24 CONTINGENT MULTI-CRAFTING, SURPLUS HOUSEHOLD PRODUCTION, AND THE MAYA QUEST FOR SALT

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Addressing the location of residences for ancient Maya craft workers is important in order to evaluate the organization and control of production of commodities with restricted distribution but wide appeal, such as obsidian, chert, and salt. Wooden buildings at the Paynes Creek Salt Works include salt kitchens, where brine was evaporated in pots over fires to make salt. Similar salt kitchens also were likely used at other salt works along the coast of Belize and Pacific coast of Guatemala that have briquetage but lack preserved wood. Stone architecture associated with some Yucatecan coastal salt works and with Salinas de los Nueve Cerros beside an inland salt spring in Guatemala suggest elite control or oversight of production. Spatial patterning of wooden architecture and artifacts at Site 7, the largest of the Paynes Creek Salt Works, suggests some of the buildings were used for multi-crafting or as residences, perhaps by elites.

Introduction

From at least the Late Preclassic period, the Maya sought sources of salt, a commodity that was biologically necessary, but also valued for preserving fish and meat, tanning skins, enhancing the flavor of food, and for medicinal and other uses. Paleoindian and Archaic people obtained enough dietary salt from hunting wild animals. The quest for salt began with increasing reliance on domesticated plant foods, especially carbohydrate-rich corn which was the dietary foundation that supported large sedentary populations throughout the Maya area. This pattern is mirrored in other areas world-wide where staple carbohydrates deficient in salt underwrote large populations and the rise of civilizations (McKillop n.d.). In the Maya area, salt was obtained from solar evaporation along the arid coasts of the Yucatan and by evaporation in pots over fires along the coast of Belize, Pacific coast of Guatemala, and at inland salt springs. Household production of salt and other commodities for personal use works with communities located near sources of salt water. The restricted distribution of salty water in the Maya area required strategies for those not near salty water to acquire salt (Figure 1; McKillop 2005a).

By the Classic period, even small communities such as Ceren, El Salvador, had household specialization in different commodities for marketplace trade in several other communities (Sheets et al. 2015): Householders produced surplus commodities in the course of regular subsistence and home maintenance. Surplus household production

Figure 1. Map of the Maya area showing location of Ancient Salt Works.

took place within the home or at varying distances from the home. In some cases, there were workshops at the source of resources with a restricted distribution for the extraction or production of the resource, including salt, high-quality chert, jadeite, and obsidian. The high-quality outcrops of chert in northern Belize were exploited from the Middle Preclassic to the

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Early Postclassic at Colha (Shafer and Hester 1983) by surplus household production of stone tools and tool blanks. Jadeite was extracted from outcrops along the Motagua River by non-elites (Rochette 2009). Obsidian was quarried from outcrops in the volcanic highlands of Mexico, Guatemala, and Honduras and shaped into macrocores for trade.

Household production often included multi-crafting—production of a variety of crafts, and sometimes included contingent, multi-crafting—production that required additional tasks (Hirth 1998). Householders were accustomed to multi-tasking in their daily lives in house construction, from extraction and transportation of wood and leaf for pole-and-thatch structures, to procurement of temper and clay for making pots, and production of farming implements. Contingent, multi-crafting is an extension of subsistence activities: Inland trade of salted fish required fishing or otherwise acquiring the fish, as well as sun-drying or salting the fish. Salt-drying fish required making or otherwise acquiring salt. Both sun-drying and salt-drying fish required outdoor or indoor racks.

Chert, jadeite, and obsidian objects were available in marketplaces at lowland cities and towns (Chase et al. 2015). In some cases, householders brought their goods and resources for trade at marketplaces in various communities. Sometimes traders transported commodities greater distances. Coastal trading ports such as Moho Cay (McKillop 2004), Wild Cane Cay (McKillop 2005b), Isla Cerritos (Andrews et al. 1989), and Xcambo (Sosa et al. 2014) as well as inland ports such as Cancuen (Demarest et al. 2014) provided safe harbor, accommodations, and warehousing. They also added maritime and other commodities, such as salt, stingray spines, and salted fish, or further manufacturing, such as jadeite at Cancuen (McKillop 2007, n.d.).

