

The salt-making workshop sites of the Shang and Western Zhou Dynasties in northern Shandong and their organization of production

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Abstract

Referring to the results of the special surveys on the salt-making archaeology in northern Shandong Province in recent years, the settlement pattern and the distribution rules of the salt-making workshops of the late Shang through Western Zhou Dynasties could be revealed. These workshops tended to be built in the places with the “*yangzi*” terrain (hillock or mound surrounded by wet lowland) or lacustrine landform, where the sweet water could be easily fetched. Through the comparative studies with the relevant situations in the Eastern Zhou Period, the issues such as the production organization and social attribution of the salt-making workshops of the late Shang through the Western Zhou Dynasties could be further explored. At that period, the salt-making industry was small-scaled production activities conducted by separated workshops without unified management, and this was exactly the fundamental cause for which the location selection of the salt-making workshops was heavily restricted by the natural resources.

Keywords: Location selections; production management–history–Shang and Western Zhou Dynasties; salt industry and trade–archaeology–Shandong Province

Introduction to the issue

Salt archaeology has been an important topic in the study of the Shang and Zhou Dynasties in the northern Shandong Province. Recently, with many surveys and excavations focused on this topic in the past few years, scholars have discovered that the Late Shang and Western Zhou salt-making workshops are typically located on higher elevations or near lakes and marshes in obvious clusters, whereas by the Eastern Zhou Period this distribution pattern was no longer present. The study of the organization of Shang and Western Zhou salt-making workshops involves comparison with the organization during the Eastern Zhou Period, which identifies differences and thereby shows that during the Late Shang and Western Zhou, the pattern of workshop locations was not simply based on choosing sites that were suitable to local conditions. Instead, it is likely that the distribution is related to the organization of production at workshops

and the associated social structure. This paper considers these issues and provides a basic interpretation of the existing patterns.

The organizational structure of salt making workshop sites and their spatial distribution

Survey research on salt archaeology in northern Shandong developed relatively early. Examples include a survey of several townships by the Department of Archaeology, Shandong University in northern Shouguang City in 2001 (Oriental Archaeology 2005), and a survey by Professor Shuicheng Li and colleagues of sites in the Laizhou Bay area in 2002 (Li 2003), both of which used traditional procedures for survey of significant sites along with cataloging of known artifact collections. Starting in 2003, Shengdong Yan adopted an innovative systematic regional survey approach based on the principles of settlement pattern archaeology and salt archaeology field survey (Yan 2005). Starting in 2010, archaeologists from the Oriental Archaeology Research Center of Shandong University used a large-scale “closing in on” survey methodology to study the subject of the distribution patterns of salt-making in the lower reach of Xiaoqing River (Salt archaeological team 2012). This paper is based on the data produced from these surveys. A significant point of emphasis is that comprehensive survey allows for an evaluation of the nature and structure of salt-making sites, which means that many of the conclusions that are proposed in this study rely considerably on the results of the work in the lower reach of Xiaoqing River.

Based on the results of archaeological survey focused on salt-making remains, salt production workshops of the late Shang and Western Zhou Dynasties are distributed in clusters. According to the density of these sites, we can see a general pattern of concentration in the five sites of Dongmalou, Nanheya, Dongbeiwu, Dahuang Beiyang and Wangzhuang (Figure 1). Each of these sites comprises a cluster of materials across several sq kms, the largest of which is Nanheya at about 10sq km. These site clusters range in size from 10 localities to over 70 at the largest site of Nanheya (Figure 2). Within these clusters the distance between localities is quite small, in most cases between tens and hundreds of meters apart. Furthermore, if we include the Shuangwangcheng Site (Figure 3), there are a total of six large salt-making workshop clusters within a 200sq km area along the lower reach of Xiaoqing River.

An analysis of the environment of the area within which these site clusters are located has led us to realize that the spatial distribution of the site cluster is primarily concentrated on the “*yangzi*” (hillock or



Figure 1 The distribution of the salt-making workshop remains of the late Shang to the Western Zhou Dynasties in the lower reach of Xiaoqing River.

mound surrounded by wet lowland) or nearby lacustrine landforms. Of the six salt-making site clusters, the Nanhehuang, Dahuang Beiyang and Dongmalou belong to the former type (on the highlands), and the Shuangwangcheng, Wangzhuang and Dongbeiwu belong to the latter type (nearby lacustrine landforms).

Concerning the site cluster at Nanheya, Locus 1 at the site originally was referred to as the “circular yangzi.” In 2008 this site underwent large-scale excavation (Department of Archaeology 2010). The original prehistoric strata at the site were higher in the southwest and lower in the northeast. In the northeast, it was still possible to observe lacustrine sediments. The stratigraphic differences across the site are clear.

