

Case study 27: Floodplain sites of the Mun River valley in northeast Thailand

R. J. McGrath, W. E. Boyd and R. T. Bush

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Introduction

On the floodplain of the Mun River valley of northeastern Thailand are 3 to 5m high, several hundred hectares in area, mounds of occupation debris dating to *c.* 500BC to AD500. Encircling many of these mounds are human-constructed channels, referred to as moats. The moats are shallow (tens of cm) but wide (30 to 60m) with narrow banks (order of meters wide) consisting of floodplain sediments or spoil. The floodplain sediments in the area of the study sites are characterized by thin ($\leq 2\text{m}$), weathered deposits of sand, silt, and clay, often with abundant iron nodules (pisoliths) and carbonate concretions (Boyd *et al.*, 1999). The moats are filled either with massive deposits of unweathered clay or redeposited, weathered, floodplain sand, silt, and clay. In both cases are conspicuous absences of iron nodules and carbonate concretions.

The moats have been interpreted as being built for defence, aquaculture, agriculture, or water management. Their intimate association with large archaeological sites, however, does imply a close relationship between paleohydrological conditions and prehistoric human settlement patterns. This case study relates the archaeological sites to the former river drainage patterns in order shed light on aspects of lifestyle, economy, and industry.

Methodology

The sedimentological and geochemical characteristics of sediments are used to determine the processes responsible for their deposition. Such data may indicate the sediment source, reworking patterns, transport processes, and hydrological flow rates. The case study also considers the complex paleohydrology of the floodplain, and a moat was compared with natural paleochannels. The hydrological regimes represented

by the alluvial sequence helps to reconstruct the landscape context of the archaeological sites.

Profiles were examined in the Ban Non Ngiu paleochannel, the mound of Ban Non Wat, the mound's moat bank and channel, and the floodplain. Samples were collected at 0.1m increments to the base of the trench exposure. At Ban Non Ngiu the lower three samples were retrieved using PVC pipe driven into the bottom of the trench.

Particle size was analysed by wet sieving, dry sieving, and X-ray (sedigraph) particle size analysis. Geochemical analysis included reaction (pH), electrical conductivity (EC); total carbon, sulphur and nitrogen; and inorganic carbon. Inductively coupled plasma-mass spectrometry (ICP-MS) was used to determine the concentration of acid extractable metals; and acid extractable salts were determined by atomic absorption spectrophotometry (AAS). Finally, mass specific magnetic susceptibility was determined and a magnetic extract formed, which was dried and evenly distributed on glass slides for examination by light microscopy and X-ray diffraction (XRD).

Results

The sediments collected from the paleochannel of Ban Non Ngiu have distinctly different particle-size distributions compared with the sediments at Ban Non Wat. The paleochannel has a clear textural boundary between the channel fill and the underlying sand. The fine-grained fill in the paleochannel has similar particle-size characteristics to the fill in the moat at Ban Non Wat though the fill at the moat site is loamier. The mound, bank, and floodplain profiles indicate the presence of larger particles, most of which are iron nodules. The mound profile has two concentrations of nodules, one just above the buried channel fill within the mound, and the other near the contact with bedrock. In the moat bank profile, nodules occur near the surface, whereas in the floodplain profile, there are two concentrations of nodules: one near the surface and the other near the boundary between the alluvium and bedrock. However, nodules were not found in the channel fill at Ban Non Ngiu, in the moat profile at Ban Non Wat, or in other Ban Non Wat channel-fill sediments.

The pH of the sediment in the paleochannel at Ban Non Ngin is largely neutral. In contrast, EC is high near the surface of the channel fill and at depth in the sand. Both

Mn and Fe concentrations in the Ban Non Ngiu paleochannel are consistently low, and magnetic susceptibility is also low, especially in the sand layer. The pH values of sediments in the Ban Non Wat profile are more alkaline compared to the values in the Ban Non Ngiu profiles and tend to increase with depth. EC generally increases with depth and closely matches the depth function of Na, indicating that NaCl is abundant. In the floodplain profile, very high concentrations of Mn occur at the alluvium-bedrock boundary, which also coincides with peak Fe concentrations. The coincidence of Mn with Fe occurs in the other profiles at Ban Non Wat, but with Fe being more abundant. Peaks in magnetic susceptibility closely match the coarser particle-size fraction and iron nodules.

Concentrations of Na, K and Mg at the Ban Non Wat mound reach peaks in the underlying channel fill. Negligible amounts of Ca occur within the upper part of the mound, but Ca is concentrated in the channel fill and bedrock. All units in the Ban Non Wat moat bank profile are sodic, with Na generally increasing with depth. Significantly more K and Ca, however, occur within the spoil than in the underlying channel fill.

Low concentrations of inorganic carbon are recorded throughout the channel fill at Ban Non Ngiu, and the concentrations of organic carbon and nitrogen decrease with depth. Inorganic carbon is concentrated in the bedrock underlying the mound at Ban Non Wat. Organic carbon and nitrogen are elevated near the surface at all of the study sites, and exhibit peaks in the channel fill.

Peaks in magnetic susceptibility occurred in the mound at 1.8 to 1.9m and 2.6 to 2.7m and the floodplain deposits at 1.0 to 1.1m. XRD diffractograms identified the magnetic mineral associated with peaks in magnetic susceptibility as Maghemite.

Conclusion

The mound sediments at Ban Non Wat appear to be more similar to the floodplain sediments compared with the moat sediments. The mound and floodplain sediments have similar particle-size distributions (although the mound material has more sand), and both have elevated magnetic susceptibility values. These similarities suggest that the source of much of the mound-building material is from the surrounding

floodplain. This may explain the presence of iron nodules within the mound material and the associated high magnetic susceptibility values. Since iron nodules are concentrated at the boundary between floodplain deposits and the bedrock, it is feasible that they were in sediment used for construction of the mound. Furthermore, XRD analysis indicates that the magnetic mineral associated with the iron nodules is maghemite, which is formed under extreme weathering conditions as would occur at the water table boundary.

Iron nodules present near the surface at this site indicate that the moat bank was constructed from material excavated at great depths. The carbonate content of sediments comprising the upper part of the moat bank is similar to that of the bedrock, but distinctly different compared to the channel fill immediately beneath the moat bank. This suggests that the banks may be largely composed of material excavated from bedrock underlying the channel fill.

References

Boyd, W. E., R. J. McGrath and C. F. W. Higham (1999) The geoarchaeology of the Iron Age ditched sites of the upper Mae Nam Mun valley, N.E. Thailand II: Stratigraphy and morphological sections of the encircling earthworks *Indo-Pacific Prehistory Association Bulletin* 18: 169-179