

## Turquoise ornaments and Inlay technology in Ancient China



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**ABSTRACT** Most turquoise objects from early Neolithic sites in China are pendants made of a single material. From the later Neolithic period, however, people started to create turquoise ornaments with two or more composite materials. Ornaments were inlaid with turquoise and other materials using new techniques. In the Early Bronze Age, the turquoise production process reached its peak. At the Erlitou site, archaeologists found a large dragon-shaped turquoise mosaic, a variety of animal-shaped turquoise decorations, and turquoise workshops. The purpose of this paper is to understand the importance of turquoise products in the formation process of early state formation in China by analyzing the following topics: the technological evolution of turquoise manufacture, the combination of composite materials, the use of adhesive in turquoise inlay, and the associated production processes as they developed from the Neolithic to Early Bronze Age.

**KEYWORDS:** Ancient China, turquoise ornaments, inlay technology, Yellow River region, Erlitou Culture, regional exchange.

### INTRODUCTION

Inlays are small fragments of material embedded in objects made of different media. The purpose of inlay is to enhance the beauty of objects by adding color and texture. Archaeological researchers in China have documented the earliest use of inlays to the Middle Neolithic period (c. 3300 B.C.). During that era, the most common material used for inlay was bone, while turquoise was rare. Turquoise inlay became popular starting in the Late Neolithic period (c. 2500 B.C.). Turquoise inlays are more interesting and attractive than bone inlays, and they continued to play an important decorative role through the Erlitou Culture period (c. 1900–1600 B.C.) around the Yellow River region.

During the transition from the Neolithic to the

Early Bronze Age, a number of social changes and technological innovations took hold in the upper reaches of the Yellow River. The use of bronze and turquoise inlays is an example of significant technological developments that relate to major social change in the area. Turquoise inlay was often used in objects related to ritual activities or symbols of power. However, understanding turquoise inlay technology requires analysis beyond that of the inlays themselves. It is important to examine all relevant components, including the composition and origin of raw turquoise materials, the nature of adhesives used to affix the turquoise, and the various materials (i.e., bone, stone, wood, leather) of which the main objects were made.

Turquoise is a hydrous phosphate of copper and

aluminum. Some scholars believe that turquoise is produced in dry geological environments such as deserts.<sup>1</sup> Turquoise nodules usually form between other stones, so they rarely appear as large pieces. For this reason, and unlike jade, it is not possible to carve turquoise into a wide range of different shapes. Consequently, turquoise was typically used to produce small, simple ornaments or as inlays in larger objects. The bright colors and striking features of turquoise create a striking contrast with other materials. The color of the turquoise mainly depends on the content of copper and iron in the rock. Copper enhances the blue, while iron brings out the green. Because of these natural characteristics, turquoise has often been incorporated into mosaics.

This article explores the background of inlay technology involving turquoise, including discussion of relevant materials such as the adhesives used and the main media into which turquoise inlays were set. Ancient Chinese people began using turquoise inlay approximately 5300 years ago, but their inlay methods varied between regions. For example, a black gum or jelly adhesive was a key fixative in the upper reaches of the Yellow River, whereas strings strung through holes were used to affix different materials to each other in the Shandong area. Research on the complex technology of turquoise inlay should elucidate the relationship between the origins of raw materials and inlaid products and their association with social change. This research may also help determine why turquoise was so popular as a decorative medium during the Erlitou Culture period. An analysis of inlay technology, comparisons of inlay methods, and exploration of turquoise sources and distribution will assist us in understanding the aesthetic views of the ancient Chinese, along with their associated cultural background and probability of cultural exchange.

<sup>1</sup> See *istone* website managed by Ishino Iwanosuke (2009), <http://www.istone.org/turquo.html>.

## TURQUOISE DECORATIONS AND INLAY TECHNOLOGY IN ANCIENT CHINA

### *Early to Late Neolithic Age*

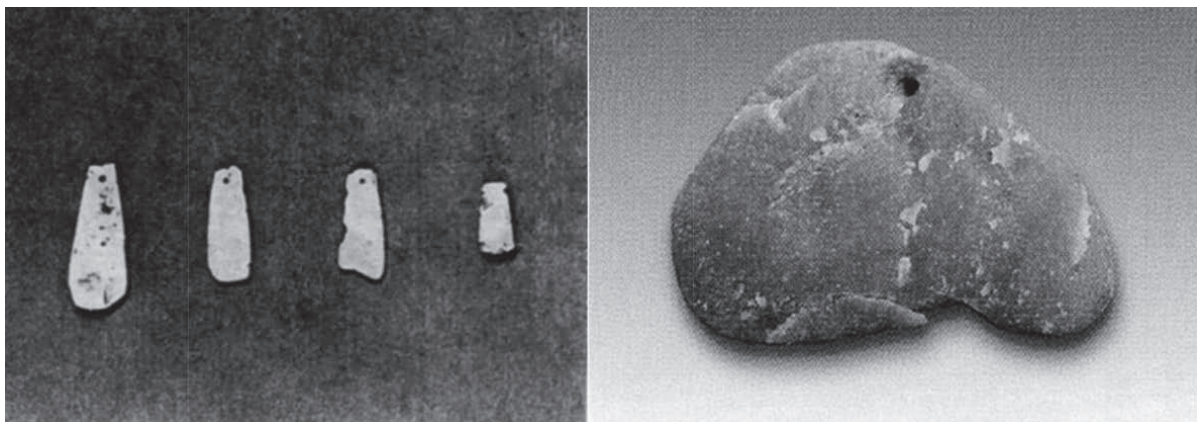
Turquoise was probably first exploited in China around 7000 B.C. Excavation data show that turquoise was mainly found at sites along the Yellow River. The distribution, form, and ornament production technology changed with time. Dong Junqing and other scholars (Dong et al. 2011) have compared the unearthed jade ornaments found in Henan Province from the Neolithic to the Early Bronze Age. Based on their research data, from the Neolithic to the Erlitou Culture period, the most common material used for ornaments was turquoise, but after the early Shang dynasty, the main material changed to tremolite. The largest numbers of turquoise objects were found at the Jiahu 贾湖 site of the Peiligang Culture, the Xiawanggang 下王岗 site of the Yangshao Culture, and the Erlitou 二里头 site of the Erlitou Culture. The chemical composition of the turquoise objects was the same at Jiahu and Xiawanggang. Where these objects were made cannot be confirmed, but they were all pure turquoise, in the iron turquoise and zinc turquoise categories. Main Neolithic to Early Bronze Age sites, especially those associated with more than ten pieces of decorative turquoise objects, are shown in Figure 1.<sup>2</sup>

Archaeological evidence of the earliest use of turquoise ornaments comes from the Peiligang 裴李岗 Culture (c. 7000–5000 B.C.). According to Chen Xingcan (2009), turquoise pendants in different shapes were unearthed from 5 Peiligang sites in the middle of Henan Province. A total of 68 turquoise artifacts were found at these 5 sites. Approximately 74 percent of these artifacts were found in tombs; 13 percent were found in pits; and another 13 percent were found in cultural layers. The presence of these objects at multiple sites means that turquoise ornaments had become thoroughly

<sup>2</sup> Over 100 sites have been identified that contained fewer than 10 pieces of turquoise each.