The site cluster of Dahuang Beiyang was excavated under the guidance of Wang Qing in 2001. At the time the center of the site cluster was higher than the surrounding areas, which lead the excavators to believe that there was originally an elevation difference in the surface of the site and that this yangzi

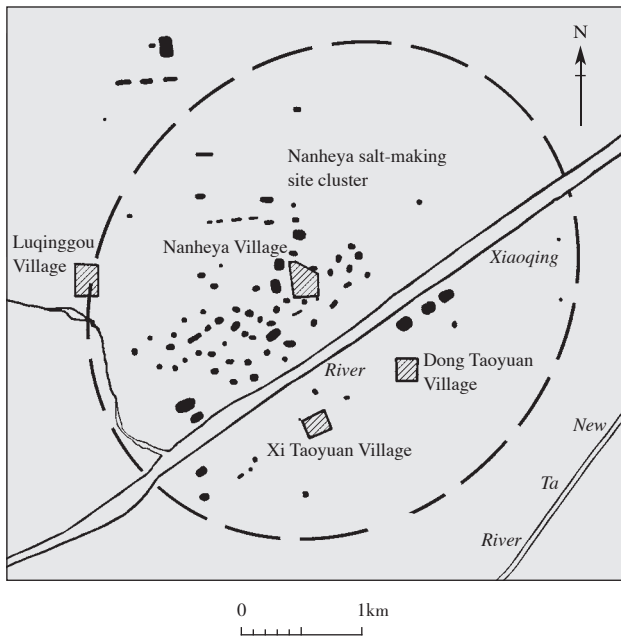


Figure 2 The distribution of the salt-making remains of the late Shang and Western Zhou Dynasties in the Nanheya salt-making site cluster.

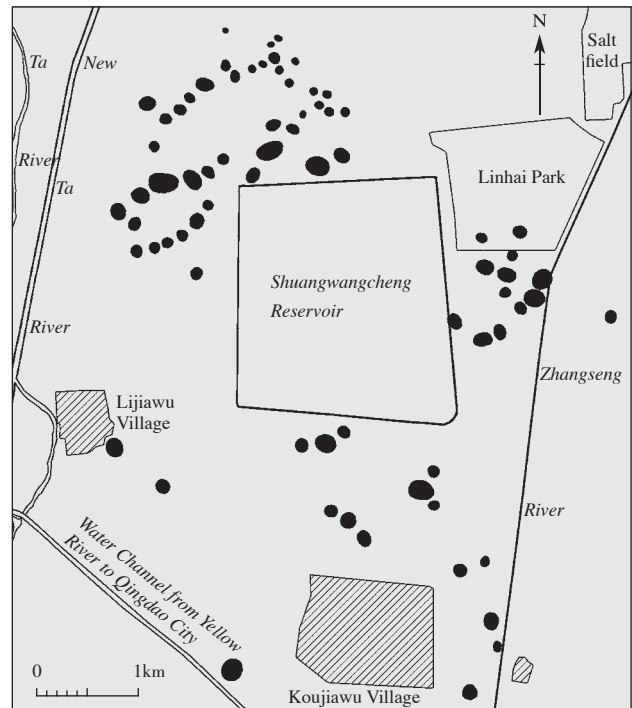


Figure 3 The distribution of the salt-making remains of the late Shang and Western Zhou Dynasties in the Shuangwangcheng salt-making site cluster.

was not the result of activities related to salt production at the site in antiquity. In 2011, survey by the author revealed that the center remained higher with a gradual slope downward, particularly toward the east.

On the eastern part of the Dongmalou site cluster there has been the “Xiajiayang” hillock, which is now an area of unmarked cemetery. Local villagers know the Xiajiayang as a place where fresh water is available by digging wells. The northwestern part of the Dongmalou cluster originally included the “Zhujiayang”, but the “*yangzi*” of this site has been leveled. Furthermore, in the records of the *Yudi zhi* 輿地志 (Records of geography) chapter of the *Guangrao Xianzhi* 广饶县志 (Guangrao County gazetteer) compiled in the 1930s, it states in an entry called “pottery helmets (*wa doumou* 瓦兜鍪)” that “more than ten *li* east of Majialou in Area Seven, there is a *zhaibu* (lit. village pier; a castle-shaped highland), on which there are helmet-shaped pottery objects (七区马家楼东十余里有一寨埠, 其上有盔形瓦质物).” The so-called “Majialou in Area Seven” (七区马家楼) should be located in modern Dongmalou Village. The so-called “village pier” should be the *yangzi*, and “helmet-shaped pottery objects (盔形瓦质物)” should possibly relate to the brine-boiling vessels dated to the late Shang to Western Zhou period – “*kuixingqi* (盔形器)”.

