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Ancient Copper Mining in Laos: Heterarchies, Incipient States or Post-State Anarchists?

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Abstract

In early 2009 the remains of wooden structures supporting ancient mining shafts were discovered during modern-day industrial copper mining in Savannakhet Province, Laos. Subsequent 'rapid-response' archaeological excavations within the Khanong A2 mining pit revealed over 130 tightly clustered vertical shafts measuring between 1.5 and 2.5m in diameter, and dating to around 2000 BP. A long-term conservation process was begun in order to preserve the rare wooden finds. In 2012 a second site with preserved wooden structures was revealed. Comparing these two sites and discussing them in relation to other sites discovered within the modern mining tenement, and in the wider Southeast Asian context, allows us to investigate the social context of mining in prehistoric Southeast Asia. The central question is whether local mining in Vilabouly is an example of complex industry and exchange relationships developed outside of traditional models of hierarchical social structures.

Keywords: Southeast Asia, Laos, Iron Age, Copper, Mining, Heterarchies

1.0 Ancient Mining and Political Organisation

Mining has been a human endeavour for thousands of years. Sites located in South America, Europe, Africa, North America and even Australia attest to its global nature (Sagona 1994; Kassianidou 1998; Knapp 1998;Bamforth 2006; Salazar et al. 2011).

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Further, while mining and metal production in the ancient world is often thought to be associated with the rise of state society, archaeological and anthropological evidence indicates that there have actually been many different forms of mining societies, including Hunter-Gatherer miners in South America (Salazar et al. 2011, p. 463), and ethnographic observations of tribal seasonal mining in Papua New Guinea (Chappel 1966; Burton 1984). These examples indicate that small-scale societies can and do engage in activities similar in complexity to those of larger state societies. It is interesting to consider whether such examples are unusual or if they were in fact common in the past and this has certainly been a topic of debate in Southeast Asian archaeology (Bennett 1989;White & Pigott 1996; Pigott 1998; Higham 2002; Pigott & Ciarla 2005). While the advent of metal production is clearly congruous with the rise of social complexity in Bronze Age and Iron Age China (Shang and Zhou Dynasty hierarchies, writing, and bureaucracy) the case is not as clear in the few copper and iron metal producing sites known in Southeast Asia (Wilbur 1943; Winzler et al. 1976; White 1986; Murillo-Barroso et al. 2010). This was remarked upon in the much quoted 1988 statement by James Muhly that 'In all other corners of the Bronze Age world ….we find the introduction of bronze technology associated with a complex of social, political and economic developments that mark the rise of the state. Only in Southeast Asia….do these developments seem to be missing' (Muhly 1988, p. 16). More recently, in an effort to move beyond a simple 'state' versus 'non-state' dichotomy it has been argued that early metalworking activities in Southeast Asia were associated with heterarchial societies (White 1995, p. 103). It is in the context of this debate that the new Lao evidence assumes particular importance (Pryce & Abrams 2010; Pryce et al. 2011, 2012).

2.0 Archaeology of Copper Mining in Vilabouly

Building upon earlier cultural heritage surveys a series of archaeological excavations within the modern MMG-LXML mining tenement have investigated several ancient mining related sites including Peun Baolo (2008 - 2012), Dragon Field (2008), Khanong A2 (2009), Malachite Cave (2011) and Tengkham South D (2012). Together with a considerable collection of 'chance find' artefacts collected by local people and mining staff these are creating a picture of a vibrant copper producing community in place over a period of at least 1000 years (2500-1500 BP), possibly much longer (Pryce et al. 2011, 2013). In this article we focus on the Khanong A2 (KA2) and Tengkham South D (TKSD) sites as it is at these that we find well preserved wooden structures directly related to ancient copper mining.

These sites sit firmly within the local Iron Age, however evidence from nearby Peun Baolo strongly suggests Bronze Age (prior to about 2400 BP) copper mining also existed in the area (Pryce et al. 2013, p. 11).