In this paper I evaluate the conditions and significance of extraction and production of restricted resources carried out as part of household production. In some cases, extraction and production of restricted resources was carried out as part of surplus household production at home. In other cases, surplus household production was spatially segregated from homes. Independent factory or attached specialization for the state are situations in which the extraction and production of restricted resources was not directly tied to household production. With household and surplus household production, labor is controlled by the householders. In contrast, labor is controlled by factory owners. State control of corvée labor for public works removes both the worker and control of labor from the household. Attached specialization to produce commodities for the state at the Maya city of Aguateca consisted of elite household production where highly-trained specialists produced goods for the royal court, but also some goods they produced and traded themselves (Inomata 2001).

Surplus household production is carried out in catchment zones that vary by the localized abundance of resources. Some resources are seasonally abundant, such as deer, manatee, and green sea turtles. Other resources are naturally restricted in distribution, such as obsidian, chert, and jadeite. Some resources are suitable for extraction or production in specific conditions, including chocolate, cotton, and scarlet macaws. There are limits to daily travel to extract and produce commodities, with distances significantly greater by boat than by land.

Modern salt makers live near their salt kitchens or salt pans, either year-round or seasonally. At Sacapulas, Guatemala, up to 30 salt kitchens are located near a salt spring, with the homes located farther back. Production takes place year-round, although most production is carried out in the dry season when the salt spring is accessible (Reina and Monaghen 1981). On the southeast coast of China in Shandong Province, salt works were located along the coast, with residences located farther back (Flad 2013). State-sponsored overseers were located still farther back. In central Mexico, salt works were located a few km from the salt workers' residences. Residences were suspected of being nearby Zhongba, a large salt works flooded by the Three Gorges Dam in China (Flad 2011). Northern River Lagoon was a village and trading port where salt was produced to salt fish for inland trade (Masson and Mock 2004: 372-373). In west Mexico, salt makers travel during the