The Shuangwangcheng site cluster is located along the northeastern edge of the ancient Judian Lake. To date, the locations of brine boiling workshops are densely concentrated around the Shuangwangcheng Reservoir. A painstaking survey has been conducted inside the reservoir area and discovered no archaeological sites of the Shang or Zhou Dynasty. This has led those who conducted the survey to speculate that the area within the reservoir was swampland during the Shang to Zhou Dynasties (Yan and Lan 2008).

Sites with similar situations to Shuangwangcheng include the site clusters of Wangzhuang and Dongbeiwu. A close neighbor to Wangzhuang on the west is Guantai (lit. “Official terrace”, the location of the salt administrator in the area during the Yuan Dynasty) Village in Shouguang City. To the north of Guantai Village there is a large low-lying area that locals call “Guantai wa” or “Guantai Depression.” It is quite possible that the Wangzhuang site cluster and the neighboring brine-boiling workshops are associated with this depression. The relationship between the Dongbeiwu site cluster and lakes and marshes still remains unclear because to the east and south are relatively lower areas and, according to local lore, the stretch from Dongbeiwu to Gaogang used to be a harbor where shipping boats would gather. For this reason, I would propose that this area would have also been a low area of lakes and marshes, although additional research is needed to confirm this suggestion.

The influential features of brine boiling localities

Based on the previous information, it is apparent that the brine-boiling workshops dating to the late Shang and

Western Zhou Dynasties in the lower reach of Xiaoqing River were inclined to be located on high ground like *yangzi* or otherwise in the vicinity of wet marshy depressions. Now we need to consider, what sort of significance do these two types of topographic features have that made them attractive to salt-making workshops? I believe the most significant factors to consider were the ease of acquiring fresh water and materials necessary for building the furnaces needed for making salt.

Based on the excavation results at Nanheya and Shuangwangcheng it seems that the brine boiling furnaces from the late Shang to Western Zhou Dynasties were large pit furnaces constructed through digging into the ground surface. In order to operate more conveniently, the surface of the furnace needed to be of a certain height so that it was easier for salt-making to be accomplished. The salt furnace no. 4 at Nanheya (YZ4), although disturbed to the point where only the firebox remained, still illustrates that the entrance to the firebox was higher than the surrounding surface. The salt furnace was built on the highest point in the workshop and the furnace surface was higher than surrounding areas in order to facilitate the salt making activities and according to the technical requirements of fuel burning and air drafting. Also, the positioning of the workshop slightly higher than the surrounding topography also undoubtedly lowered the earth-moving requirements of constructing the furnaces. Furthermore, based on the construction of the furnaces in the Shuangwangcheng site cluster we can consider a different perspective. In this site cluster, 014A and 014B, two excavation loci with salt production furnaces, contained elevated areas that were first built up using rammed earth and then in the elevated area they dug a firebox, resulting in an area that was higher than the surrounding terrain (Shandong Provincial 2010).

A number of researchers who have focused on this topic have considered the relationship between the distribution of underground brine sources and salt-making workshops (Wang et al. 2006). However, it seems to me that brine sources are quite widely available in this region near the coast in northern Shandong, and therefore this factor would not have played a major role in the locations of salt workshops. Conversely, what was more important role would have been the unevenly distributed sources of fresh water in this region. Taking into account the research of physical geographers, we can discover that the high-ground *yangzi* and marshy area topography was advantageous for the collection of fresh water in this region.

During the transgression of the Yellow Sea after approximately 6000 BP, silt carried by the river entering the sea was brought into this area and deposited to form a number of lagoons, the earliest of which created salt lakes. As the sea coast retreated, fresh water runoff acted to dilute these lakes, which gradually became fresh water lakes. The area around the Shuangwangcheng site cluster contained this kind of ancient precipitate lake. Large precipitate lakes were called “Juding 鉅定” in historical

texts, such as the *Hequ shu* 河渠书 (Treatise on rivers and canals) chapter of the *Shiji*: “after this (the gap of the dike of the Yellow River was successfully filled and the flood was blocked) the men who were concerned with such affairs all rushed to the emperor with proposals for utilizing the rivers to greater advantage. As a result..... the Donghai Commendary (drew water) from the marsh of Juding, and at the foot of Mount Tai from the Wen River: in all these places canals were dug to water the fields, providing irrigation for over ten thousand *qing* of land in each area (自是之后,用事者争言水利.....东海引钜定,泰山下引汶水:皆穿渠为溉田,各万余顷. English translation by Watson, B.)” Another passage in the *Wudi ji* 武帝纪 (Annals of Emperor Wu) chapter of the *Hanshu* 汉书 (the Book of Han, by Ban Gu) reads: “(in the fourth year of Zhenghe Era), the third month: the emperor performed plowing at Juding [(征和四年)三月,上耕于钜定].” Based on these textual records, by the early Western Han at the latest, the precipitate lakes had already become fresh water and large areas could be cultivated and irrigated. We can also look at it from another angle to prove that the precipitate lakes were bodies of fresh water by the Western Han. From this other perspective, we know that these types of ancient lakes, such as Judian Lake, were formed by the blockage of the river into the sea and formed over a long period in the river delta (Figure 4). Over a long period of dilution, even if still brackish during the late Shang and Western Zhou Dynasties, such a lake would have been nothing in

