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Underwater Maya: Spatial Analysis of Briquetage and Wooden Buildings at the Paynes Creek Saltworks, Belize, Central America

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Underwater survey in Punta Ycacos Lagoon, a large saltwater lagoon in Paynes Creek National Park, in southern Belize, revealed briquetage associated with wooden buildings that had been inundated by a rise in sea level (McKillop 1995, 2002, 2005a; Braud 1996; Sills 2007; Somers 2007). Dating to the height of the Late Classic Maya civilization (AD 600 – 900), these remains attest an extensive infrastructure of salt production and distribution. The large number of saltworks, and the standardization of the vessels in which brine was boiled, suggest mass-production of salt and the existence of a salt industry of considerable size. The Paynes Creek saltworks are located at least 24 km from the nearest urban center; this suggests that the dynastic Maya rulers at inland urban centers did not directly control the production and mass distribution of this basic dietary resource. In the following I report on the GIS-based spatial analysis of wooden architecture and associated briquetage, and I spell out some of the implications of our salt-industry research for understanding the ancient Maya economy.

Background

During the Late Classic period, the ancient Maya reached the height of their civilization. Some eighty city states were flourishing in the tropical rainforests and highland areas of Guatemala, Belize, the Yucatan of Mexico, western Honduras, and El Salvador (Fig. 1) (McKillop 2006). Each city state was ruled by a dynastic king or queen, and an entourage of royal family members, artisans, courtiers, and others were living at the royal court. In addition, the large cities had subsidiary towns and villages in the surrounding countryside (Martin and Grube 2000).

Although some researchers argue that the Late Classic Maya were centrally organized (Chase and Chase 1996), others suggest that their political organization was decentralized (Demarest 1996; McKillop 2006), or that it may have fluctuated over time or geographically between centralized and de-centralized modes (Marcus 1993). In contrast to other ancient civilizations that had strong central governments—such as Imperial China, the Aztecs, and

图一　文中提及的玛雅地区遗址分布图

Fig. 1　Map of the Maya Area Showing Sites mentioned in the text

the Incas—the Classic Maya lacked a well-developed bureaucracy, an obsession with tax records, or a strong military force; by comparison, thus, they were certainly less centrally organized. Instead, negotiation was an important way for dynastic Maya leaders to establish and maintain their power. Their palaces functioned as administrative offices as well as royal residences (Christie 2003). There were court scribes and a hierarchy of elites at the royal courts and in subsidiary communities within each polity, who served in administrative functions and were accountable to the dynastic leaders; but the written records they have left behind concerned events of dynastic history rather than matters of taxation. Warfare expanded during the Late Classic, but the military was focused less on subduing and controlling people within a polity than on conquering dynastic leaders in other Maya polities and annexing their land (Demarest 1997).

In the absence of a strong bureaucracy or military force, feasting, gift exchange, marriages, and trade provided important means for the ruling elite to establish, maintain, and reinforce power relationships (Foias 2007). At such events, held in the royal courtyard and elsewhere, Maya rulers brokered power hierarchically with the elite, and they asserted their superior status vis-à-vis elite rulers of smaller communities within the polity. They also displayed their powerà through monumental architecture, stone or stucco depictions of rulers on building facades, and propaganda texts on stelae recounting, sometimes in exaggerated form, their exploits and those of their dynastic forebears. Economically, the dynastic Maya exercised their political power through taxation and tribute. With urban populations reaching 100,000 at the capital city of Tikal (Harrison 1999), agricultural products and labor were in high demand for public works such as the rebuilding and renovation of stone temples, palaces, and causeways. Representations of tribute payment can be seen in painted scenes on pottery vessels and on the temple murals at Bonampak (Miller 2001; Reents-Budet 1994, 2001). Since the large number of artisans and others living in the cities had to be fed, food must have constituted an important part of the tribute items.

Royal court artisans included highly skilled craft workers who produced painted pots, jade ornaments, painted murals, and sculpture, as well as scribes who painted hieroglyphic texts in paper books (Reents-Budet 1994). These goods were produced for the dynastic leaders, who used them as gifts to their peers in other Maya polities and to lesser lords within their own polity, in royal feasts, and in other affairs of state. Sometimes, such objects are found in burials; their usages are recorded on pictorial painted pots and carved building façades. Use of exotic materials added value to highly crafted goods, and an impressive array of resources were obtained from distant locations: jadeite, obsidian, basalt, marine shells and stingray spines, and mercury, among others. In contrast, food, materials for tools, and other subsistence goods and resources generally were obtained in the vicinity of settlements.

In general, the economy of Classic Maya civilization (A.D. 300 - 900) had a dual structure. The "political economy", by which the dynastic leaders acquired and maintained political power, included the court artisans who made highly crafted goods for royal feasts, alliances, and other affairs of state (Masson and Freidel 2002). By way of contrast, the "subsistence economy" included household production of goods and resources that did not figure in the geopolitical landscape of dynastic Maya power struggles (McKillop 2006). Although much is known about the Classic Maya, it remains controversial to what extent the dynastic rulers controlled the production and distribution of goods and resources outside the royal court—in the remoter parts of the capitals and in the surrounding realm. The study of Maya salt production can illuminate this important issue.