2.1 Khanong A2 (KA2)

The KA2 pit is part of a system of modern open-cut mines constructed over the Khanong deposit. The archaeological features were found along the western side of the modern pit. Most of the archaeological work was carried out close to what was at the time the base of the pit, approximately 14.5m below the original ground level. Several shafts bottomed out at about this depth, however, at least one was excavated to 23m below ground at which point the base had still not been reached.

The ancient shafts are concentrated within an area stretching approximately 60m northeast to southwest and about 30 metres wide. In many cases, shafts are not only directly adjacent to each other but also intercut. Individual shafts may have been filled in prior to, or as part of, the digging of new shafts.

Figure 1: Excavating ancient mine shafts amongst 21st Century mining. Khanong A2 pit, 2009 (Photo: N. Chang).

Figure 2: An Example of the Remarkable Condition of the Rattan Binding at TKSD 2012. Vertical Post Aprrox. 10cm in diameter (Photo: N. Chang)

All the shaft features uncovered during the course of the excavation were vertical constructions with no evidence of horizontal tunnels or adits. Also, there is a distinct lack of any evidence of 'belling out' or widening of the shafts at the base. This is a common practice in other ancient mining sites that allows a larger area of ore to be exploited (Hooker & Ritchie 1997; Timberlake 2005). At KA2, however, a substantial amount of effort was expended to construct individual shafts that could access only small areas of ore. An analysis of 107 shafts showed that 45% measured between 1.1 meters and 1.5 meters in diameter (allowing access to just 1.8 m² of ore) (Tucci 2012 p. 58). A further 40% of the shafts had diameters ranging between 1.6 meters and 2.5 meters (an area of up to 4.9 m²) (Tucci 2012 p. 58).

Perhaps the most striking aspect of this site is the well-preserved wooden structures. While there is some variation, the general pattern is of a star-shaped structure of beams (when viewed from above) made up of two squares, one rotated 45 degrees relative to the other, and the whole lashed together with rattan fibres.

This structure is repeated at approximately 70cm intervals vertically and vertical posts further serve to tie the structure together. Sheets of bamboo or rattan matting form a wall between the structural beams and the clay wall of the shaft. The main beams are often bevelled at the ends in a manner that is still in use in the local area today (known locally as 'pig-trotter' joints) which bear some similarity to carpentry traditions found at the late Western Han Dynasty Chinese copper mining site of Tonglushan (Golas 1999, p. 294). Vertical pieces are often grooved to provide a lodging point for the 'pig-trotter' horizontal beams.