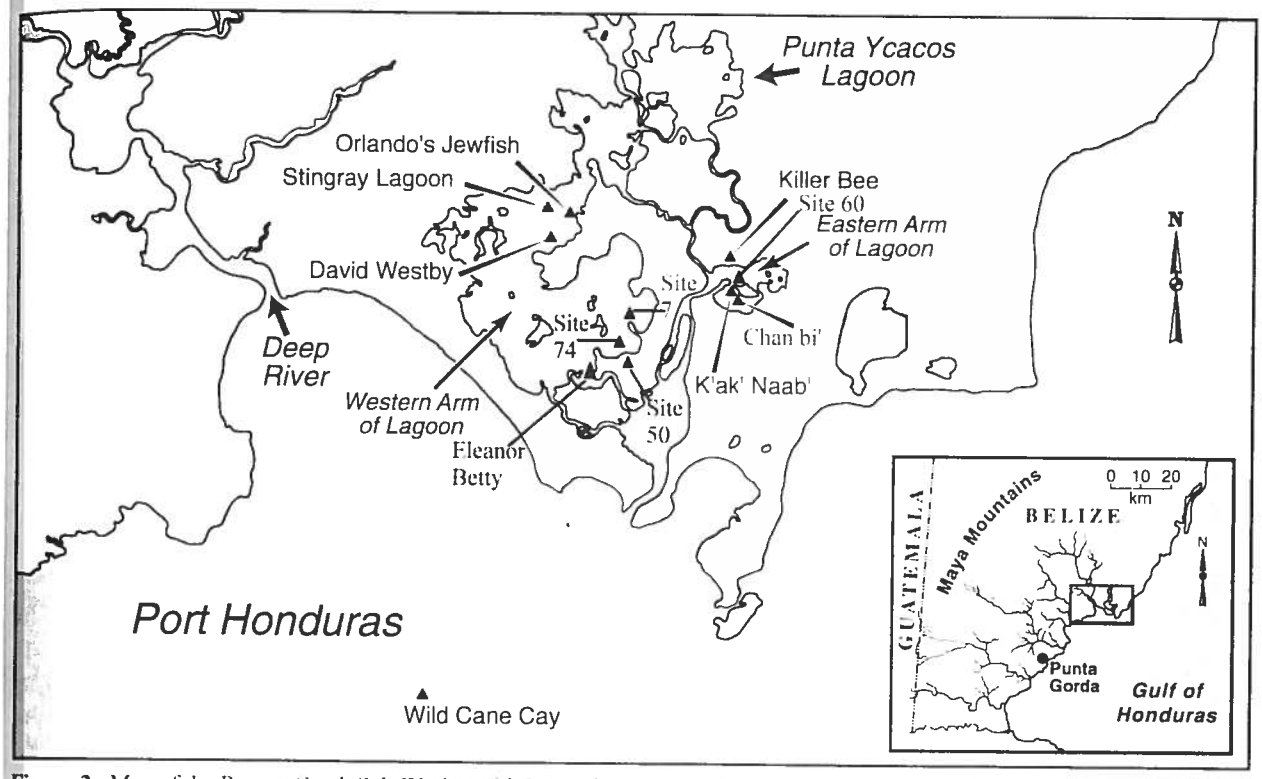

Figure 2. Map of the Paynes Creek Salt Works, with insert showing location in southern Belize. Base map by Mary Lee Eggart.

dry season to the coast to make salt, setting up temporary homes (Williams 2003).

The Paynes Creek Salt Works

The Paynes Creek Salt Works include 110 sites over a five square km area in a salt-water lagoon system on the south coast of Belize, north of the modern town of Punta Gorda (Figure 2; McKillop 2005a, n.d.). During the dry season, the shallow lagoon system becomes a natural solar evaporation pond, concentrating the salinity, thereby reducing the time for evaporating brine in pots over fires to make salt, as compared with the open sea. Furthermore, less wood fuel is needed. As indicated by excavations at two sites with earthen mounds that are not underwater, the salt water was poured through salty soil to enrich the salt content before the evaporation process (Watson et al. 2013). The canoe excavated at the Eleanor Betty site was held in place by stakes and had a pottery funnel below (McKillop et al. 2014). Sediment chemistry research at Chan bi' (Site 24) suggests that salty red mangrove peat may have been cut from the seafloor or land (Sills et al. 2016). Pouring brine though salty soil is documented in historic times at Sacapulas, in the highlands of Guatemala (Reina and Monaghen 1981), in West Mexico (Williams 2003), and elsewhere. With the preservation of wooden buildings, a canoe, and abundant briquetage not subject to breakage from trampling after the sites were abandoned, the Paynes Creek Salt Works are a model for salt production elsewhere along the coast of Belize.

Transect excavations along the interior walls of salt kitchens at 10 sites revealed high percentages of briquetage, from 90-98%, indicating that salt production was the main activity (McKillop n.d.; McKillop and Sills 2016, 2017). The salt works may have been the location of surplus household production, with the possibility that some of the wooden buildings were houses. Alternatively, the salt workers lived nearby in the coastal area, perhaps at Wild Cane Cay, a short canoe paddle from the salt works. Wild Cane Cay was a 10-acre village and trading port, originally settled in the Early Classic that expanded in the Late and Terminal Classic (McKillop 2005b).

Mass-production of Salt as Indicated by Standardization of Briquetage

Standardization of briquetage at the Paynes Creek Salt Works suggests mass-production of salt. However, the results indicate differences among individual salt works, suggesting there were work parties that may have consisted of families from nearby communities or seasonal residents from inland cities. In addition to calculating the co-efficient of variation, which is commonly used in standardization studies in archaeology, I also reported the average median variation to evaluate the standardization of briquetage from three sites in the Stingray Lagoon area: Stingray Lagoon, David Westby, and Orlando's Jewfish sites (Figure 2; McKillop 2002:127-132, Tables 4.1-4.6). The average median variation (AMV) statistic was used instead of the coefficient of variation (CV) because some of the samples have distributions significantly different from normal. The AMV reduces the effect of outlying values in a distribution, unlike the CV. To calculate the AMV, each value is subtracted from the median. The absolute value of this number is divided by the median. The average of this number is then multiplied by 100 to produce the AMV.

The diameters of jars and bowls of Punta Ycacos Unslipped, as well as the diameters of the salt pot vessel supports—solid clay cylinders—were standardized, as compared to a sample of pots from Wild Cane Cay (McKillop 2002: Table 4.1). The differences were statistically significant. Interestingly, the average median variation of the briquetage from the three salt works was different for each site, and the results were statistically significant (McKillop 2002: Tables 4.4, 4.6). The standardization of briquetage was further supported by findings at Chan bi' in the East Lagoon (McKillop and Sills 2017: Table 4.1). The statistically significant differences in standardization of Punta Ycacos bowls, jars, and vessel supports at the three main salt works in the Stingray Lagoon area indicate the salt workers at each of the sites likely made their own salt pottery.