Previous Research on sea-salt production in the Maya area has been quite limited. The salt flats along the north coast of Yucatan, Mexico (see Fig. 1), where a solar-evaporation method is used, have been heralded as a significant source of salt for the ancient Maya (Andrews 1983). However, the above-mentioned discovery of briquetage along the coast of Belize indicates that the north coast of the Yucatan was not the sole source of salt and that salt also was produced by boiling brine in pots over fires (Graham 1994; MacKinnon and Kepecs 1989; McKillop 1995, 2002, 2007; Valdez and Mock 1991). A debate is continuing over the relative importance of the salt from Belize and that from the salt flats of Yucatan in satisfying the demand of salt in the large inland Maya cities, particularly during the Classic period (Andrews and Mock 2002).

The Paynes Creek Saltworks

Three underwater saltworks and one saltwork in the adjacent mangroves were discovered and excavated in 1991 and 1994 in a large salt water lagoon system, Punta Ycacos Lagoon, in Paynes Creek National Park, on the coast of southern Belize (McKillop 1995). The presence of briquetage at the sites clinched their identification as saltworks, using ethnographic analogy to modern and historic salt production (Reina and Monaghen 1981). That salt production took place is thus without question. The challenge now consists in evaluating the relative importance to the inland Maya, during the Late Classic period, of salt produced on the coasts of Belize and Yucatan. I examined the organization of salt production to see whether salt was produced in bulk for trade or merely as part of household activities for home or local use. As will be seen below, the former alternative is highly likely. But even mass production at just four sites would hardly begin to satisfy the biological requirements of salt for the inland Maya. I therefore initiated a comprehensive survey aiming to investigate the scale of salt production in southern Belize, and to see whether additional saltworks existed that might have helped meet the inland demand for salt during the Late

Classic period.

A five-day survey in 2003 revealed eight new saltworks, indicating that further survey was warranted. Thirty-three underwater sites were discovered in a 2004 pilot study, making a total of 45 saltworks. Continued survey during 2005 to 2007 revealed additional saltworks, bringing the total to 100 sites. The number and density of saltworks indicate that salt production was far more extensive than evident from the previous research (McKillop 2005a, 2006, 2007; Sills 2007; Somers 2007). Moreover, remains of wooden structures discovered in the course of the later surveys indicated that the infrastructure of coastal Maya salt production and distribution was far more sophisticated than originally imagined (Plate 14.1).

Lines of wooden posts were unexpectedly discovered during the 2004 underwater survey (McKillop 2005a). The posts were preserved in pristine condition, albeit waterlogged, due to their location in a peat bog below the sea floor. The peat is mangrove peat resulting from detritus trapped in red mangrove (*Rhizophora mangle*) roots as the mangroves grow taller to keep pace with the ongoing rise in sea levels (McKillop 2002). Late Classic period sites in Punta Ycacos Lagoon and the adjacent Port Honduras coastal region have been extensively inundated; radiocarbon dating indicates a sea level rise of at least one meter since the end of the Classic period (McKillop 2002).

The posts were decayed and discolored black where they protruded above the peat into the silt that formed a loose film on the sea floor. One post at Site 15 was excavated in order to determine if it was a natural tree root or a post; it turned out to be a straight post with a sharpened base. Thereafter the underwater survey refocused on the search for the architecture defined by these posts. Three field seasons of survey and mapping have resulted in the discovery of at least 72 sites with wooden architecture. The wooden structures have been mapped at 46 of these sites.

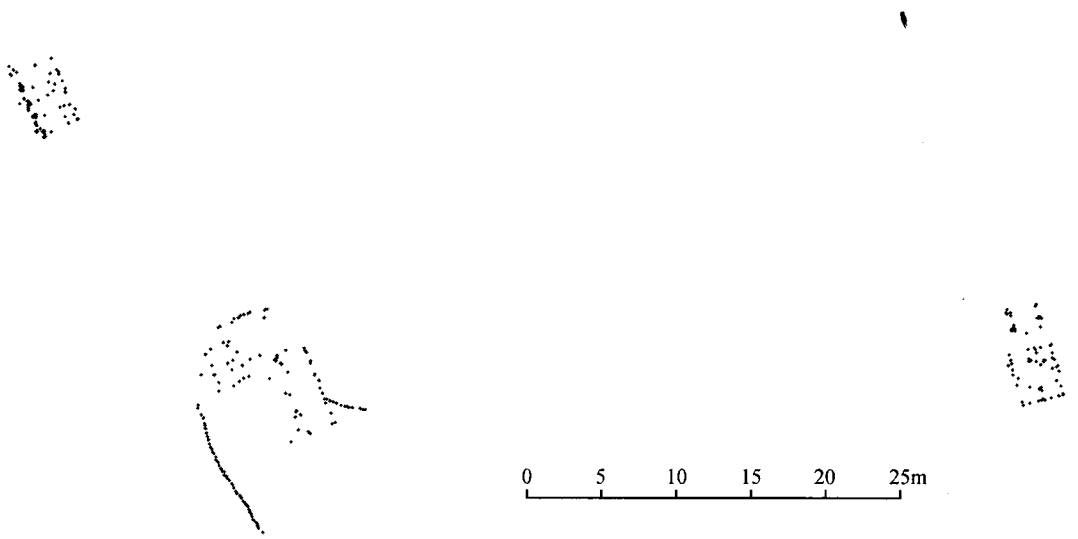
Patterns may be discerned in the distribution of sites and in the distribution of wooden posts within sites. At many of the sites, buildings are arranged lineally, suggesting orientation along a former shoreline. Although now under water, the sites are located on firm mangrove sediment that we assume was dry land at the time when the saltworks were in operation. Between the sites, there is loose silt that may represent areas formerly covered by salt water. Obviously, salt water was essential for obtaining brine to boil in the saltworks. Water access was also needed for transporting the salt and the saltworkers.

