

Case study 29: Social change in late Holocene mainland SE Asia: A response to gradual climate change or a critical climatic event?

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Introduction

The Iron Age archaeology of the Mun River floodplain in NE Thailand (Figure 1) represents a period of prehistoric settlement dating from *c.* 500BC to AD500. It is characterised by many settlement sites consisting of 3 to 5m high mounds of several hundred hectares, with distinctive encircling earthworks and channels commonly known as ‘‘moats’’ (see Case study 27). The channels imply a relationship between hydrological conditions and patterning of prehistoric settlement. The sites are closely associated with a landscape of palaeochannels, which in turn reflects former conditions differing markedly from those at present.

Management of Iron Age water supply to the sites permitted long-term and successful settlement of the valley. However, that settlement eventually ceased, which raises important questions of cause, notably the roles of a possible critical threshold climate event or long-term gradual climate change.

Methodology

To provide context for the settlement history of the Mun River valley, Boyd *et al.* (1999a) established a floodplain landscape model. This model showed patterns of former drainage, locations and types of rivers notably differed in the past from the present rather limited drainage. During these early periods, floodplain drainage was through a multi-channel anastomosing system; such a fluvial system typically has channel location stability and periodic channel abandonment and revitalisation (Nanson and Croke, 1990; Brown, 1996). A shift from these to the modern system of over sized single string meandering channels implies changes in discharge and/or sedimentation, influenced by external factors such a human activity or climatic change

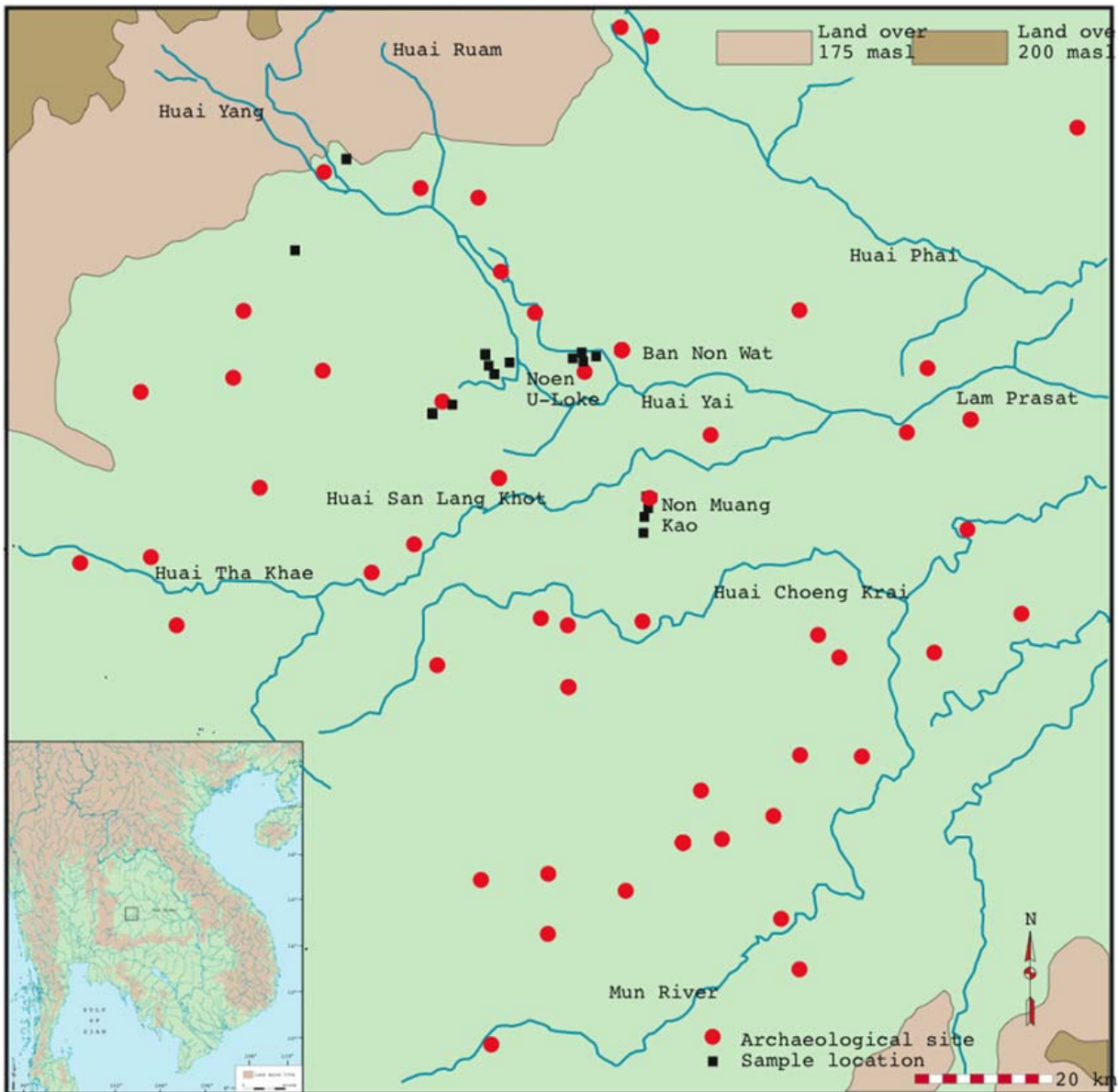


Figure 1: Location map of the upper Mun River valley in NE Thailand. The small squares represent geoaerchaeological sample sites used to develop the palaeoenvironmental understanding discussed in this case study.

The floodplain mapping indicated that the prehistoric sites are clustered within approximately one-fifth of the floodplain in which the former rivers flowed (Boyd *et al.*, 1999a). This suggests a real landscape relationship between sites and former drainage patterns. Furthermore, at sites examined in detail, the encircling channels were shown to be connected with the former rivers.