Multi-crafting at the Salt Works

Salt production required a variety of supporting activities, so it can be evaluated in terms of contingent multi-crafting (Hirth 1998). In addition to salt production, other activities at the salt works included making the salt making pottery, collecting posts and sharpening the ends, and other wood-working. The sand and clay for making the salt-production pottery is available widely within the lagoon system. Clay is exposed in the cut banks where the lagoon abuts the broken pine ridge (savannah) in many locations. Quartz sand is available in thick lenses below the sea floor in multiple locations. Punta Ycacos Unslipped pottery was poorly formed and fired at low temperatures, making it friable and not viable for transporting from the place of production. Posts for building construction were obtained from nearby locations in the mangroves, from the nearby deciduous rainforest to the south, but not from the adjacent broken pine ridge to the north. Some deciduous hardwoods such as Sapodilla grow in dry patches within the mangrove ecosystem. Palmetto palms are ubiquitous on higher ground behind the mangroves, so would have taken little effort to obtain. Post diameters indicate that most hardwood trees were young, with diameters rarely exceeding 18 cm. The hardwood posts were cut and sharpened at one end, before they were driven into the ground. Other wood working included making canoes, paddles, and other wooden objects.

Living at the Salt Works?

Although most of the salt works have one or two wooden buildings, a few sites have significantly more, prompting the question whether some of the buildings may have been residential. Excavation of two buildings at Site 74 indicate both were salt kitchens, with extremely high densities of briquetage compared to other pottery (McKillop and Sills 2016). High densities of briquetage also were discovered in transect excavations at other salt works (McKillop n.d.). Site 7 and 60 are large sites, each with multiple buildings. The possibility of residential use of Site 7 will be evaluated using the spatial patterning of wooden buildings and artifacts that were individually mapped on the surface of the sea floor.

Figure 3. Labeling flags that Mark Wooden Posts and Artifacts at Site 7. Photo by H. McKillop.

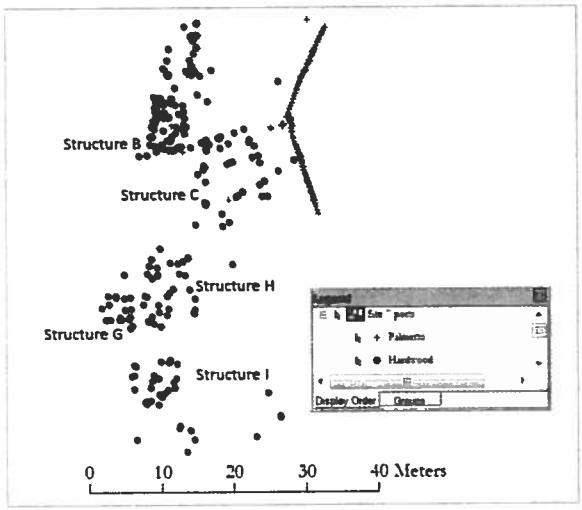

Figure 4. Map of Site 7 wooden posts.

Site 7 is an underwater site at the entrance to the West Point area of the lagoon system (Figure 2). We used flotation survey in order to protect the wooden posts that protruded from the seafloor and not trample on the artifacts embedded in the sea floor (McKillop 2005a). The entire site area was systematically traversed by flotation survey, with the team on Research Flotation Devices (RFDs), back and forth across the site and beyond in all four directions. During survey, all wooden posts were marked with pin flags. All diagnostic pottery, all stone artifacts, and a selection of briquetage were flagged by pin flags (Figure 3).

Few of the wooden posts were visible on the sea floor, which is covered by a thin layer of silt. In cases where the posts protruded slightly above the sea floor, they are worm-eaten and decayed. The palmetto palm posts retain the outer shell of bark. Posts were embedded in solid, red mangrove peat that was virtually indistinguishable from wooden posts. When discovered, posts were cleared around the exterior in order to define the post for a diameter measurement, and to verify the post was indeed a post and not a mangrove root or mangrove peat. Certainly, some wooden posts were not found.

The flagged posts and artifacts were labeled, with each post and artifact location mapped using a total station. The locations of buildings were not evident during survey, but only became evident after the digital data were downloaded and added to the project GIS. Mapped posts include a line of palmetto palm posts and hardwood posts. Most of the palmetto palm posts form a closely-spaced line interpreted as a land-retaining wall on the east side of the site. In contrast to most of the other underwater sites that consist of one or two wooden structures, Site 7 has over 400 wooden posts that define the outlines of 10 or more wooden buildings around three plazas (Figure 4). Several of the buildings have distinct rectangular footprints, including Structures B, C, and G. Most buildings are oriented slightly northeast to southwest. Most buildings are single-room structures, similar to the salt kitchens at Site 74 (McKillop and Sills 2016). Structure 3 has at least two rooms, as well as an anteroom.