There is no evidence at the Paynes Creek sites of plazuela groups—buildings arranged around plazas that were the building blocks of ancient Maya settlements, from public stone architecture in the center of cities down to modest domestic household groups. Instead, rectangular wooden structures formed by lines of wooden posts are common, as shown by

的建筑范围。经过3个田野季度的调查和测绘，我们至少发现了72处带有木构建筑的遗址，并对其中的46处木结构进行了测绘。

我们掌握了遗址及遗址内木桩的分布规律。在许多遗址这类建筑都呈线性分布，标示了过去的海岸线走向。尽管现在这些遗址都位于水下，仍埋藏在结实的红树林堆积中。我们还是能推测，在这些制盐作坊废弃以前，当时地表很干燥，各遗址之间有着松散淤泥层的部分可能代表着以前盐水覆盖的区域。显然，盐水对于获取盐卤煎煮制盐至关重要，水道对于盐的运输和运送盐工也是必需的。

从市中心公共石构建筑到普通民众的家庭建筑，没有证据能证明四方形建筑群的 Paynes Creek 遗址——围绕广场的建筑是古代玛雅聚落的建筑区。由几排木桩构成的长方形建筑倒是非常普遍，见75、74和77号遗址（图二）。这些长方形建筑的走向是从西北向东南。有些内部是分间结构（75号遗址），其他遗址则具多重结构（如74和77号遗址），且大小不一（表一）。



图二　木柱分布揭示出 Paynes Creek 75、74和77号遗址（由左至右）中的长方形建筑遗迹

Fig. 2　Distribution of Wooden Posts Reveals Rectangular Building at Paynes Creek Site 75, 74, and 77 (left to right)

表一　木构建筑的尺寸（根据有代表性的水下遗址中已测绘的木桩）

遗址	建筑宽（米）	建筑长（米）	建筑的面积（平方米）
75	4.8	8	38.4
77a	5	6.3	31.5
77b	3.6	2.2	7.92
74a	3.5	20	35
74b	4	5	20

sites 75, 74, and 77 (Fig. 2). These rectangular structures are oriented NW to SE. Some have interior room divisions (Site 75). Elsewhere, multiple structures are seen (Sites 74 and 77). The structures vary in size (Table 1).

Table 1 Dimensions of Wood Structures Defined by Mapped Posts at Selected Underwater Sites

Site	Building Width(m)	Building Length(m)	Building Area(sq m)
75	4.8	8	38.4
77a	5	6.3	31.5
77b	3.6	2.2	7.92
74a	3.5	20	35
74b	4	5	20

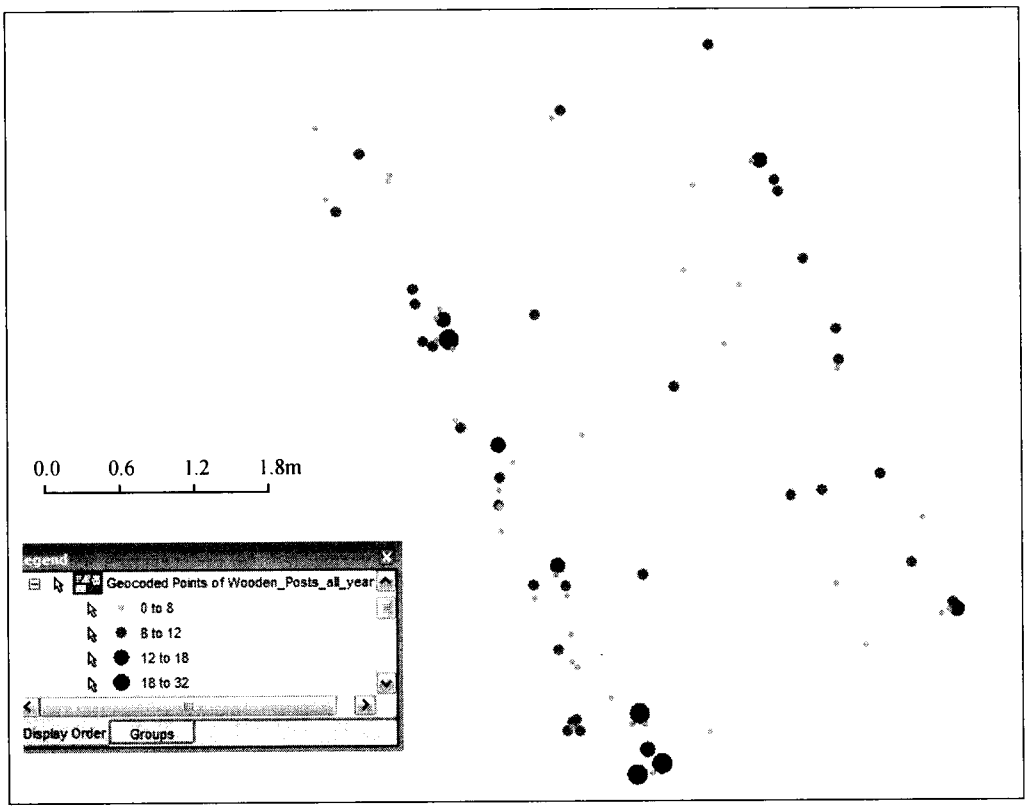
We were interested in seeing whether the modern patterns of wooden architecture were replicated in the past, or whether there were ancient building types not represented by modern correlates. To investigate this, the wooden post dimensions were divided into size brackets in order to discover patterns. Based on the diameter of the posts, we could discern a pattern of larger, load-bearing posts at the corners of structures with smaller posts in between, as shown in the Site 75 structure (Fig. 3); this closely parallels the construction principles of modern Maya houses (Wauchope 1938).