**Fig. 1.** Distribution of turquoise and turquoise inlay decorations at Neolithic and Bronze Age sites. Sites in which less than two pieces of turquoise have been recovered are not shown on this map. 1) Peiligang 裴李岗; 2) Shawoli 沙窝李; 3) Shuiquan 水泉; 4) Jiahu 贾湖; 5) Xiawanggang 下王冈; 6) Xiajin 下靳墓地; 7) Taosi 陶寺; 8) Dongxiafeng 东下冯; 9) Yuanxu 垣曲商城; 10) Beigou 北沟; 11) Fengxia 丰下; 12) Bei fudi 北福地; 13) Dawenkou 大汶口; 14) Wangyin 王因; 15) Yedian 野店; 16) Zhufeng 朱封; 17) Huating 花厅北区; 18) Jinzhai 金寨; 19) Fuquanshan 福泉山; 20) Shixia 石峡; 21) Daxi 大溪; 22) Xisiping 西寺坪; 23) Beishouling 北首岭; 24) Jiangzhai 姜寨; 25) Laoniupo 老牛坡; 26) Longgangsi 龙岗寺; 27) Liuwan 柳湾; 28) Zongri 宗日; 29) Zhujiashai 朱家寨; 30) Dianhe 店河; 31) Caiyuanqiedaoba 菜园切刀巴; 32) Qinweijia 秦魏家; 33) Dahezhuang 大何庄; 34) Yuanyangchi 鸳鸯池墓地; 35) Huangniangniangtai 皇娘娘台; 36) Dibaping 地巴坪; 37) Erlitou 二里头; 38) Dongxiafeng 东下冯; 39) GaochengTaixicun 藁城台西村; 40) Zhukaigou 朱开沟; 41) LiangchengYaozi 凉城窑子; 42) Beipiaofengxia 北票丰下; 43) Aohanqi Dadianzi 敖汉旗大甸子; 44) Shajing 沙井; 45) Siba 四坝.



**Fig. 2.** Turquoise pendants unearthed from: (left) Longgangsi site (Shaanxi Kaogusuo 1990: fig. 124-3); (right) Beifudi site (Hebei Kaogusuo 2010: 156, fig. 13).

incorporated into the material culture of Peiligang (Kong 2002; Pang 2014).

Simple pendant artifacts made of turquoise have been discovered dating to the middle Yangshao 仰韶 period (c. 5000–3000 B.C.), but the number of turquoise ornaments found in Yangshao contexts is very uneven. For example, while many turquoise pieces have been found at the Xiawanggang 下王岗 site in Henan Province and the Longgangsi 龙岗寺 site in Shaanxi Province, nearby sites such as the Beifudi 北福地 site in Hebei Province only contained one or two pieces (Hebei Kaogusuo 2010) (see examples in Fig. 2).

Most turquoise objects unearthed from Neolithic contexts are circular, trapezoidal, square, or rectangular; they were usually made into pendants or earrings. The Longgangsi site, located in southern Shaanxi Province, is an Early Neolithic Yangshao Culture site dating to c. 5000–4000 B.C. A total of 77 pieces of turquoise have been recovered from this site (Shaanxi Kaogusuo 1990). Except for 3 pieces from the Early Neolithic period, all were unearthed from 30 Middle Neolithic period tombs.<sup>3</sup> The turquoise ornaments appear in a variety of forms such as spades, trapezoids, rectangles, polygons, and circles, among others. The spade shape (27 pieces) and circle shape (28 pieces) comprise 80 percent of the objects. All of the objects served as pendants. The shapes and functionality of these Longgangsi Culture turquoise ornaments are generally similar to those of Peiligang Culture ornaments.

The Xiawanggang site is located to the south of the Han River in Henan Province. Excavations have focused on a large Yangshao period cemetery at this site. Only 2 turquoise earrings from Yangshao Culture Phase 1 contexts have been found there. Phase 2 contexts yielded 23 pieces, but the number decreased to 5 in Phase 3. Three turquoise earrings belonged to the Longshan Culture period (Henan Kaogusuo and Changjiang 1989).

<sup>3</sup> The tombs were occupied by 19 female adults, 8 male adults, 3 children, and 2 individuals whose age/sex has not been determined.

Turquoise is often discovered in the upper reaches of the Yellow River in the Gansu–Qinghai–Ningxia region. A lot of turquoise ornaments have been unearthed from the Majiayao 马家窑 Culture (3300–2000 B.C.) sites. For example, the Liuwan 柳湾 site in Qinghai Province is a multicultural site that includes Banshan 半山 (2900–2350 B.C.) and Machang 马厂 (2335–2035 B.C.) components, as well as graves associated with the Qijia 齐家 Culture (2200–1600 B.C.) and the Xindian 辛店 Culture (1300–1000 B.C.) (Qinghai Wenguanchu and Shekeyuan Kaogusuo 1984). Excavations have uncovered 257 tombs of the Banshan type and 872 of the Machang type. A total of 40 turquoise ornaments were found in 26 Banshan-type tombs and 204 turquoise ornaments from 16 Machang-type tombs. Most of these artifacts were positioned near the heads, necks, or chests of the deceased. Strung ornaments (i.e., necklaces, bracelets) consisting of combined turquoise and seashell artifacts were found for the first time in the Machang-type tombs M615 and M916. A flat turquoise ornament inlaid with bone beads was recovered from M1086. A total of 119 non-perforated, flat rectangular and trapezoidal turquoise artifacts, each 1 cm long and 0.4–0.5 cm wide were found in M1406. These flat, non-perforated objects appear to be pieces of a turquoise mosaic, but the material that housed the mosaic was not found, probably because it had decayed (Qinghai Wenguanchu and Shekeyuan Kaogusuo 1984). Another example of turquoise mosaic in Qinghai comes from the Zongri site, during the Majiayao Culture (Chen Honghai 1999). The mosaic turquoise inlay appears on a bone bracelet (Fig. 3b). These examples support the contention that mosaics occurred in the Middle Neolithic of ancient China.