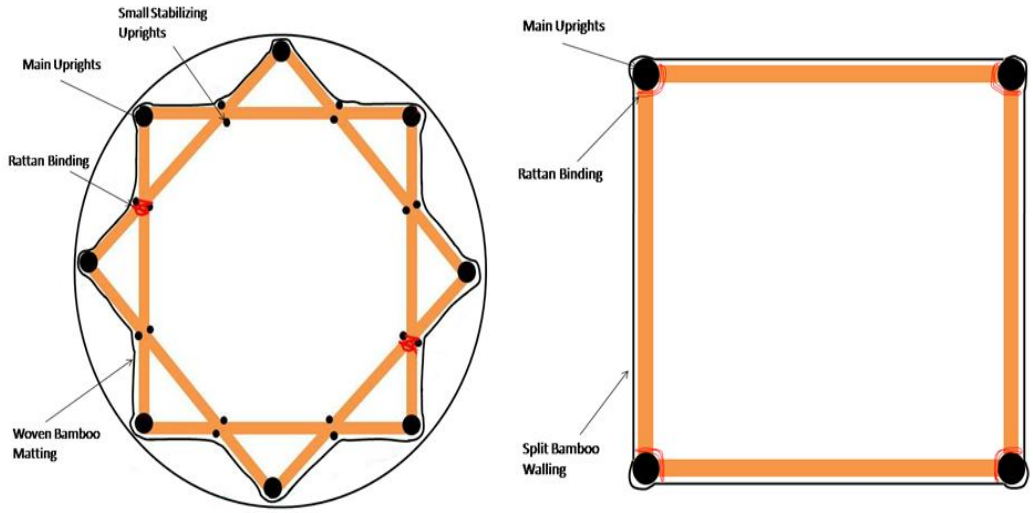

Figure 3: Plan View (Schematic) of Khanong A2 Mining Shaft Wooden Structures (Left) and the Square Shafts Found at Tengkham South D (Right) (Diagram: A. Tucci).

These structures have been remarkably well preserved, most likely due to an anaerobic environment and the high concentration of copper salts in the surrounding clays.

Two radiocarbon determinations were taken from rattan binding and small diameter wood that indicate dates of 1889 +/- 38 calBP (WK-26272) and 2142 +/- 39 calBP (WK-26243). Thus the mining complex appears to have been in use for at least 250 years.

The adjacent site of Dragon Field is likely part of the same complex of activity with evidence of copper smelting and cemetery activity, along with a single radiocarbon determination from a sealed context of 2126 +/- 28 cal BP (WK – 32284).

Following the 'rapid response' excavation at KA2, 21st century mining continued and the pit is now used as a water storage and treatment facility. The shafts likely extend to the west, beyond the current pit, and further excavation work is planned in coordination with modern mining activities.

2.2 Tengkham South D (TKSD)

As with KA2, this site was discovered during modern mining activity necessitating a similar 'rapid response' archaeological investigation. Again, the site name refers to the modern MMG-LXML mining pit designation and much of the archaeological excavation was carried out on an artificial terrace within the modern pit at between 10m and 20m below the original (sloping) ground surface. This site differs from KA2 in that three quite different structures have been recovered in the same area. First, round shafts similar to the Khanong A2 examples were uncovered. These differ from KA2 in that they include diagonal main beams between each horizontal level, resulting in a much sturdier structure at TKSD.

Second, two square shafts were located nearby at about 20m below the original ground surface. These measure approximately 2.2m along each side with vertical posts at each of the four corners. Horizontal framing is again repeated approximately each 70cm with the whole lashed together with rattan fibres. 'Pig-trotter' joints connect the horizontal and vertical beams. A new feature here is regular, vertical; split-bamboo walling that has been carefully added between the framing and the clay wall of the shaft.

Third, within 30m of the above features, and 10m below the original ground surface, an area that suggests open-pit or another larger scale form of mining was investigated. Neither round nor square shaft structures were identified here. Rather a long wall-like structure was identified made up of vertical posts and heavy bamboo and rattan matting. When viewed in section this defines a cut into the clay and siltstone substrate running into the sloping face of the original hill with several metres of disturbed soils extending away from the wall.

This may indicate an open pit that was later filled in by erosion, or tunnels. The wall feature was also associated with iron tube-like objects ranging between 5cm and 25cm in diameter. Originally it was thought that these tubes might be the result of mineralisation around a wooden beam or post; however very preliminary portable XRF analysis indicates that these objects are predominately iron in composition, suggesting manufactured objects.

Figure 4: Tengkham South D Site Immediately Prior to Archaeological Excavations, 2012. Excavations Were Carried Out Near the Base Of The Pit Face Where a Small White Vehicle can be Seen in the Picture (Photo: N. Chang)

Figure 5: The Woven Style of Bamboo Matting Clearly Displayed (Left) Compared to the Split Bamboo Style on the Square Shafts (Right) at TKSD (Photo: N. Chang)

Figure 6: A Top Down view of the Shaft Crosspieces (left) and a Side on view of Both the Horizontal and Vertical Pieces (Right) at Tengkham South D site 2013 (Photo: N. Chang)

Three radiocarbon determinations are currently available. A section of rattan binding from the 'round shafts' provided a date of 2102 +/- 28 calBP (WK-36348). This date is similar to the earlier of the two dates from the Khanong A2 shafts and the single determination from Dragon Field. A similar result was also returned from the bamboo and rattan matting area (2105 +/- 28 calBP (WK-36350). However, bamboo from the square shafts returned a significantly later result of 1552 +/- 27 calBP (WK-36349).