Aside from the wooden posts defining rectangular structures, many sites also have linear arrangements of posts fashioned from palmetto palm (*Acoelorraphe wrightii*). Some of these are up to 10 m away from the wooden architecture. In other instances, the lines of palmetto-palm posts abut the solid wooden posts. The site of Chac Sak Ha Nal has a line of palmetto-palm posts forming a "U" shape around a structure formed by wooden posts. This "U"-shaped pattern is replicated at other sites. There are few artifacts inside these palmetto-palm post "walls". We do not yet know whether such lines of palmetto-palm posts were land-retaining walls or household/workshop boundary fences; another possibility is that they enclosed salt pans.

Briquetage from the Paynes Creek Saltworks

In addition to mapping the wooden architecture at the underwater sites, we mapped the boundaries of the artifact distributions at each site and also selectively mapped individual artifacts. Since the overall focus of research is on the nature of the ancient Maya salt industry, it is important to study the briquetage used in the brine-boiling process. In a previous study of four saltworks in the lagoon (McKillop 2002), I reported that pottery

我们很想考察一下过去是否存在与现代完全相同的木构模式，有些类型是否在相关的现代建筑中已难觅踪迹。为了研究这个问题，我们把木桩依尺寸的不同分组，以辨别不同的类型。通过桩子的直径，我们发现这样的规律：大型承重木桩用于建筑的边角，小型木桩则分布在中间，如 75 号遗址的木结构所示（图三），这与现代玛雅的房屋建造原理非常相似（Wauchope 1938）。



图三　75 号遗址柱子可按尺寸大小分为不同等级，边角的承重柱（直径 12 ~ 18cm）与现代玛雅房屋相似（据 Wauchope 1938）

Fig. 3　Posts at Site 75 classed into size brackets by diameter show load bearing posts (12 – 18cm) at corners, similar to modern Maya houses in Wauchope's (1938) study

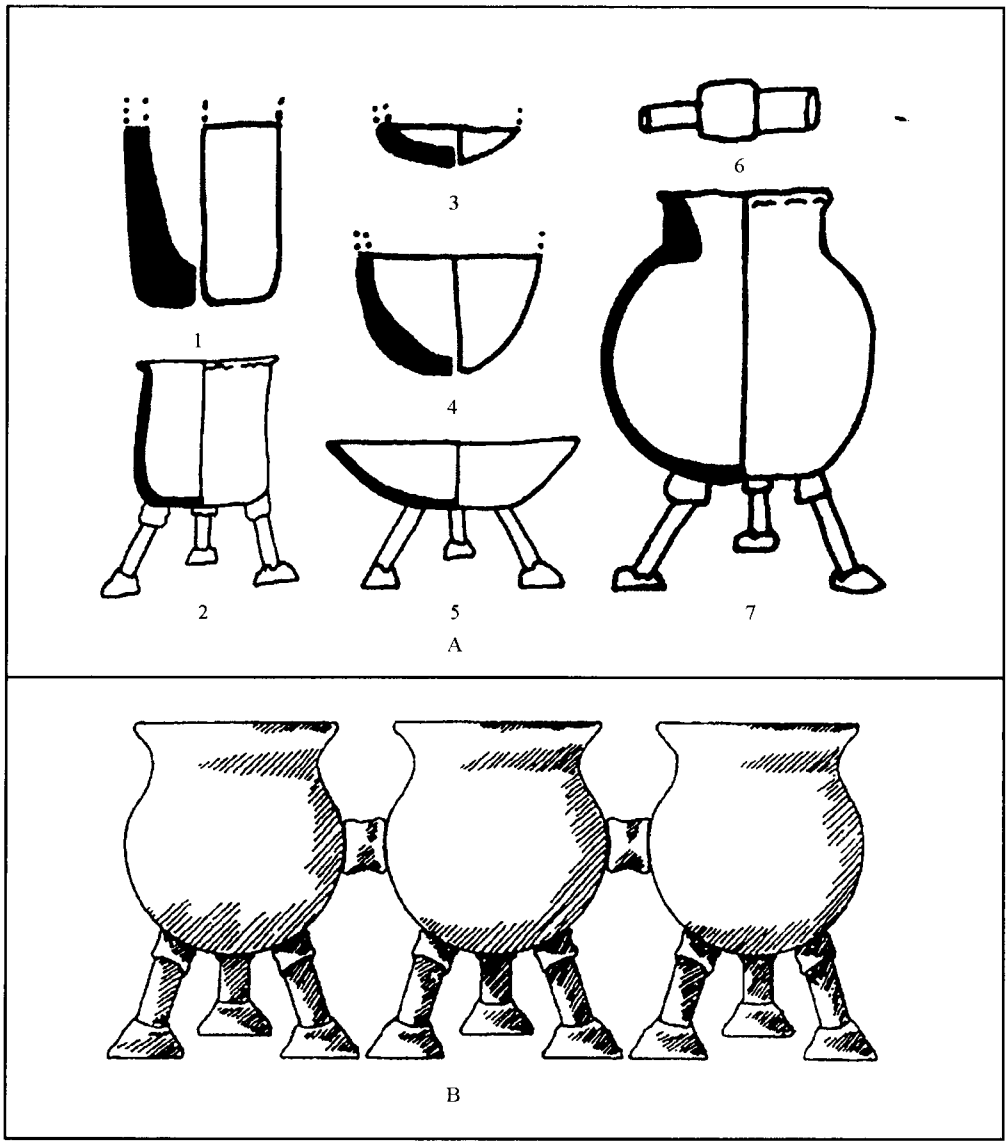
除了构成长方形结构的木桩以外，很多遗址的柱子也按直线排列，这些柱子是用美洲扇形蒲葵棕榈（*Acoelorraphe wrightii*）制作的。有些柱子距木构建筑达 10 米远，而另外一些排列成行的棕榈柱子则紧靠着坚固的木柱。Chac Sak Ha Nal 遗址中有一组排列成行的棕榈柱子呈 U 形排列，环绕着一处木构建筑。其他遗址也常见这种“U 形”柱群。在这些棕榈柱构成的“围墙”里很少见人工制品。因此，我们尚