Tomb M58 at the Yuanyangchi 鸳鸯池 Machang-type site contained a bone arm ornament similar to those found at the Dibaping 地巴坪 site in Guanghe 广河, Gansu. The bone bracelet is made with many cut and polished elongated bone chips attached to a black gum mount encircling the left wrist of a





**Fig. 3.** (a) Bone ornaments with inlay from Yuanyangchi site (Ganbo and Wuwei 1974 : 302, fig. 5); (b) turquoise inlay on bone bracelet from Zongri site. Photo by Chen Honghai.

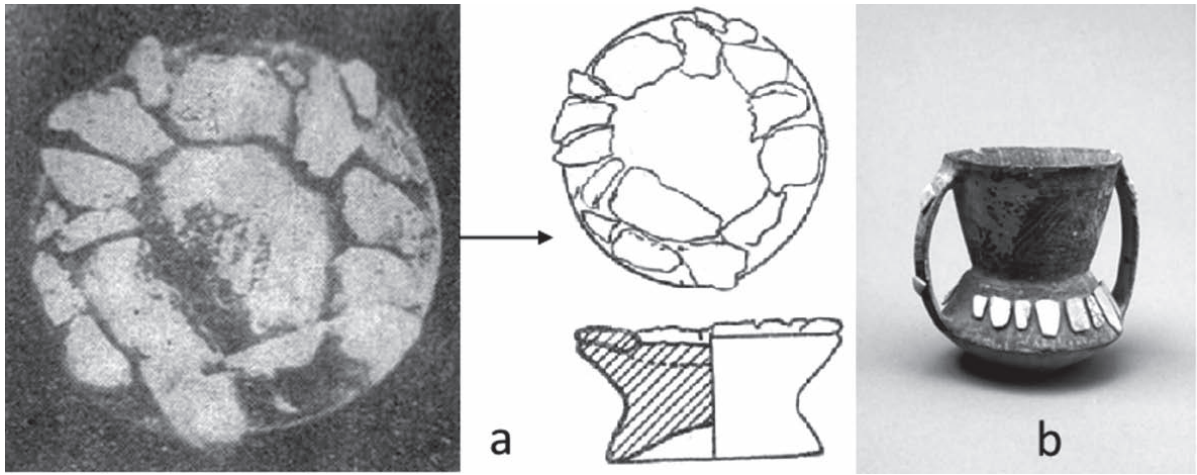
human arm (Ganbo and Wuwei 1974). From M32 at the Yuanyangchi site, two pieces of beautifully crafted bone hairpins were recovered. One of them has a round bar shape with a black gum cone on its base, while another one has an additional 36 white bone beads inlaid on the black gum on the base (Fig. 3a).

In addition to turquoise and seashells, agate beads are found for the first time in contexts associated with the Qijia Culture. A total of 141 ornaments have been found in Qijia Culture graves. Thirty-four turquoise ornaments have been found in 26 Qijia Culture period tombs at Liuwan. Among these were necklaces for 11 women. Turquoise has also been found in the mouths of deceased men and women in tomb M1061. White marble, white seashells, and red carnelian artifacts were also found. Combining such materials with turquoise would have made the body decorations quite colorful.

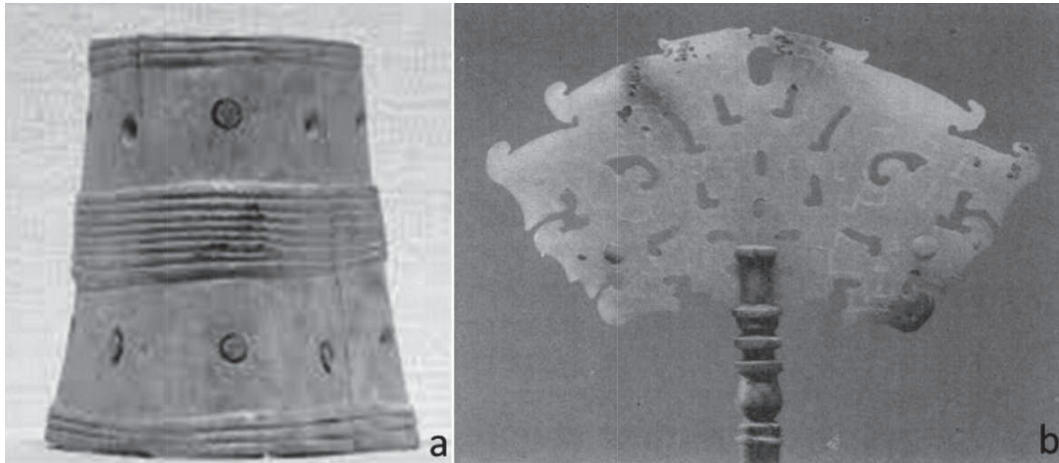
QM52 of the Majiayao Culture site of Caiyuan Qiedaoba 菜园切刀把 in Ningxia contained eight examples of turquoise inlay on pie-shaped black adhesive. The turquoise pieces were polygonal and of different dimensions, but all were between 0.1 and 0.15 cm thick. Their surfaces were smooth. A

turquoise pendant was also found at QM52 (Ningxia Kaogusuo and Libo 2003). Sixty-six Banshan-type tombs have been excavated in Dibaping. Most of the ornaments there were bone beads and bracelets. In total, 342 bone beads were found near the necks and wrists of the deceased in 7 tombs. No turquoise ornaments were discovered, but 12 unusual bone bracelets were unearthed from 7 of the 66 tombs. These bracelets were not the commonly found simple bone circles, but instead were made by connecting many elongated pieces of bone together with a black gum. They were placed around the wrists of the deceased, one on the right wrist and one on the left. Most were in a poor state of preservation; the black gum had lost its shape and was difficult to identify. The well-preserved bone pieces are all similar sizes: around 2 cm long and 1.4 cm wide. Their front faces were cut and polished smooth, but their backs were rough and affixed to a black adhesive material (Gansusheng Bowuguan 1978).