Thus, the clearly different square shafts seem to be the product of a second mining venture in this site's history. Pottery sherds associated with the square shafts, the only two pieces found at the site, are black stoneware that is consistent with this later, mid-first millennium AD date.

The most unexpected finds at TKSD were what appear to be two complete dugout canoes, one directly overlying the second separated by about 40cm of fine silty clay fill. Portions of two further canoes were found nearby. These appear to be on the edge of the mining area and while it is possible they were used in some way in mining or processing ore an alternative explanation is that they were coffins; this is not an uncommon practice in upland Southeast Asia and Dong Song sites in northern Vietnam (Taylor 1983; Higham 1989, 2002, 2009; Bellwood et al. 2007). These objects were found approximately 10m below the original ground surface; however, the steeply angled stratigraphy suggests that they may have been originally buried more shallowly, with subsequent erosion depositing soils above. Unfortunately acidic soils mean that no bone survives in any of the sites so no human remains were recovered. If these 'canoes' were indeed used as coffins then their location suggests a close personal association between miners and mines – supporting a possible interpretation of small family groups working on family 'owned' mining claims.

3.0 The Vilabouly Complex

The relatively close proximity of all the sites investigated thus far allows us to consider them as various aspects of a larger site or complex, although more radiocarbon determinations are clearly required to understand how many were in use at the same time(s). In a clear example, KA2 and Dragon Field are only separated by 300 meters, and many of the KA2 shafts bottom out at the same 240 metres mRL (mine relative level, an MMG-LXML established height datum) as the base of the Dragon Field valley. Some geologists with long personal experience in the area suggest that Dragon Field may itself be the remains of an early open cast mine. Based on small-scale excavations that included likely mortuary ceramics as well as crucibles and other copper smelting evidence, we argue that Dragon Field was a cemetery and occupation site associated with the KA2 mining shafts. Similarly TKSD, located 7kms to the west, appears associated with log or canoe coffins and Peun Baolo, a further 2kms to the west, clearly includes mining, smelting and cemetery evidence.

Together, these sites reinforce the impression of a close association of family life, the ancestors (cemeteries) and mining in ancient Vilabouly. The evidence from Peun Baolo will feature elsewhere, however, we can note here that while a single determination dates the upper layers to 2261 +/- 29 cal BP (WK-33832) grave goods, including bronze or copper 'ge' (dagger-axes), suggest the deeper graves date to the Bronze Age, before about 2400 BP. It seems likely that Peun Baolo was in use for several hundred years spanning the local Bronze Age to Iron Age transition.

4.0 Copper Mining and Social Complexity in Southeast Asia

In recent decades studies of prehistoric Southeast Asian social complexity have set heterarchial models against more traditional hierarchical interpretations (White & Hamilton 2009). Those developing the former model argue that an understanding of social complexity requires an understanding of social structures that are either unranked or much more fluid and flexible than rigid hierarchical systems (Crumley 1987; Scott 2009). At Phu Lon, for example, on the NW margin of the Khorat Plateau of Northeast Thailand, the copper mining complex includes substantial tailings deposits that might record periodic visitations (possibly seasonal) over a long period of time (Pigott 1998, p. 219). It is argued that these ore deposits were directly available to miners and that access to the resource was not controlled by, and did not prompt the development of, local elites (Pigott 1998; White & Hamilton 2009).