comparison with the underground brine, and it neither was possible to consume nor could be used to make salt, would never have become the focus of so many salt-making workshops. Based on the Western Han situation, I believe that the ancient Judian Lake had already been able to provide fresh water resource by the late Shang to Western Zhou Dynasties, and therefore people in the area did not hesitate to establish production areas in these locations.

As mentioned above, the original elevation of the excavated sites at Nanheya, Dahuang Beiyang and other sites are clearly relatively high with *yangzi* formed by natural processes. Regarding these natural processes, generally speaking there are roughly two factors. The first involves alluvial deposition of high ground. In areas within a delta of a coastal plain it is easy for naturally formed dikes and other parts of alluvial fans to occur. Frequently these dikes burst and water courses change and in the process, often segments of hills and broken up alluvial fan sections remain, leaving behind remnants that may comprise the higher areas within a coastal plain (Wu 1991). The second involves eolian deposition of high ground. Along the southern shore of the Laizhou Bay there is an area of hilly topography made up of loess. These hills are locally called “*bu* 埠” and widely distributed across the coastal plain, particularly being concentrated in the area between the Yu 虞 and Wei 潍 Rivers. According to research by Zulu Zhang (1995) and others, during the sea level low stand of the Last Glacial Maximum, the Bohai continental shelf was dried up and exposed and these loess hills were all formed by marine sediments being blown in from the northwest. Possibly the reason why the *yangzi* of the Guangrao and Shouguang areas are not as typical as these *bu* is related to the topography of the area, possibly reflecting a greater distance from the origin point of the loessic sediments, and consequently the *yangzi* are not as large or as densely distributed as the high ground in the south Laizhou Bay area.

Along the coastal plain, the precipitate concentration in the groundwater is rather high, mostly comprising high concentrations of salts. During the rainy season, lower areas collect water and in a short time it becomes salty, whereas on higher ground a significant amount of fresh water can be found, which is why areas like shell middens where fresh water can be collected are continuously settlement locations in the coastal areas. In the Dahuang Beiyang site cluster the Guojingzi 郭井子 shell midden, for example, was the locus of a site of the Longshan Age as well as a salt workshop of the Eastern Zhou Period. In the *Yuanhe jun xian tuzhi* 元和郡县图志 (Yuanhe maps and records of prefectures and counties, ed. by Li Jifu in 813 CE) the following is recorded about Putai 蒲台 County in Dizhou 棣州 Prefecture (today under the jurisdictions of Dongying 东营 and Binzhou 滨州 Cities in Shandong), “On the edge of the sea there is a sandy mound, one *zhang* 丈 high (about 3.3m) and two *li* 里 (about 1km) in circumference, that local people call ‘Doukou Dian (Fighting mouth lake).’ It is located where

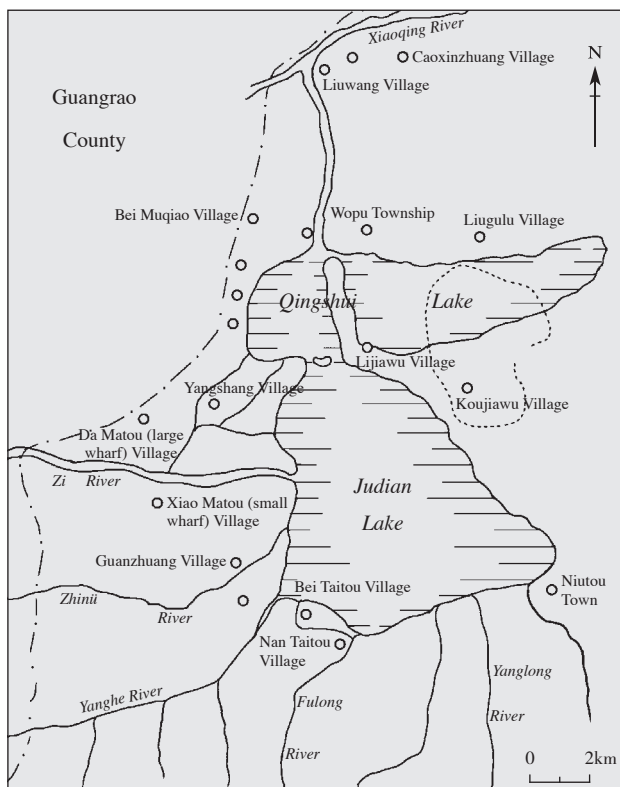


Figure 4 The Judian and Qingshui Lakes in the 1930s.