sherds were much larger and retained more of the vessel shape than sherds found at land sites in the area, making the study of pottery from the underwater sites worthwhile for estimating vessel shape and size. As shown in the underwater image of pottery sherds on the sea floor at Site 49 in the West Lagoon (Plate14. 2), the pottery coming out from the currently ongoing investigations is also large and well preserved, enabling estimates of the vessel shapes and sizes. Since 2006 we have mapped each artifact individually, and funding was obtained for a pilot study to map all the artifacts from the K'ak' Naab' saltworks.

The ceramics were classified according to the type-variety system commonly used in Maya ceramic studies, using the types established for the coastal area (McKillop 1995, 2002, 2005b). We also did an attribute analysis of the ceramics, describing 25 characteristics for each pottery sherd (including discrete observations such as shape, as well as measurements such as rim diameter). These data were entered into an excel spreadsheet that was attached to the GIS in order to investigate spatial patterning. The GIS maps in Geomedia of K'ak' Naab' reveal briquetage outside of wooden structures but not inside, suggesting that the workshops were kept clean and workshop debris was discarded outside (*www. famsi. org*).

The pottery types include Punta Ycacos Unslipped jars, bowls and other briquetage (Plate15. 1), Mangrove Unslipped and Warrie Red water jars, Moho Red dishes and bowls, and Village Farm mold-made figurine ocarinas (Plate. 15. 2). At the 100 sites now known, there is additional as yet unclassified pottery, albeit in small quantities, of types not found in the initial research on the first 4 saltworks. The overwhelming quantity of ceramics is briquetage from the brine boiling process. Briquetage included sherds from jars, basins, and bowls as well as solid clay cylinder supports used to hold the vessels over a fire during the brine boiling (McKillop 1995, 2002, 2005a). Flat bases with cylinders embedded at an angle indicate the vessel supports were slanted. There likely were three cylinders per vessel, following the Late Classic tripod tradition. The top end of each cylinder had a socket with a concave upper surface on which the vessel rested(Fig. 4A). Multiple salt pots placed over a fire may have been separated from each other by spacers, which are disks with concave surfaces(Fig. 4B). Also recovered were large quantities of amorphous clay lumps, baked clay items of various shapes and sizes, that are the residue of pottery manufacture, as well as discarded pots and other briquetage no longer useful for brine boiling. A hearth consisting of congealed clay, charcoal, and briquetage was excavated at the Stingray Lagoon site (McKillop 2002).

Vessels used to boil brine include jars, bowls, and basins with thin walls that would have maximized heat conductivity. The rims are thick, a trait useful for holding or moving the



图四　伯利兹 Paynes Creek 盐场玛雅制盐陶器的复原图

A：1. 底部带孔的容器（口部不详）　2. 深腹盆（罐）　3、4. 底部带孔的钵或碗（口部不详）　5. 浅腹盆　6. 陶质异径管　7. 罐（H. McKillop 绘制）

B：一组复合的盐罐（李水城增补）

Fig. 4　Schematic Reconstructions of Maya Briquetage from Paynes Creek Salt Works, Belize. A: 1 vessel with hole (orientation of vessel unknown)　2 basin　3、4 jar or bowl with hole (orientation of uessel unknown)　5 jar　6 clay pipe reducer　7 open bowl (sketches by H. McKillop)

B: a set of briquetages (by Li Shuicheng)

煎煮卤水的容器包括陶罐、碗和盆，器壁都很薄，这样可以最大限度地传递热量。容器口沿很厚，便于端放或搬运；内壁光滑，有助于刮剥内壁附着的盐晶体。

ware that is also of Late Classic date and widespread in the Maya lowlands, including southern Belize (Hammond 1975; McKillop 2002). Ongoing type-variety and attribute analyses of the ceramics underscore the Late to Terminal Classic age of the saltworks. Radiocarbon dates of AD 670 – 870 (calibrated, 2 Sigma) from the Stingray Lagoon site (McKillop 1995) and AD 670 – 960 (calibrated, 2 Sigma) from Sak Nuk Naj (McKillop 2005a: 5632) corroborate the Late Classic age of these sites. Further radiocarbon dating, ceramic analysis, and dendrochronology may provide a relative chronology for the saltworks within the lagoon system that will allow finer subdivisions within the 300 years of the Late Classic period.

