they can contribute greatly to our understanding of the interaction between climate variability and social changes. People at the famous Starr Carr site in northeast England were resilient enough to cope with several abrupt events that occurred over a hundred years [15]. In that case it was temperature rather than drought that was the limiting factor. We need more high-resolution palaeoenvironmental records which are coupled with well-dated archaeological data in order to understand the full range of human-environment interactions.

Conflict of interest

The author declares that he has no conflict of interest.

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