the Ji 济 River flows into the sea and runs into the sea tide like fighting, so it is named as this. Now on this high land there is a well of sweet, potable water, and even when the tide is high it is not inundated. The locals boil salt below this (海畔有一沙阜,高一丈,周回二里,俗人呼为鬥口淀,是济水入海之处,海潮与济相触,故名.今淀上有甘井可食,海潮虽大,淀终不没,百姓于其下煮盐.)” In 2010, while conducting a survey I learned that once in Guantai 官台 Village the locals used water collected in a pond on a highland to the north of the village and that this water was more or less fresh water. That high areas could collect fresh water possibly reflects a situation in which subterranean brine is not easily penetrated upward into the fresh water stored there, and this may be another important reason why salt production workshops were frequently located on *yangzi*-high ground during the late Shang and Western Zhou Dynasties.

The organization of production at the salt-making sites and the principal reason for selecting site locations

In the previous section I suggest that the selection of sites for salt-making workshops during the Shang and Western Zhou was based primarily on factors related to the ease of constructing furnaces and the availability of fresh water. It seems that by the Eastern Zhou, these site location factors were no longer as significant. In the Eastern Zhou Period, the distribution of workshops seems to have remained somewhat clustered, but relatively speaking were more scattered than previous eras and it is therefore difficult to determine which site cluster each locus should belong to (Figure 5). If we call the previous situation one that is characterized by clustering, then the Eastern Zhou pattern might be called dispersed. We believe that the orientation and clustering of salt-making workshops dating to the Shang and Western Zhou Dynasties around locations where resources were concentrated were based on deep-seated social factors. The aforementioned two aspects of the patterns reflect the interdependence of the production and social resources associated with salt-making workshops. During the late Shang to Western Zhou Dynasties the command that salt producers had over natural conditions was considerable, and in the final analysis reflected a situation with small scale production in private workshops. From a certain point of view, than that the situation of workshop sites in the Late Shang

and Western Zhou Dynasties reflects the idiom “using methods in line with local circumstances,” it would rather be seen as a “privatized system” only really working as a last resort. Since there are plenty of textual records that can be consulted, we already seem to have a better grasp of the situation concerning salt production during the Eastern Zhou Period compared to the late Shang and Western Zhou. If we adopt the principle of moving “from the known to the unknown” and use a comparative approach we can discuss the organization of salt-making workshops and the associated social structure of the late Shang and Western Zhou and consider what impact they would have on site selection related to these workshops.

The techniques used in the salt-making during the Eastern Zhou have not been clear up to now. Based on the results of recent surveys, it is probable that there were innovations that brought new procedures that involved a very large type vat with a rounded bottom into the production process, and the scale of workshops clearly increased. Among the many Eastern Zhou sites known in the lower reach of Xiaoqing River, daily use pottery is rarely seen, although in a few of the relatively larger sites in the region a small amount of daily use vessels are known, and a few sites even are dominated by daily use vessels with very few salt production pottery evident. The patterns associated with these two different pottery categories reflect a situation in which during the Eastern