None of the wooden buildings had stone foundations or plaster floors, typical of structures at other Maya sites. The wooden structures provide form to "invisible architecture" described at other sites, where there are no visible remains of pole and thatch buildings on the modern ground surface (Johnston 2004; Somers and McKillop 2005). However, just as wooden structures built of pole and thatch form the majority of buildings in traditional Maya villages, pole and thatch buildings likely formed the majority of houses, workshops, and other structures in antiquity. The wooden structures at the Paynes Creek Salt Works are the only preserved pole and thatch buildings from ancient Maya times.

The temporally diagnostic Belize Red, Pantano Impressed (also called Warrie Red), and other non-briquetage pottery support the main

use of Site 7 in the Late (600-800 C.E.) to Terminal Classic (800-900 C.E). Unit-stamped decorations occur on the exterior of jars around the shoulder and sometimes extending farther down the body of the vessel, as with the single example from Site 7 (Figure 5). The surface finish and color are eroded and the calcite temper is dissolved by the acidic peat.

Other pottery corroborate the Late to Terminal Classic age of the site and point to multi-crafting and perhaps residential use of some buildings. A partial vase with incised glyphs below the rim on the exterior is typical of the Terminal Classic elsewhere. The surface finish and paint are eroded, so the vase has not been assigned to a pottery type. A miniature vessel described by other researchers as a snuff bottle, also was recovered. Vases with glyphs and snuff bottles were not recovered from any of the other underwater sites. A perforated potsherd disk used as a spindle whorl is typical of the Classic period and suggests spinning cotton for clothing or fishing lines or nets. The only notched sinker, which was made from a pebble, was found at Site 7. Sherds from large incense burners, as well as candeleros, were recovered from Site 7. The presence of incense burners, candeleros, Belize Red, snuff bottle, and the vase with glyphs, point to residential use of one or more buildings at Site 7.

Spatial patterning of artifacts suggests buildings were used for different purposes, including some dedicated to salt production, other crafts or residential use (Figure 6). Most artifacts are found along the interior walls of buildings. This pattern was observed at the Ceren Site, which was rapidly abandoned due to an imminent volcanic eruption that covered the sixth century village with volcanic tephra, which also sealed the remains (Sheets et al. 2015). The interpretation for Ceren was that artifacts were stored in the rafters or on shelves along the walls and dropped during the volcanic eruption. They represent evidence of household activities but are not activity areas. There is a different distribution of briquetage and non-briquetage pottery, suggesting different uses for buildings. Buildings B, C, and G include Belize Red and Pantano Impressed pottery but no briquetage. The lack of briquetage in the three wooden buildings at Site 7 suggests they were not salt

Figure 5. Unit-stamped decoration on Site 7 Pantano Impressed (Warrie Red) sherd. Photo by H. McKillop.

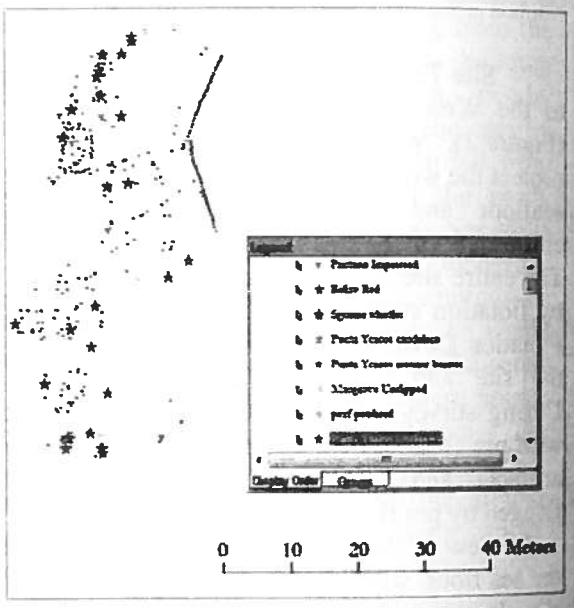

Figure 6. Distribution of pottery types and wooden buildings at Site 7.

kitchens, but were instead used for other purposes, including as residences for the salt workers. Structures C, H, and I include briquetage but no other pottery types. Mangrove Unslipped jars occurs in limited numbers with the briquetage.