To determine whether there was mass production of salt at the Paynes Creek saltworks, we used the standardization of briquetage vessels as a measure (McKillop 2002). The diameter of the vessel opening for jars and bowls and the diameter of the vessel supports were used in the analysis. The sample included rim sherds from the Punta Ycacos Unslipped jars and bowls, which had been used for brine boiling; Punta Ycacos Unslipped clay cylinders, which had served as supports for the boiling vessels; and Mangrove Unslipped and Warrie Red water jars, which had been used to fill and refill the brine boiling pots. As a control sample, we included Bedford Unslipped bowl rim sherds from the nearby trading port of Wild Cane Cay (McKillop 1987, 1989, 1996, 2005b) in the analysis; this is a kind of household pottery that one would not expect to be standardized.

The average median variation for the briquetage, both the pots and the vessel supports, was twice as standardized as the Wild Cane Cay pottery in the sample. This supports our interpretation that the salt workers at the four Punta Ycacos Lagoon saltworks mass-produced salt in units of standardized size and volume (McKillop 2002; Table 2). At the level of production, standardization of the vessels would have been useful if a dozen or more brine-boiling vessels were supported over a fire at one time, as is the case at the modern salt-producing town of Sacapulas, in the highlands of Guatemala (Reina and Monaghen 1981), and at many premodern saltworks (see, e. g., the contributions to this volume by Hees, Olivier, and Yankowski).

Comparisons with Briquetage Elsewhere in Mesoamerica

In addition to the production of salt by solar evaporation along the north coast of the Yucatan (Andrews 1983; Andrews and Mock 2002), brine boiling was common in Mesoamerica in antiquity. The widespread occurrence of briquetage along the coast of Belize demonstrates

that salt production involving brine boiling was a viable technique (Andrews and Mock 2002; Braud 1996; Graham 1994; MacKinnon and Kepecs 1989; McKillop 1995, 2002, 2007; Sills 2007; Somers 2007; Valdez and Mock 1991). That most saltworks with briquetage date to the Late Classic period indicates the saltworks expanded or arose in response to the increased demand for salt to meet basic dietary requirements of the larger population at inland cities (McKillop 2005a). Saltworks are documented in lagoons along the coast of Belize at Placencia Lagoon (MacKinnon and Kepecs 1989), at Watson's Island and elsewhere at Colson Point in central Belize (Graham 1994), at Northern River Lagoon (Valdez and Mock 1991; Mock 1994), Midwinter's and Salt Creek Lagoon north of Belize City (Mock 1994), on Ambergris Cay (Graham and Pendergast 1989; Guderjan 1988), and at Moho Cay (McKillop 2004).

The Paynes Creek saltworks differ from other briquetage-yielding sites along the coast of Belize. The other sites are described as settlements where salt production was one of many activities, perhaps carried out as a cottage industry. Likewise, after the abandonment of the Paynes Creek saltworks, salt was locally produced as part of the household economy during the Postclassic at the major trading port of Wild Cane Cay and at nearby Frenchman's Cay (McKillop 2002:112). Comparison of the two kinds of sites demonstrates variation in the organization of production. The Late Classic Paynes Creek saltworks are clearly an industry, whereas elsewhere production was for household needs, as at Wild Cane Cay and Frenchman's Cay in the Postclassic; even if the household-produced salt was intended to be traded elsewhere, that trade was organized at the household level.

Brine boiling styles differed along the coast of Belize, as indicated by the existence of at least two types of briquetage. The use of open bowls, jars with restricted orifice, or straight-walled basins supported by solid clay cylinders, together with sockets, spacers, and bases, is common to southern Belize, including Paynes Creek and Placencia Lagoon. The rims of the vessels are thick (as are the necks of jars) for holding or carrying, but the vessel bodies are thin, suitable for conducting heat. Farther north along the Belize coast, solid clay cylinders have been reported from Moho Cay and from coastal lagoons to the north, but not from Colson Point or Ambergris Cay. Instead, from Colson Point to Northern River Lagoon, including Ambergris Cay, the containers reported are thin-walled open platters and designated as the Coconut Walk Unslipped type. Solid clay cylinders are common at Moho Cay, including one from a burial (McKillop 2002: Fig. 3.52), but the associated vessels

have not yet been identified.

Modern ethnoarchaeological studies indicate that brine boiling was often combined with various techniques that aimed to concentrate the brine prior to boiling (Williams 2003). For example, Williams (2003) describes solar evaporation in pans and leaching of salt-saturated soil as two preferred methods to increase the salinity of the brine at modern sites in West Mexico. Such techniques were likely practiced as well in Mesoamerica in antiquity. An earthen mound at the Killer Bee saltworks in Paynes Creek National Park is interpreted as a slag heap remaining after brine had been leached through salt-saturated soil (McKillop 2002: 49, Fig. 2.25). At the other Late Classic-period saltworks in the same area, any similar heaps would have been submerged below the sea (McKillop 2002: 49). There is hope, however, that future excavations may yet discover elevated wooden platforms to store salt-saturated soil and wooden containers to receive the concentrated brine after filtering, equivalent to those described for modern times (Williams 2003).

Modern saltpans are formed by lines of posts or by baked earth or clay. Olivier (2003a: Fig. 40; see also Olivier, this volume) excavated Celtic saltpans in Lorraine, France. They served to increase the salinity of the brine by solar evaporation. In the large saltworks on the north coast of the Yucatan, lines of posts demarcate the edges of saltpans (Andrews 1983: Fig. 2.3). As mentioned, some of the linear alignments of palmetto palm posts mapped at several of the Paynes Creek saltworks may have defined saltpans.