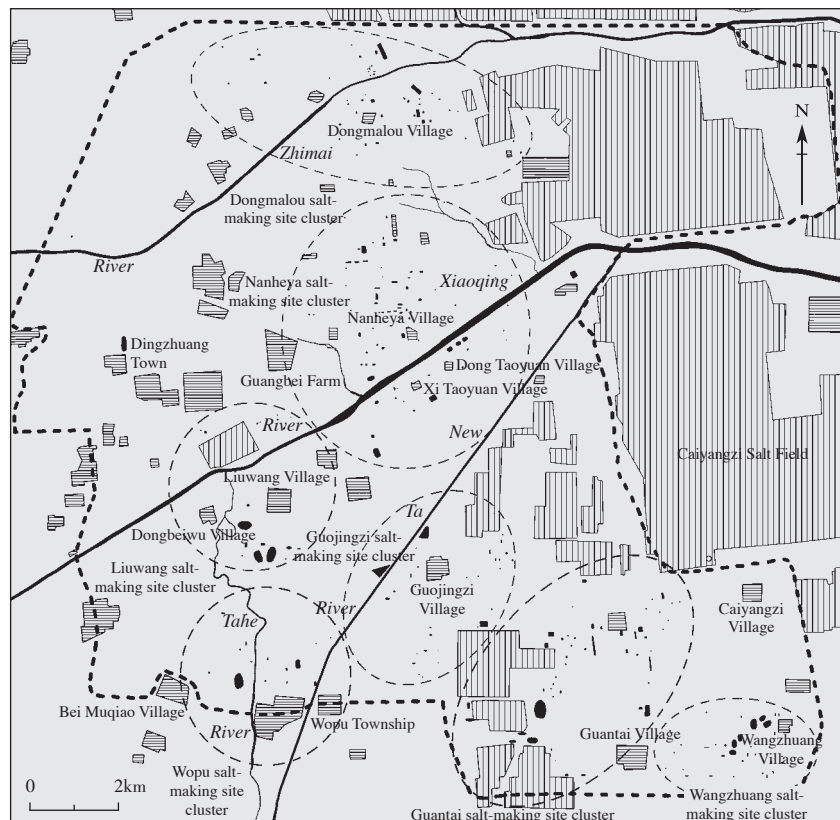


Figure 5 The distribution of the salt-making workshop remains of the Eastern Zhou Period in the lower reach of Xiaoqing River.

Zhou the production locations and residential locations are not the same. The salt workers likely lived in specific locations and scattered among different locations where they would undertake salt production. Taking the inferences one step further, during the Eastern Zhou Period the scale of salt production had expanded and was larger than before. During the survey of the lower reach of Xiaoqing River in 2010 a number of Eastern Zhou sites that were larger than 6ha in size were surveyed. Among these sites, N336 (north of Bei Muqiao Village) was 8ha in area and had abundant materials on the surface among which most were daily use vessels such as *fu*-cauldrons, pots, *dou* 豆 stemmed-bowls, and *pen* 盆 - and *yu* 盂 -basins, along with a small number of large vats used for salt production. In addition, among the artifacts collected were four examples of Qi State pottery inscriptions that included identifiable phrases, one of which read “the many of Chengyang (城阳众),” and another “Douli X (豆里□).” Based on research these inscriptions should indicate these ceramics were made in the vicinity of Linzi the capital of the Qi State (Liu 2011). I believe that this type of site possibly was responsible for logistics of nearby workshops and was a large settlement in charge of regional administration. Under the administration and control of this organization the salt production workshops had the ability to surmount the limits imposed by the distribution of resources necessary for daily life such as fresh water, and consequently expanded the scale of production by reducing the costs of production and daily life. To date, the known salt production workshop sites of the Eastern Zhou Period are all distributed around large settlement sites, perhaps confirming this point.

Based on these lines of information, the salt production of the Eastern Zhou Period has two clear characteristics. First, salt-making workshops were distributed more widely than before, and the scale of salt production was also greater than during the late Shang or Western Zhou. Second, the scale of the organization of production was expanded as well such that salt production may have become administered by government officials. These two characteristics are also proven in textual evidence. For example, in the records of the *Guanzi* 管子 that concern calculation of amounts of edible salt consumed in the Qi State, there is a clear record of the typical amounts of edible salt consumed by adults and children, which indicates that edible salt was no longer a consumable restricted to the royal and aristocratic members of society as it was in the late Shang and Western Zhou. Instead, by this point it had entered into the daily lives of common people. Furthermore, also in *Guanzi* it is recorded that the authorities controlled the marketing and production of edible salt in the Qi State, and even used the profits from salt to control other states. Similar records can be found in *Zuozhuan* 左传, *Guoyu* 国语, and *Zhanguo ce* 战国策, among other texts, and due to the previous work by Shengdong Yan (2011) it is not necessary to say more about this. Based on the materials in textual accounts we can see that by the Eastern Zhou Period, the production

of edible salt was, in fact, getting larger, and the salt administration of the Qi State was increasingly involved in the making, transportation and sale of edible salt.

Now we can take the situation that characterized the organization of salt production workshops during the Eastern Zhou Period and use it to consider that of the late Shang and Western Zhou.

First, at the macro level we can see from the distribution of salt production workshops that during the late Shang and Western Zhou Dynasties the sites were relatively more concentrated than during the Eastern Zhou. During the Eastern Zhou, because of the participation in government institutions that could ensure the stability of the logistical aspects that were similar across the homogenized administration, it was therefore possible to create a situation in which the restrictions of natural resources necessary for daily life could be overcome. This was only possible with integration across a more favorable environment. If this proposition stands up to scrutiny then it is the case that those aspects of the natural environment that facilitated salt-making workshops during the late Shang and Western Zhou conversely became less important.