Scott's work (Scott 2009, p. 13) on mountain dwelling communities of the Southeast Asian massif (which he terms *Zomia*) suggests a third model. Scott argues that these peoples (often referred to as 'hill tribes') are not on an alternative trajectory to complexity (heterarchy). Neither are they backward and in some way incapable of joining state society (Scott 2009, p. 315). Rather, these communities actively avoid state control, having adapted social and subsistence practices to their upland refuges as a strategy to retain independence (Scott 2009, p. 326). Scott argues that their existence is a 'state effect'; in many cases these societies have been created as refugees have fled the expanding Chinese state over the last 2000 years.

Which model of social organisation and interaction best explains the Vilabouly evidence? First, it is clear that the Iron Age components of the Vilabouly complex dating to approximately 200 BC-AD 200 could represent heterarchial or community-based operations.

Archaeological studies into seasonal mining operations have shown that relatively small groups could still undertake large operations over a long period of time (Chappel 1966; Burton 1984; Sagona 1994; Kassianidou 1998; Salazar et al. 2011). These studies also found that ritual factors played a large role within these operations either as a method for passing down technical knowledge or as an essential component of the process (Budd & Taylor 1995; Sagona 1994). However, it should also be noted that the Vilabouly complex is located deep in the Annamite Range, in the southern reaches of *Zomia*, with a local elevation of 250-600m above sea level (valleys versus hilltops). It may be that the prehistoric mining sites of Vilabouly evidence the beginning of the 'state effect' process in the region; producing actively state-avoiding (post-state) societies rather than pre-state heterarchies. It is important to emphasize here that each shaft appears to be an entirely independent structure.

The later 'square' mining shafts of TKSD may point to a different socio-political context. These shafts bear a striking resemblance to those found at the copper mining site of Tonglushan in China (believed to have been in use until the late Han Dynasty – first two centuries AD). Vertical shafts, as well as horizontal and inclined adits were found at these Chinese sites, with some of the shafts reaching depths of 60 meters (Baoquan 1986, p. 125). What we know as 'pig-trotter' joints in Laos are termed 'tongue-in-groove' method joints in China. This technological similarity *could* indicate a more direct relationship with expansionist Chinese states by the middle of the first millennium AD. Alternatively, post-state upland society may simply be importing new technologies from their lowland neighbours.

Lead isotope studies on copper artefacts recovered from Phu Lon and the Khao Wong Prachan Valley reveal samples that share the Vilabouly signature (Pryce & Pollard 2011, p. 147). This raises the possibility that the ancient miners of Vilabouly were trading with other copper producing societies across Southeast Asia (Pryce et al. 2013, p. 7). Whether they were operating under similar or different social systems remains to be shown. Archaeometallurgical evidence is perhaps revealing the complexity of the socio-political variety across mainland Southeast Asia, including *Zomia*, two millennia ago. Were heterarchical miners at Phu Lon, interacting with post-states producers in Vilabouly who in turn exchanged technologies with incipient state societies (Dong Son) and then actual states in Vietnam?

5.0 Heterarchies, Incipient States or Post-State Anarchists?

It is likely that the socio-political context of mining in Vilabouly changed over the millennia or more of use, spanning the Bronze to Iron Age transition. However, we suggest that at least at times the Vilabouly mining complex likely operated similarly to small family or tribal enterprises known elsewhere in the world (Chappel 1966; Burton 1984;Sagona 1994; Kassianidou 1998; Salazar et al. 2011). At the same time, however, Vilabouly was connected to the larger trading networks of Southeast Asia that ultimately included some form of link to Dynastic China (Stech 1986; Higham 1986; Higham et al. 2011). These connections may have become more direct by the middle of the first millennium AD. The question remains whether relationships were controlled by the local Vilabouly community or from the outside?

Continuing investigations of the Vilabouly copper mining complex will contribute to our understanding of the process of technology transmission and its relationship to social complexity in Southeast Asia. While many questions remain, these new archaeological sites and the associated radiocarbon determinations add a completely new and unique data-set for researchers considering the variability of early mining communities and their socio-political contexts.

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