The distribution of artifacts indicates most activity was indoors instead of the plazas. The three plazas are virtually devoid of artifacts. Artifacts do not extend beyond the line of palmetto palm posts that form the east side of the site.

The missing element in salt production at Site 7 is any trace of the brine enrichment process. Only Site 50 and Killer Bee have earthen mounds that represent discarded, soil

leached of its salt (Figure 2; Watson et al. 2013). The wooden canoe raised by wooden stakes with a funnel below from the Eleanor Betty Site represents the brine enrichment process, in which salty water was poured through a container of salty soil, with the enriched brine collected below (McKillop et al. 2014). Earthen mounds were likely associated with each salt kitchen, as they are in modern salt works (Williams 2003). Sea-level rise and wave action have deflated the earthen mounds and spread the leached soil over the sea floor at the Paynes Creek Salt Works. The Placencia Lagoon Salt Works (Sills 2016, 2017) further corroborate the hypothesis that earthen mounds were once common at the Paynes Creek Salt Works. The Placencia Lagoon Salt Works lack known wooden structures and are known by the presence of earthen mounds.

Other salt works along the coast of Belize, the Yucatan coast of Mexico, and the Pacific coast of Guatemala, also likely had perishable structures of pole and thatch. Salt works along the coast of Belize and the Pacific coast of Guatemala had salt kitchens associated with briquetage. Excavations at the single earthen mound at the Guzman Site indicates it was a discard mound from the brine enrichment process (Nance 1992). Salt works elsewhere along the Pacific coast of Guatemala also had salt kitchens, but are only known by the presence of earthen mounds and briquetage (Coe and Flannery 1967). On the Mexican coast of the Yucatan, where salt was produced by solar evaporation due to the arid climate, temporary housing may have consisted of pole and thatch structures that have not preserved.

The Quest for Salt

The restricted distribution of salt sources in the Maya area did not coincide with centers of population. The ancient Maya quest for salt resulted in salt works associated with inland salt springs and salty ocean waters. On the arid climate along the Yucatan coast, salt water was collected in salt pans where it was evaporated by solar evaporation. The resulting salt was collected for local use and transport elsewhere. The earliest known salt production in Belize is during the Late Preclassic at Cerros, using evaporation of brine in pottery vessels to make salt (Robertson 2016). Elsewhere in Belize, salt production was associated with briquetage during the Late and Terminal Classic at Wits Cah A'Kal (Murato 2011), Marco Gonzalez (Aimers et al. 2016), Northern River Lagoon (Masson and Mock 2004), Placencia Lagoon (Sills 2016, 2017), and at the Paynes Creek Salt Works (Figure 1).

The widespread availability of salt works along the coast and at inland salt springs during the Late and Terminal Classic underscores the likelihood that salt was produced for local use and regional distribution, but not for long-distance trade. During the expansion of circum-Yucatan trade in the Terminal Classic, Itza Maya traders based on the Gulf Coast of Mexico evidently took control of north coast salt works and Chichen Itza, some 100 km inland from its coastal port of Isla Cerritos (Andrew and Robles 2004). Some researchers have argued that other inland centers controlled salt produced in salt flats in coastal estuaries along the Yucatan coast. Komchen may have controlled salt production on the north coast of the Yucatan and its distribution elsewhere during the Late Preclassic.

In some cases, elite residences at salt works suggest control or oversight of production, as at Salinas de los Nueve Cerros, Xcambo, and Emal (Figure 1). Salinas de los Nueve Cerros has elite residential stone architecture located beside salt production facilities where brine was evaporated in large jars to make salt (Woodfill et al. 2015). The site dates from the Preclassic through Classic period and may have supplied salt for nearby cities and smaller communities in the interior of the southern lowlands (Figure 1). Northern River Lagoon, Marco Gonzalez, and Moho Cay are coastal trading ports where salt was produced, so presumably the residents of the trading ports controlled salt production and trade (Figure 1). Some of the salt works likely had wooden architecture and leaching mounds as at the Paynes Creek Salt Works. Although wooden architecture was used for salt kitchens at the Paynes Creek Salt Works, it may also have been used for residences for the salt workers, as suggested by the spatial patterning of wooden buildings and artifacts at Site 7.

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