There are also ways that the differences in the organization of production and its character at different workshop sites are reflected. During the Eastern Zhou there are different trends in the briquetage (pottery wares used to manufacture salt) relative to pottery wares used for other daily activities, a situation attributed to the administered nature of the salt production workshops. Furthermore, although most pottery artifacts found at late Shang and Western Zhou sites are the “helmet-shaped vessels (*kuixingqi*)” used in salt production, nevertheless there are often a certain number of other pottery wares as well. Excavations in 2008 at the site of Nanheya exposed a complete salt-making workshop (Figure 6), to the southeast of which several house foundations with daily use vessels such as *dou*-stemmed bowls, *li*-cauldrons, and *gui*-tureens, possibly representing the residential area for the salt workers. From this we can see that the production activity and the daily life of the salt workers were nearby the workshops and consequently workshops were not merely production sites but also were independent locations of life. The consumption, residence, and other activities took place within the zone of the workshop, such that production locales and residential places were one and the same, and production was organized as an independent, privately owned business.

Second, there are several lines of evidence that help us to evaluate the nature of late Shang and Western Zhou workshops at the micro level. For example, it is quite common to find a considerable amount of wild animal remains in the salt workshop zones of this era. At the site cluster of Nanheya, a total of 3467 zooarchaeological specimens were recovered, among which the number of mammal bones, including deer, cattle, and caprine bones were small relative to the large number (n=3300) of bivalve shellfish specimens, including clams, blood clams

and mussels (Song et al. 2011). Based on the identification of these specimens, the diversity of animals consumed at the salt-making workshop was rather small, with a considerable portion of wild taxa. Invertebrates such as shellfish from marine and fresh water sources comprised an important dietary component for salt workers.

Based on the aforementioned lines of evidence, it seems that there was no specialized management of the logistics of salt workshops during the late Shang and Western Zhou Dynasties, and so the salt workers not only worked hard at the salt production but also hunted, collected, and otherwise procured foodstuffs. Production and daily life at workshops were closely integrated, such that a single workshop was an independent, self-sufficient entity. Therefore, if we say that during the Eastern Zhou Period there was large scale, administered production that was more highly organized, the corollary is that late Shang to Western Zhou salt production was smaller in scale, independently operated and private. This then led to a situation in which during this period the distribution of salt production sites was limited to those areas with appropriate natural conditions.

Discussion

To date, in addition to the archaeological remains already mentioned earlier in this paper, there are numerous other lines of evidence suggesting that the salt production of the late Shang and Western Zhou Dynasties was not an example of attached craft production, but due to limitations of subject and space these are not expanded upon here. Based on preliminary analysis, I believe that those who were responsible for setting up the salt-making workshops during the late Shang and Western Zhou Dynasties primarily came from inland parts of northern Shandong. They selected a technique through which they could satisfy their tribute obligations to the royal courts of the late Shang and Western Zhou by making salt in the non-specialized private workshops that they then transferred to the court through local Shang aristocrats, or later that of the Qi State or Dong Yi chiefs, constituting a loose system for officials to receive their products. Therefore, even though the late Shang and Western Zhou situation was one characterized by independent private workshops, nevertheless it had a pronounced political character. This special production management situation not only influenced various aspects of the production of salt but also probably was related to the nature of the formation and evolution of the political geography of northern Shandong during the late Shang and Western Zhou Dynasties. The significance of this issue cannot be overestimated, and I hope that this paper can give rise to additional consideration and reexamination.

References

Coastal northern Shandong pre-Qin salt industry sites research team 鲁北沿海地区先秦盐业考古课题组. 2012. 鲁北沿

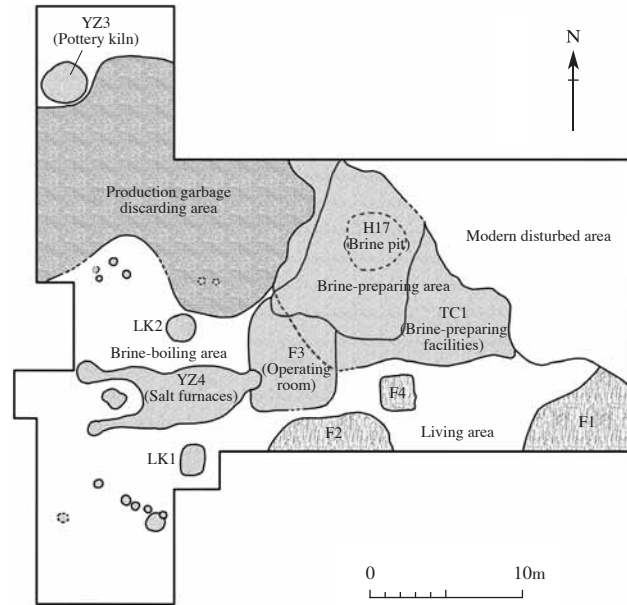


Figure 6 The functional zoning of the Nanheya salt-making workshop site.

海地区先秦盐业遗址 2007 年调查简报 (Brief report of a 2007 archaeological survey of the salt industry sites of the pre-Qin period in the coastal areas of northern Shandong). *Wenwu* 文物 (Cultural relics) 7:4–15.