Politics, Economics, and Ritual

The wooden buildings and associated artifacts from ancient Maya saltworks preserved in a peat bog below the sea floor at Paynes Creek provide an opportunity to examine not only salt production and the organization of the ancient salt industry, but also the political, economic, and ritual factors that linked producers and consumers in Late Classic Maya society.

At Paynes Creek, salt was produced in rectangular wooden buildings, where brine was boiled in pots over fires to produce loose salt or salt cakes, leaving behind the broken bowls and jars, the cylindrical clay vessel supports, and water jars. Several activities took place at the saltworks: Salt boiling vessels were made using local clays and quartzite sand temper that was commonly available locally. Brine was boiled to produce salt. Salt production took place inside wooden structures, providing protection from rain, which is common even during the dry season. Buildings also were used to store equipment and supplies, such as firewood

and water jars for storing brine and salt pots for boiling. Moreover, there were warehouses where salt was stored before it was transported elsewhere. A full-size wooden canoe paddle found at the K'ak' Naab' saltworks provides evidence for water transport (McKillop 2005a). Some of the saltworks hosted periodic salt rituals, as evidenced by pottery ocarinas and serving vessels. These ceramics were not locally produced, in contrast to the salt boiling vessels.

Arguably the Paynes Creek saltworks were not part of the Maya "political economy", for they were located at a considerable distance from the royal courts at inland cities with their attached specialists providing goods for the dynastic leaders. Nor were the saltworks part of the household-centered "subsistence economy", since they appear not to have been directly associated with residences or communities, and because the scale of production manifestly exceeded household demand. Instead, these saltworks seem to have been independent workshops located near the natural resource they were exploiting—a super-saline salt-water lagoon. Their wooden structures and the associated massive quantities of briquetage indicate specialized salt production. The ceramic assemblage contrasts with the diversity of pottery vessel forms and types found at Wild Cane Cay and other nearby settlements (McKillop 2002). The salt workers presumably lived year-round at the contemporary coastal settlements nearby. It seems likely that they were independent, local producers who were engaged in a negotiated trade relationship with the inland dynastic Maya.

The Paynes Creek salt industry consisted of mass production at non-domestic saltworks that were not directly controlled by the dynastic leaders at inland cities. The main trading port of Wild Cane Cay was located 7 km from the Paynes Creek saltworks, at the mouth of the Deep River and the northern end of the relatively sheltered waters of Port Honduras. This location was at the nexus of the riverine and coastal trading routes. Maya coastal settlement dates back to as early as the Middle or Late Preclassic at the Butterfly Wing site (McKillop 1996, 2002) and from the Early Classic at Wild Cane Cay (McKillop 2005b). Because of the distance and the special skills needed for salt production and canoe navigation, the dynastic Maya at their inland urban centers may have found it more cost effective to negotiate trade and perhaps marriage alliances with the coastal salt producers than to manage the production and distribution of salt directly. Moreover, the Late Classic Maya polities of southern Belize, closest to the saltworks, were decentralized, putting the coastal Maya in an advantageous position both economically and politically.

It is obvious that there was a stong inland demand for salt from the coast to meet the basic daily biological needs of the inhabitants of the urban areas. But why would the coastal elite have wanted to satisfy that demand by establishing trade alliances with the dynastic leaders of the inland cities? Arguing by analogy with overall socioeconomic trends in Maya civilization, we may hypothesize that the inland Maya induced the coastal Maya to trade with them by allowing them to adopt the status paraphernalia and the material and ritual trappings of power, thus including them in the political hierarchy of the realm. Watanabe (2007) suggests that early Maya leaders capitalized on existing efforts of individual householders at the urban centers to produce beyond household needs in order to attract marriage partners. The expansion of surplus production would have opened a door for aggrandizing the leaders because the latter were able to broker intergroup relationships in their capacity as ritual experts. The state thus became a beneficiary of this economic expansion under the guise of ritual. Such mechanisms enabled the incorporation of common folk into the political hierarchy, bringing them economic as well as ritual benefits. As to how they were played out in Maya social life, Foias (2007) discusses how feasts and other rituals served to create, maintain, and reinforce power relations during the Late Classic period.

Though located at some remove from the main urban centers, it seems likely that the Paynes Creek saltworks were similarly tied into a complex network of ritual and economic relationships. The coastal Maya, with their center perhaps at the trading port of Wild Cane Cay, received goods such as ocarinas, serving vessels, and other trade pottery, all of which were markers of status and made them part of the political hierarchy of feasting. In this way they became invested in the ritual ideology underlying the political structure of Maya dynasties, which was enacted in huge feasts overseen by shaman kings. Driven by such an understanding of the world, the gods, and people's place in the world, the coastal Maya reenacted these feasts in their homes and workplaces. Rather than using military force or imposing satrap rulers in order to incorporate the coastal Maya saltworks into a regional tribute economy, the ruling élites at the inland dynastic centers thus maintained a regular trade in salt by means of ritually sanctified alliances.