Turquoise inlay on pottery objects appears starting in the Qijia Culture period. Two ceramics inlaid with turquoise were discovered in the Ningxia Guyuan Dianhe 固原店河 site Qijia Culture tombs.



**Fig. 4.** Pottery with turquoise inlay: (a) from Guyuan Dianhe (Ningxia Kaogusuo 1987 : 676, figs. 7, 8); (b) from Siba (Gansu Ribao 2013: n.p.).



**Fig. 5.** Turquoise inlay unearthed from Shangdong: (a) Dawenkou Culture context (Shandong Kaogusuo 1974: n.p., fig. 29); (b) Longshan Culture context (Du 1994 : 55, fig. 2).

M1:10 is a vessel with a constricted waist; unfortunately, the turquoise inlay has separated from this object. Another one (M2:7) is better preserved. Seventeen flat turquoise fragments were intact and inlaid on this vessel (Fig. 4a). The turquoise fragments average around 2.8 cm long and 1.3 cm wide (Ningxia Kaogusuo 1987).

From later Siba 四坝 Culture (1800–1300 B.C.) sites, archaeologists have also unearthed an orange ceramic with turquoise inlay on its shoulder (Fig. 4b). Inlaying turquoise on an orange background created a very bright decorative effect (Gansu Ribao 2013).

Finds at Neolithic sites in Shandong Province suggest this was one of the areas where turquoise

inlay developed. In the Wangyin 王因 cemetery, which belonged to the Dawenkou 大汶口 Culture (4200–2400 B.C.), 18 turquoise pendants and 2 bone bracelets have been unearthed. Unlike the bone bracelets from the upper Yellow River area, the ones here were not put together using a black gum adhesive. There are two or three bone pieces per bracelet; both sides of each piece have holes, probably for linking the pieces together using string (Fig. 5a). This shows that different processes were used to produce similar effects in different regions (Shekeyuan Kaogusuo 2000).

The Dawenkou cemetery has material from all three periods of the Dawenkou Culture. There is only one known turquoise necklace from the



**Fig. 6.** Turquoise inlaid ornaments from Taosi Culture sites: (a) two bracelets (Shanxi Kaogusuo 1998 : 9, figs. 10, 12); (b) hair ornament. Photo by author.

early period, but excavators found three beautiful rings with turquoise inlay from the middle period tomb M22. Dating to the late period, tomb M10 contained a bone tube with turquoise inlay, along with a necklace composed of 19 turquoise pieces. Another bone tube with turquoise inlay was found in tomb M4. This tube was 7.7 cm long with a smooth polished surface. Excavators also unearthed a small turquoise earring from a small tomb (M5) (Shandong Kaogusuo 1974). Likewise, four turquoise pendants and four bone and ivory cylinders were found at the Yedian 野店 Dawenkou cemetery in Zouxian 邹县. Four turquoise fragments were inlaid in the upper and lower ends of the cylinders (Shandong Kaogusuo 1980). Also, in a tomb at Zhufeng 朱封, a Longshan Culture site, a jade engraved crown with turquoise inlay was found (Shekeyuan Kaogusuo Shandongdui 1990) (Fig. 5b).

Aside from the Erlitou Culture, a lot of turquoise pieces have been unearthed from Taosi Culture sites. For example, in the middle reaches of the Yellow River in Shanxi Province, at the Xiajin 下靳 cemetery of the Taosi 陶寺 Culture (2500–1900 B.C.), three bracelets with turquoise inlay were found on the wrists of deceased people (Fig. 6a). These turquoise inlays were on a black gum-like substance, but the substance could not be identified because of decay (Shanxi Linfen and Shekeyuan Kaogusuo 1999; Xiajin Kaogudui 1998). A similar bracelet was supposedly found at the Taosi cemetery (Shekeyuan Kaogusuo and Shanxi Kaogusuo 2015).

According to Gao Wei, one of the excavators of the Taosi cemetery, 24 jade hairpins decorated with bone and turquoise inlays were also recovered from 24 separate tombs (pers. comm. 1998; Gao 2001) (Fig. 6b). The turquoise inlays in these 24 tombs were mosaics, each consisting of 10–60 pieces of turquoise. An additional 900 small turquoise pieces have been found at the Taosi cemetery.

Gao (2001) divided these artifacts into three types of collections. The first collection type is typified by the burial M2010, which contains 3 jade ornaments and a bone hairpin. The bone hairpin was inlaid with 27 turquoise pieces attached with a paint or gum (represented by a black carbonized material). M2001 contained 2 jade ornaments and a single hairpin; 26 turquoise pieces were inlaid on the hairpin. M2028 had 3 jade ornaments and a bone hairpin with 10 pieces of turquoise inlay. M3018 also had 3 jade ornaments and a bone hairpin with 26 turquoise pieces of inlay, similar to the hairpin from M2001. The second collection is similar to the first type except it contains L-shaped jade pendants that use black jelly to cohere inlaid turquoise. An example is from M2023, which included a bone hairpin with 60 turquoise pieces of inlay. There are no turquoise inlays in type 3.

According to Gao (2001), black adhesive gum is a very important material for the inlay of turquoise on bone hairpins. However, this black substance has yet to be identified. All that is known is that it is a natural material. The results of future analysis will help us understand why some areas had this sort



of inlay technology, while others did not.

### **Early Bronze Age**

Turquoise production peaked during the Early Bronze Age. Excavators unearthed many different types of artifacts inlaid with turquoise at Erlitou (capital of the first Chinese state). Some of the most famous discoveries from the Erlitou site include ritual artifacts such as turquoise-inlaid bronze plaques with animal masks and a large turquoise dragon-shaped artifact made of over 2000 pieces of turquoise; each piece has one smooth side and one rough side with black gum. Excavations of the Erlitou site also uncovered a turquoise production facility. Turquoise inlay technology and its products may have played an important role in China's early state formation.

As many as 980 turquoise ornaments dating to Erlitou Period III have been found. In addition, 3 bronzes with inlaid turquoise were found from Erlitou Period III. Five circular bronzes with inlaid turquoise were also found, but it is unclear what these bronzes were used for. On the edges of the circular bronze from VKM4:2, 61 pieces of turquoise were arranged uniformly, like a clock (Fig. 7a1). Two circles of turquoise pieces were inlaid in cross shapes in the middle. Each circle has 13 crosses. The front was covered with 6 layers of textiles of different thicknesses, each with a 17 cm diameter. On the outside edge of the circular bronze from VIKM3:16 were inlays of turquoise pieces each 0.1 cm thick and 11.6 cm in diameter. A piece of turquoise was sandwiched between two copper circles of another, smaller (10.3 cm diameter, 0.2–0.3 cm thick) circular bronze from VIKM3:17.