Results

Examination of the lithology, stratigraphy and cross-sectional morphology of the encircling channels indicated:

1. The channels were either in-filled rivers with minor modification in the past (small cut channels, some cleaning of channels, and some construction of interchannel banks) or broad and shallow constructed channels (McGrath, 2001).
2. The channels functioned while the sites were occupied, and sites expanded over earlier infilled channels.
3. The channels date from a relatively short period during the middle and late Iron Age (C14 dating of 2130 ± 50 BP to 1364 ± 63 BP) and each was infilled relatively rapidly after its formation (McGrath and Boyd, 2001).
4. The later channels tended to be constructed, whereas earlier ones were slightly modified river channels.
5. The older channels silted up with catchment sediments and were replaced by other river channels.
6. Later channels silted up with local floodplain sediments and were not replaced.
7. Site abandonment and the cessation of channel functioning are synchronous.

The Holocene sediments include the Old Alluvium, which contains lake and swamp deposits that suggest warmer and more humid conditions than at present. Young Alluvium sedimentation commenced at *c.* 2000BP and lying stratigraphically between the Young and Old Alluvium is aeolian sand, probably dating from the 4th millennium BP, representing drier conditions than present.

Discussion

This chronosequence suggests that the initial prehistoric settlement in the region was associated with conditions of physical environment and climate amelioration. The wide multichannel river system identified by Boyd and McGrath (1999a) probably reflects the early wetter conditions that prevailed as Neolithic or Bronze Age people first settled the area.

The earliest known human occupation during the Neolithic was associated with a well-watered late mid-Holocene landscape. This provided a local landscape with a range of resources for swidden-type agriculture and broad-spectrum hunter-gathering.

By the Late Bronze Age (*c.* 3000 to 2500BP), the hydrology associated with the sites underwent major change as lower energy and drier conditions became established. Such conditions probably related to the establishment of savannah-like floodplain grasslands and significant anthropogenic impacts on the forests (Boyd and McGrath, 2001a, b). By the time of Iron Age settlement (*c.* 2500 to 1500BP), landscape change was well under way, with the establishment of a managed landscape and increasing aridity (Boyd and McGrath, 2001a, b). Settlement by this time was associated with declining natural resources in the immediate locality of sites, and a reliance on rice cultivation, animal husbandry and some broadspectrum gathering (McCaw, 2000).

The geological evidence of an increasingly fragile water supply to the floodplain during the Iron Age supports an argument for decreasing reliability of water supply. The social response was to engineer a system of continuing supply of water at a time when previously-reliable supplies of water were under threat.

The evidence of infilling of the channels surrounding prehistoric settlement sites, especially towards the end of the Iron Age, indicates that soil erosion was typical in this region. However, although the progressive silting of rivers is evidence for soil and sediment loss in the upper catchment, the final infilling of the encircling channels appears to better represent wet-season flooding, during which surface sediments are saturated and washed around the floodplain, rather than necessarily removed from it.

Some evidence exists for local geomorphological change including faulting and salt dome upwelling (Utha-Aroon, 1993; El Tabakh *et al.*, 1998, 1999). Some of the mapped drainage patterns show stream dog-legs and alignments that imply a regional tectonic control. Salt doming may be important as the floodplain pattern of both drainage, flooding and, prior to modern landuse, vegetation, indicates that gentle land surface warping by upwelling salt

domes has been influential in defining the micro-topography of the floodplain. Also, it is possible that the slight rises upon which people originally settled represent salt dome upwelling warping of the land surface. The importance of this significant geological feature of the region is evident also in the long history of salt working. However, in terms of explaining regional social and environmental events, it should be questioned whether salt doming or faulting would have had anything other than a local effect.

The study area is currently a marginal and seasonally arid region, in which farming communities struggle to raise crops; this is in distinct contrast to conditions prior to the end of the Iron Age. A significant shift in climate, such as reduced rainfall, would provide a mechanism for the changes described, although whether this is a reduction in volume of annual rainfall or a shift in rainfall seasonality is currently unclear. The region lies in the shadow of mountain ranges to the west, south and, further a field, the east, effectively making this a rain-shadow area under all monsoon conditions. Gagan *et al.* (2004) note that, for the Indo-Pacific region, there was a marked increase in El Niño activity at around 3000 years, with ENSO variability reaching and possibly exceeding modern levels at *c.* 2500 to 1700BP. These developments would have amplified precipitation variability throughout the region. On the other hand, while there is little evidence for a specific climatic shift at around 1400BP in SE Asia, there are examples of significant environmental changes elsewhere in southeast Asia. Bishop *et al.* (2003) identifies substantial vegetation and hydrological changes in the 5th and 6th century AD on the Mekong Delta that they assign to changing land-use practices or priorities.

Conclusions

The cause of the abandonment, *c.* 1400 years ago, of the Iron Age communities is unclear but is probably related to changing environmental conditions. The archaeological and geoarchaeological study of these sites indicates that environmental conditions were good during the early periods of settlement, and relied on the successful management of water supply. During the late 3rd millennium BP, active water management was being practised, continuing a tradition of settling beside and using rivers. These rivers increasingly became integrated into the settlement sites, with increasing evidence for engineering management of

river channels, and eventually the engineering construction of artificial channels around the sites. In tandem to this change, the hydrological conditions of the floodplain were changing, with, eventually, a critical transition from a well-watered plain to a relatively dry environment, and a change of river style; reliability of water supply reduced. The human response to this environmental deterioration was to further engineer conditions to maintain the form of water supply to the settlements; this eventually ceased to work.

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