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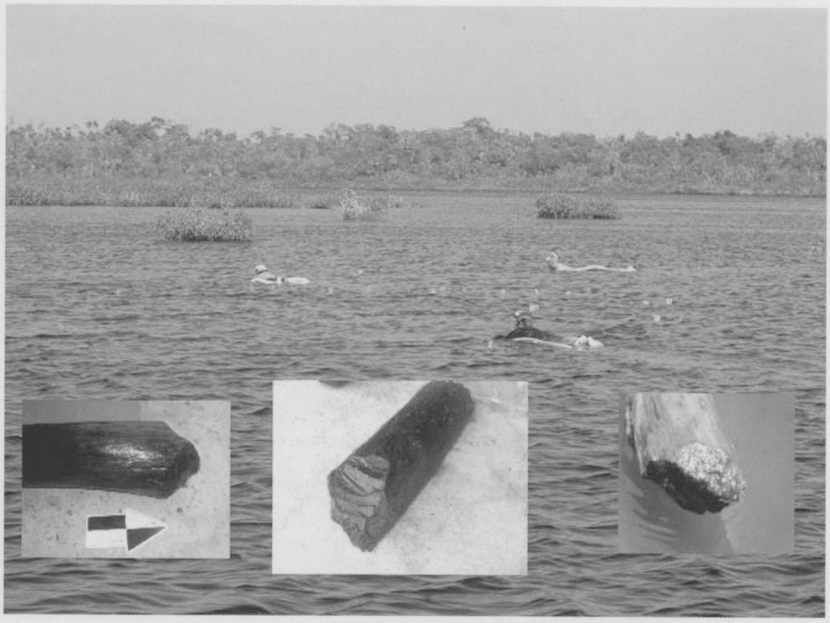
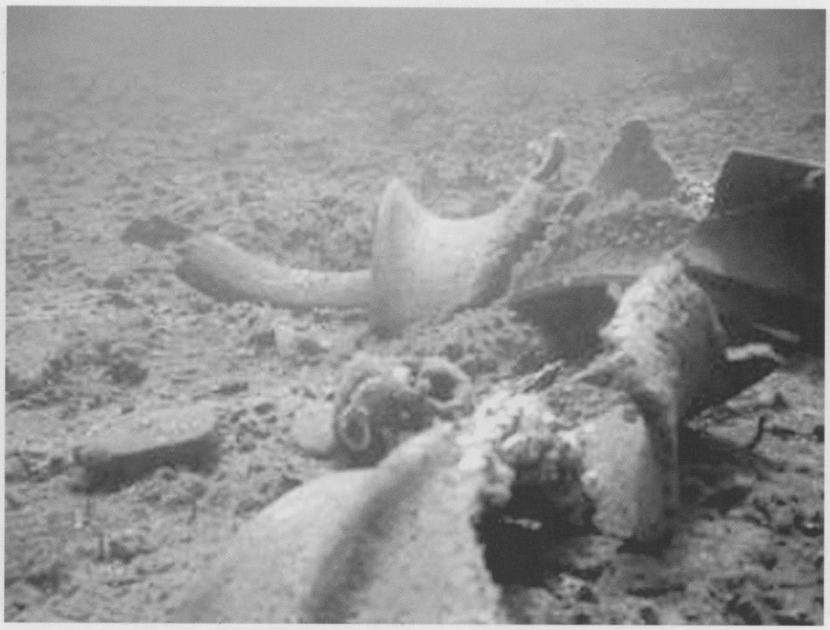
图版一四 Plate 14



1. 用旗子浮标标记尖底木桩的水下位置

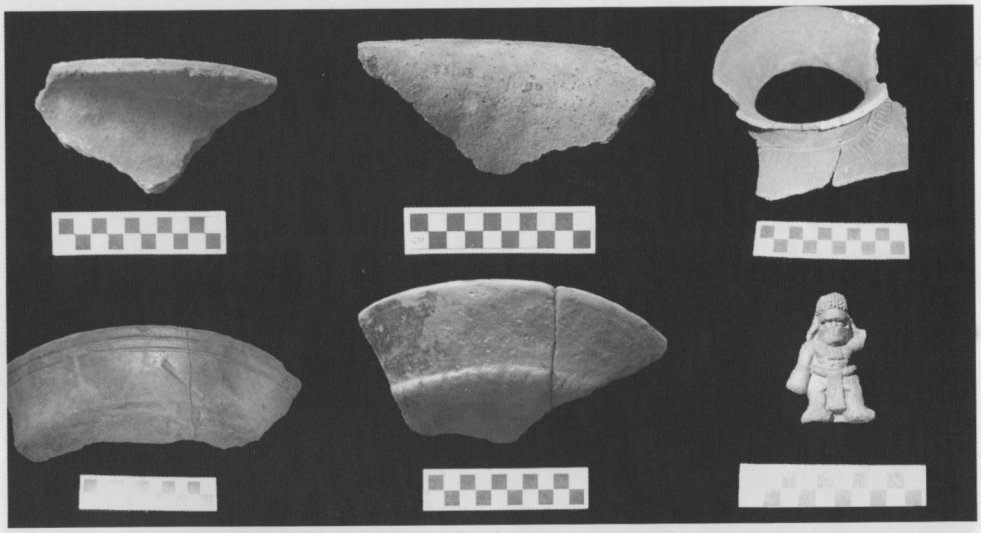
Surveying on Research Floatation Devices（RFDs）with flags marking locations of wooden structural posts with sharpened ends,as shown in inserts



2. Paynes Creek 49号海底遗址的陶器残片

Underwater image showing large size of water jar pottery rims on the seafloor at Paynes Creek Site 49

1. Punta Ycacos 无釉容器和其他制盐陶器残片
Punta Ycacos unslipped vessels and other briquetage



2. Mangrove 无釉水罐和Warrie红陶水罐,Moho红陶盘、碗残片以及乡村农场模制人形哨
Mangrove unslipped and Warrie Red water jars, Moho Red dishes and bowls,
Village Farm mold-made figurine whistles