An inlaid turquoise tip-like device was unearthed from 80YL3M4. Furthermore, excavators found 150 turquoise pieces dating to Erlitou Period IV from burial 84YL4M6. These were probably inlay fragments that were formerly affixed to organic materials.

The Erlitou site excavations demonstrate that, in addition to common turquoise decorations, a striking

emphasis was placed on turquoise inlay. The large number of objects inlaid with turquoise that were produced is particularly noteworthy. Through out the entire span of Erlitou periods I–IV, more than ten intact objects with turquoise inlay have been found (Chen Xuexiang 2003; Hao 2008) in addition to the innumerable turquoise pieces that have fallen away from the objects on which they were originally inlaid.

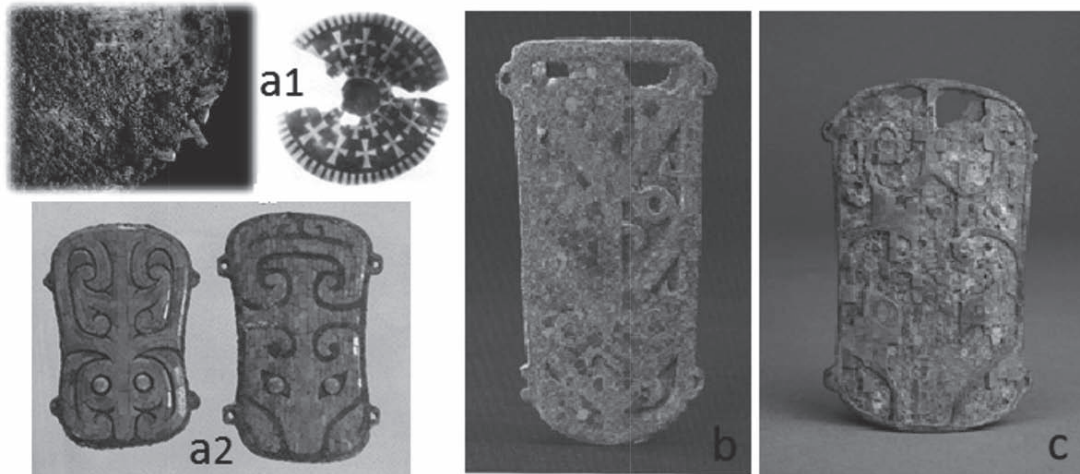
After the discovery in 2002 of a dragon-shaped turquoise inlay figure, a large number of turquoise wasters were found. These wasters mark a turquoise workshop occupying an area of approximately 1000 m<sup>2</sup> (Du 1994; Li 2006). This archaeological discovery brought scholarly attention to turquoise and its associated unique inlay technology.

Bronze animal plaques inlaid with turquoise have been found at sites other than Erlitou. One example was recovered from Gansu Tianshui 甘肃天水 (Zhang 2002). This object measures 15 × 10 cm and is decorated with a sheep's head-shaped pattern (Fig. 7c).<sup>4</sup> Another example comes from the Gaopian 高骈 locus at the site of San xingdui 三星堆 in Guanghan 广汉, Sichuan 四川 (Du 1995). This example measures 12.3 × 5 cm and has a surface covered with geometric decorations (Fig. 7b). Another example from Sichuan was found at the Zhenwu 真武 locus at Sanxingdui and measures 13.8 × 5.2 cm (Du 1995). These pieces are similar in shape and style to the artifacts from Erlitou.

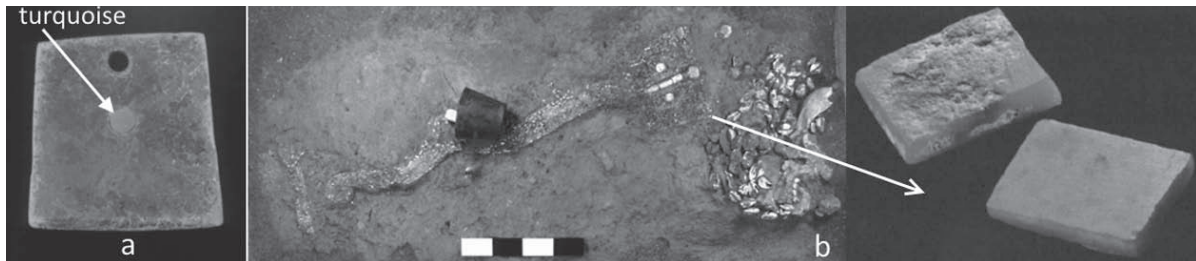
Turquoise inlay technology can be separated into three types: turquoise embedded in copper or bronze utensils and plaques; turquoise embedded in organic materials such as bone; and turquoise embedded in jade. An example of the first type is from the 1987 excavation at the Erlitou site in context 6-M57, where a medallion-shaped bronze plaque and a bronze ornament were found (Shekeyuan Kaogusuo Erlitou Gongsuodui 1992). Most bronze plaques share a generally rounded rectangular shape with

<sup>4</sup> This ornament is now conserved at Tianshui Museum in Gansu Province.





**Fig. 7.** Turquoise inlaid bronze artifacts from: (a1 and a2) Erlitou (photos by Xu Hong); (b) Sanxingdui (photo by author); (c) Tianshui (photo by author).