Department of Archaeology, Shandong University 山东大学考古系 et al. 2010. 山东东营市南河崖西周煮盐遗址 (Excavation to the salt industry remains of the Western Zhou Dynasty of Nanheya Site at Dongying City, Shandong). *Kaogu* 考古 (Archaeology) 3:37–49.

Han, Mei 韩美 and Lina Zhang 张丽娜. 2005. 莱州湾南岸巨淀湖沉积地层分析与沉积环境辨识 (Sedimentary analysis and environmental evolution of Judian Lake in the south coastal plain of Laizhou Bay). *Dili kexue* 地理科学 (*Scientia geographica sinica*) 25(6):678–82.

Li, Shuicheng 李水城 et al. 2003. 莱州湾地区古代盐业考古调查 (Archaeological survey of the ancient salt production sites in the Laizhou Bay area). *Yanye shi yanjiu* 盐业史研究 (Salt industry history research) 1:82–91.

Li, Shuicheng 李水城 et al. 2009. 鲁北胶东盐业考古调查记 (Archaeological surveys of salt production in northern Shandong to the Jiaodong Peninsula). *Huaxia kaogu* 华夏考古 (Huaxia archaeology) 1:11–25.

Liu, Haiyu 刘海宇. 2011. 寿光北部盐业遗址发现齐陶文及其意义 (The pottery inscriptions of Qi State discovered in salt industry remains of north Shouguang and their significance). *Dongfang kaogu* 东方考古 (East Asia archaeology) 8:219–24.

Oriental Archaeology Research Center of Shandong University 山东大学东方考古研究中心 et al. 2005. 山东寿光市北部沿海环境考古报告 (Report on environmental archaeology of the northern coastland of Shouguang City, Shandong). *Huaxia kaogu* 4:3–17.

Salt archaeological team of Shandong University 山东大学

- 盐业考古队. 2012. 山东北部小清河下游 2010 年盐业考古调查简报 (2010-year archaeological survey on salt manufacture in the lower valley of Xiaoqing River within northern Shandong). *Huaxia kaogu* 3:3–22 and 78.
- Shandong Provincial Institute of Cultural Relics and Archaeology 山东省文物考古研究所 et al. 2010. 山东寿光市双王城盐业遗址 2008 年的发掘 (Excavation to the salt industry remains at Shuangwangcheng, Shouguang City, Shandong in 2008). *Kaogu* 3:18–36.
- Song, Yanbo 宋艳波 et al. 2011. 山东广饶南河崖遗址 2008 年出土动物遗存分析 (The faunal remains analysis of Nanheya Site, Guangrao, Shandong). *Dongfang kaogu* 7:387–99.
- Wang, Qing 王青 et al. 2006. 山东北部全新世的人地关系演变: 以海岸变迁和海盐生产为例 (Man-nature relationship evolution during the Holocene in northern Shandong evidenced from coastline changes and sea-salt production). *Disiji yanjiu* 第四纪研究 (Quaternary sciences) 26(4):589–96.
- Wu, Chen 吴忱 [ed]. 1991. *Huabei Pingyuan gu hedao yanjiu* 华北平原古河道研究 (A study of ancient channels on North China Plain). Beijing: Zhongguo kexue jishu chubanshe. pp. 57–89 and 132–8.
- Yan, Shengdong 燕生东 et al. 2005. 山东寿光双王城发现大型商周盐业遗址群 (The large Shang to Zhou period salt production site cluster discovered at Shuangwangcheng in Shouguang, Shandong). *Zhongguo wenwu bao* 中国文物报 (China cultural relics news) Feb 2:1.
- Yan, Shengdong 燕生东 and Yufu Lan 兰玉富. 2008. 2007 年鲁北沿海地区先秦盐业考古工作的主要收获 (The main discoveries of salt production archeology in Pre-Qin period along the coastal area in Northern Shandong Province 2007). *Gudai wenming yanjiu tongxun* 古代文明研究通讯 (Ancient civilizations review) 36:43–56.
- Yan, Shengdong 燕生东 et al. 2011. 渤海南岸地区发现的东周时期盐业遗存 (Eastern Zhou salt industry sites on the south coast of Bohai Sea). *Zhongguo Guojia Buowuguan guankan* 中国国家博物馆馆刊 (Journal of National Museum of China) 9:68–91.
- Zhang, Zulu 张祖陆. 1995. 渤海莱州湾南岸平原黄土阜地貌及其古地理意义 (Loess mounds on the Laizhou Bay Plain south of Bohai Sea and their paleogeographic implication). *Dili xuebao* 地理学报 (*Acta geographica sinica*) 50(5):465–70.

Postscript

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