**Fig. 8.** Turquoise inlay (a) in jade and (b) in lacquer or wood, Erlitou site. Photos by Xu Hong.

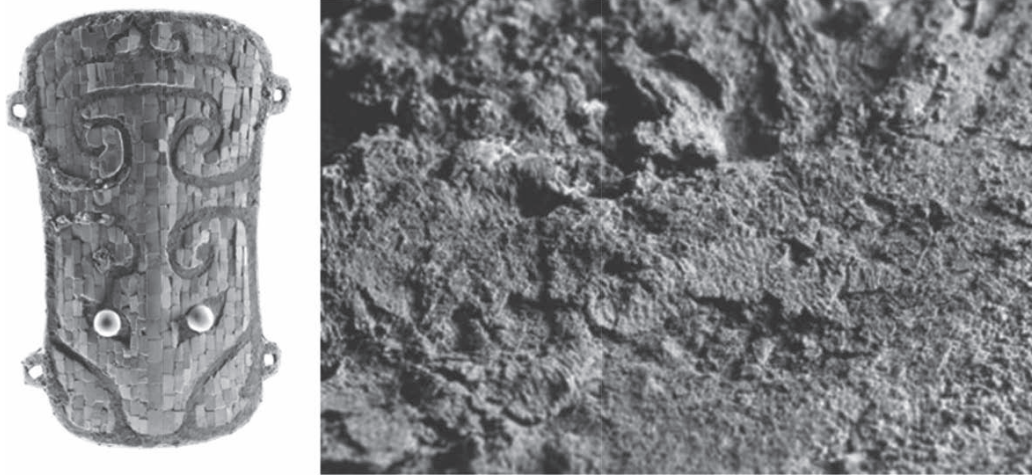
a slightly wider lower edge, but these objects had beast-shaped frames with small pieces of turquoise arranged on them. The plaque was 15.9 cm in length and 7.5–8.9 cm wide, with more than 400 turquoise inlays. In context, 5-M4, a bronze plaque inlaid with turquoise was unearthed that contained more than 320 pieces of turquoise (Fig. 7a2). The turquoise pieces were rectangular, trapezoidal, and conical.

An example of the second collection type is a dragon-shaped object found at Erlitou. The object measures 70.2 cm long and its body contains more than 2000 pieces of inlaid turquoise in various shapes (Fig. 8b). Each turquoise piece is about 0.5 cm in length, 0.4 cm in width, and 0.1 cm in thickness, with a smooth front and grooves cut into the back, originally covered with a sticky black substance (Tang 2012). According to the excavators, the pieces of turquoise were originally

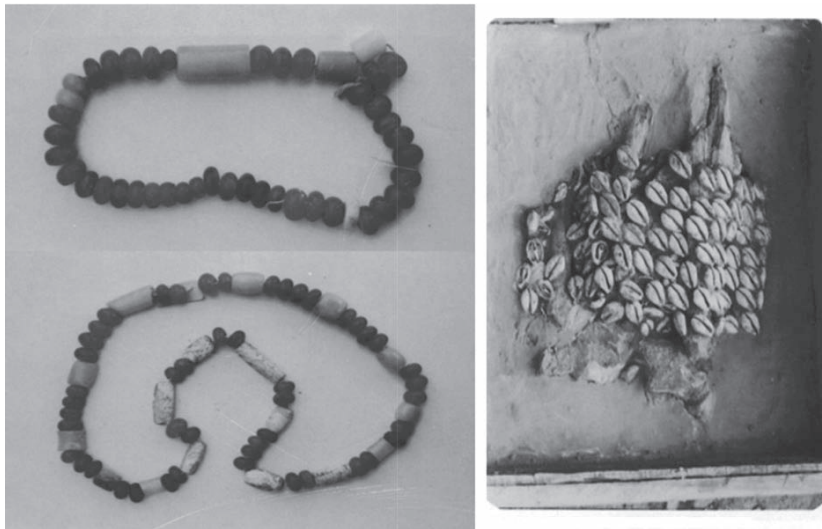
inlaid on lacquer or wood. The bedding seems to have been braided, but because of serious damage, additional research is needed to confirm this.

The third type is turquoise inlaid in jade ornaments and ritual objects. An example is the jade *yue* 钺 with a small piece of turquoise inlaid in the middle (Fig. 8a). All such objects have holes ground into them for inlaying the turquoise.

In developing methods of inlaying turquoise or shell fragments onto bronzes, Erli tou Culture inlay technology reached a peak of sophistication that continued to the Late Bronze Age. Designs incorporating the eyes or heads of animals are typical in bronze plaques with turquoise inlay (Hakari 2006; Tang 2012; Wang 2004, 2007; Zhongguo Xinwen Wang 2014). For example, turquoise pieces were embedded into the rectangular bronze plate from Erlitou locus 84M11 (Fig. 9 left). The left and right sides have two lines, and one side of the plaque has a groove for the turquoise to be



**Fig. 9.** Bronze plaque from Erlitou locus 84M11(left); traces of silk fabric on its verso side (right) (Zhongguo Xinwen Wang 2014: n.p.).



**Fig. 10.** Agate necklaces (left) and seashells (right), from the Dadianzi cemetery (Shekeyuan Kaogusuo 1996: n.p., figs. 19, 20).

inlaid within an animal-shaped pattern. The back of the plaque has traces of textile, probably silk (Fig. 9). Some scholars believe the textile was the same material people used for clothes and that the plaque may have been wrapped in the cloth after the inlay was complete (Li 1991; Zhongguo Xinwen Wang 2014). However, closer examination of the plaque reveals that most surfaces are covered in the skeuomorphism of textiles. It is therefore more likely that the textile covered the object before the inlay rather than after. The patterns on the plaques were designed before the inlay, then small stones were placed in the grooves on the plaque to create the pattern.

The Dadianzi 大甸子 site of the lower Xiajiadian Culture 夏家店下层文化 (2200 – 1600 B.C.) is another source of information about turquoise inlay. The site lacks bronze plaques with turquoise inlay, but contains a lot of lacquerware and pottery with turquoise inlay, as well as large numbers of turquoise ornaments (Shekeyuan Kaogusuo 1996). The excavated area is primarily a cemetery, comprised of 143 large tombs, 434 medium-sized tombs, and 52 small tombs. Eighty-five of the graves have yielded a total of 334 turquoise ornaments, which can be divided into two types. The first type (221 specimens) is typified by flat-bodied quadrilaterals with a hole on the long side,

probably earrings. The other type (121 specimens) consists of cylindrical beads. The turquoise earrings were associated more with men than women, while the cylindrical beads seem to have been used more by women and children than men.<sup>5</sup> In addition to turquoise, marble, onyx, and seashells with white, green, and red parts were the main media for ornamentation, demonstrating that the Xiajiadian Culture people of Dadianzi placed a strong emphasis on color and contrast (Fig. 10). Thirty-eight of the tombs in Dadianzi cemetery included ceramics, lacquerware, and woven goods inlaid with shells or turquoise (13 inlaid objects contained turquoise). Pottery with shell and turquoise inlay on the rims was found in tombs M885, M905, and M818.

## CATALOGING TURQUOISE ORNAMENTS AND INLAYS

### *Types of Turquoise Decorations*

Archaeological data shows that the majority of turquoise ornaments are small objects such as earrings and pendants; these comprise 80 percent of all turquoise decorations. Such small objects make up 95 percent of turquoise ornaments in the Peiligang Culture period. However, beads and tubular-shaped turquoise ornaments are found during the Middle Neolithic age at sites such as Xiawanggang, Longgangsi, Majiayao, and Dawenkou. These were probably used for making bead necklaces. Bead necklaces require a more complex level of technology, since beads are more difficult to manufacture. Their presence shows that turquoise technology was becoming increasingly sophisticated over time. Toward the Late Neolithic, the Qijia, Taosi, and Longshan cultures all are associated with inlay, exhibiting another development in technology. The use of mosaics, putting small pieces of different stones together to create elaborate patterns, also began at this time, indicating yet another significant step in techno-

logical development.

Inlay technology varied in different cultural contexts. The main materials used for mosaics were pieces of bone, bone beads, fragments of pottery, jade, lacquer, wood, and bronze. Auxiliary materials included adhesives, textiles, leather braids, and animal bone collagen. Wood cannot be observed as a primary material for inlay of mosaics because it decays so quickly; however there are some examples of poorly preserved traces of associated wood. Associated ancillary technology for mosaics varies by cultural period. For example, drills for creating holes in jade panels, tools for cutting bone pieces, and bronze framework for holding inlay were all developed in different places and times. These mosaic technologies were then transferred to making turquoise ornaments and artifacts.

As noted earlier, one feature of raw natural turquoise is its small size, a factor that makes it suitable for ornamental inlay. Figure 11 shows the distribution in size of turquoise unearthed from three different sites: Jiahu, Longgangsi, and Liuwan. Even though they are located in different areas, most of the turquoise fragments found in these three sites are quite small. The average size at these three sites are: Jiahu 1.7 cm × 0.6 cm; Longgangsi 3.3 cm × 2.0 cm; Liuwan 2.2 cm × 1.1 cm.

### *Inlay Technology*

The turquoise inlay technology associated with Erlitou Culture sites is highly elaborate and sophisticated. By this time, turquoise had become one of the most commonly used decorative materials. Although turquoise inlay technology was not started during the Erlitou period, Erlitou craftspeople developed a beautiful aesthetic based on various forms of mosaic inlay. Mosaic inlay can be divided into three types: monolithic inlay, amorphous inlay using panels, and neatly trimmed inlay.

*Monolithic Inlay* — This method usually does not involve the use of adhesives. The turquoise

<sup>5</sup> Of the 85 burials containing turquoise, roughly half were men's graves, a quarter were women's, and another quarter, children's.

is cut into a specific shape and embedded directly into the base object. This method is commonly found in the Lower Yellow River area during the Late Neolithic. An example from the Dawenkou site is a cylindrical bone device with turquoise inlay (Shandongsheng Wenguanchu and Jinan Bowuguan 1974). Other examples are from the Zhufeng 朱封 Longshan Culture site, where hollow jade ornaments with turquoise inlays were unearthed. Jade knives, jade scepter (*yazhang*) blades, and half-moon objects with turquoise inlays have also been found at Erlitou sites (Hao Yanfeng 2008). At Dawenkou, bone cylinders contain four to five inlay holes, and jade panels have two symmetrical holes that seem to symbolize eyes (Shandong Bowuguan and Liangzhu Bowuyuan 2014).

*Amorphous Inlay Pieces* — Amorphous inlay can be found on pottery from sites associated with the Qijia Culture (e.g., the Guyuan 固原 Dianhe 店河 site in Ningxia 宁夏 [Ningxia Kaogusuo 1987]). Other examples can be found at Taosi, where 900 pieces of turquoise have been unearthed (Shekeyuan Kaogusuo and Shanxi Kaogusuo 2015). Most were inlaid on the tail part of bone hairpins or bone bracelets, but some of the main bodies of inlaid turquoise objects are so decayed we do not know what they were made of. The turquoise pieces are of many different shapes. The Xiajin cemetery presents examples similar to those from Taosi. In both cases the turquoise pieces all used black gum as an adhesive material, a key component in inlay technology. The turquoise-inlaid objects at the Zongri site also belong to this type (Chen Honghai 1999).

*Neatly Trimmed Inlay* — Typical examples of this type of turquoise inlay are the bronze animal plaques with inlay and the mosaic turquoise dragon from the Erlitou site (Shekeyuan Kaogusuo 2014). All the turquoise inlay pieces were neatly cut and congruent. The pieces are about 0.5 cm in length and are stuck to each other using an intercropping

jigsaw pattern. Other examples are five circular bronze objects from the third period of the Erlitou site (Du and Xu 2005). The turquoise inlays on these objects were set in a counterclockwise manner. The same method, neatly cut bone inlays, can also be found on a bone arm decoration from the Majiayao Culture (Ganbo and Wuwei 1974).

In addition to the different styles of mosaics, variations in the methods used to affix inlay can be divided into seven types, outlined below.

*Type One: Bone on Black Adhesive* — In this type, black gum is first stuck onto bones, then bone pieces, bone rings, and seashells are affixed to this adhesive. This type of inlay is mostly found at Majiayao and Qijia culture sites. In the Yuanyangchi cemetery, for example, many bone bracelets with bone inlays involve the use of black adhesive (Ganbo and Wuwei 1974). The base end of a hairpin with a bone ring inlay also used a black jelly adhesive. Another example comes from the Banshan phase at the Guang he Dibaping site, where 12 bone bracelets using the same inlay method were found (Gansusheng Bowuguan 1978). Artifacts using the same inlay method were also found at the Liuwan cemetery (Qinghai Wenguanchu and Shekeyuan Kaogusuo 1984).

*Type Two: Turquoise on Black Adhesive* — In this type, turquoise pieces are directly inlaid to black adhesive. This method can be found at sites associated with the Qijia Culture and the Taosi Culture. From the Caiyuan Qiedaoba site in Ningxia, for example, archaeologists recovered a pie-shaped black substance with eight turquoise inlays (Ningxia Kaogusuo and Libo 2003). Similarly, at the Taosi and Xiajin sites, bracelets were found with turquoise and shell inlays affixed with black jelly adhesive (Xiajin Kaogudui 1998). Further analysis is required to determine the nature of the black adhesive.

*Type Three: Turquoise in Pottery* — In this third



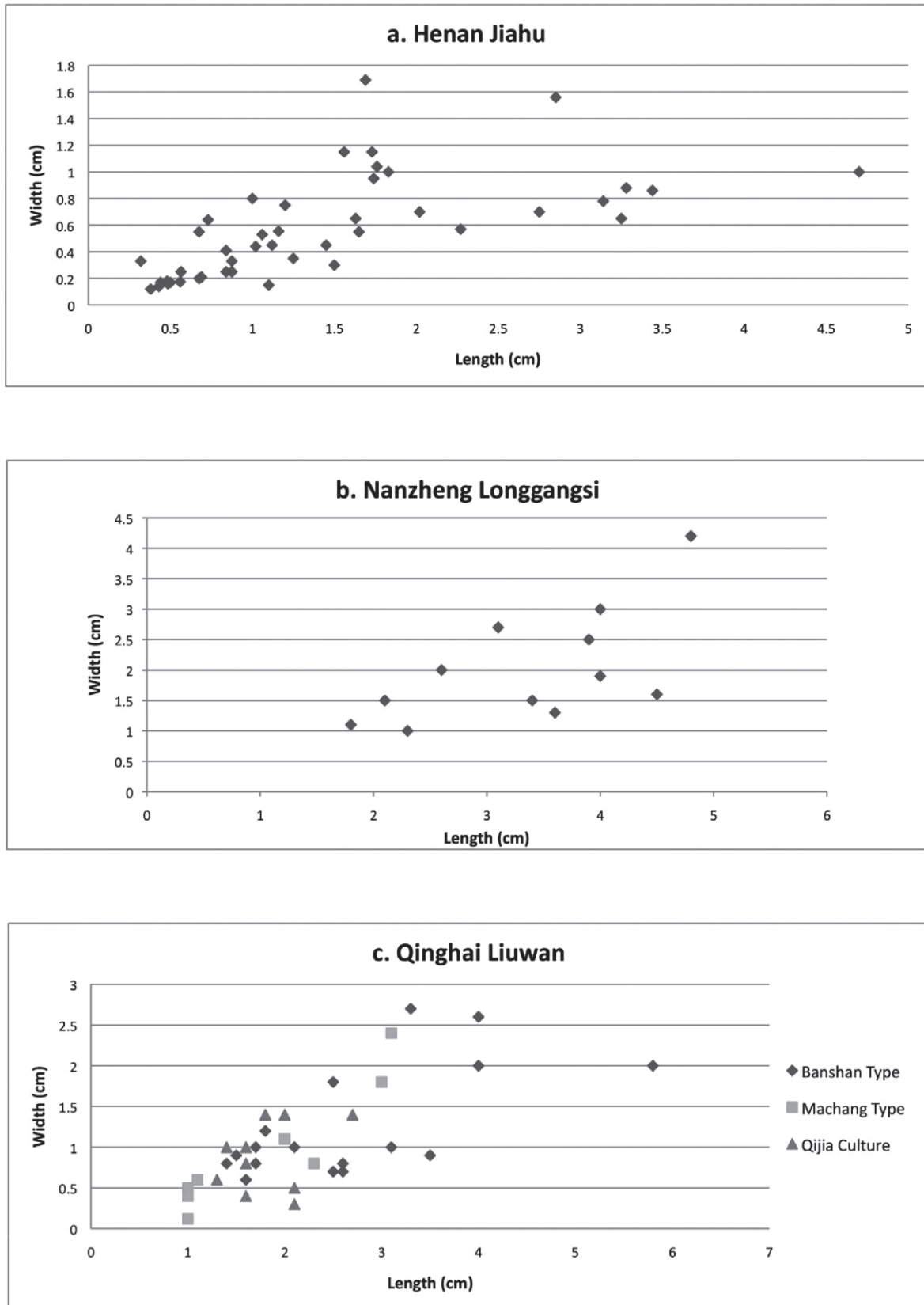


Fig. 11. Turquoise size distributions: (a) Jiahu; (b) Longgangsi; (c) Liuwan.

type of inlay technology, turquoise is directly inlaid onto pottery or grooves are made to fit turquoise inlay after firing. Turquoise inlaid on pottery was found at the Dianhe site in Qijia Culture contexts (Ningxia Kaogusuo 1987). This is the earliest example of pottery with turquoise inlay. A similar example was found at the Siba site (Gansu Ribao 2013). At this site, pottery with turquoise inlays was found and turquoise inlays were discovered on jars (Gansu Kaogusuo et al. 2012).

*Type Four: Turquoise Inlay without Adhesive* — In this inlay type, turquoise is inlaid onto bone or ivory without the use of adhesive. Instead, a hole is made into which the turquoise fits. This type is mainly found in the Shandong Dawenkou Culture area. Examples include turquoise inlaid onto ivory and bone cylinders (Shandong Wen guanchu and Jinan Bowuguan 1974). A related form of inlay uses string to attach bone pieces to different objects. A sample of this type of inlay was found in tomb M168:7 from the Wangyin cemetery (Shekeyuan Kaogusuo 2000).

*Type Five: Turquoise in Jade* — In this type, turquoise is inlaid onto jade stone objects. The traditional Chinese jade-making process involved cutting, grinding, drilling, and engraving jade to make jade ornaments; inlaying was the final step. There are two types of engraving: one type involves making a small groove, while the other involves cutting out most of the jade, leaving a small piece. Turquoise is usually inlaid with the first method. The result of this inlay technology is a strong contrast in the colors of the two materials. Presenting such a colorful contrast is the primary function of turquoise inlay production. Examples include a jade stone crown found with two turquoise inlays at a Zhufeng site (Shekeyuan Kaogusuo Shandongui 1990), and a couple of jade *yue* weapons and jade *zhang* blades found with turquoise inlays from an Erlitou site.

*Type Six: Inlay in Lacquer or Wood* — In this type, turquoise and/or shells are inlaid on lacquer or wood. There were some pieces discovered at the Dadianzi site, but because wood decays, little detail about these objects is known (Shekeyuan Kaogusuo 1996).

*Type Seven: Turquoise Inlay in Bronze* — When bronze with turquoise inlays appeared, copper-making technology (including the creation of molds and complicated smelting processes) and inlay technology became two separate processes (Gu 2011).<sup>6</sup> According to some scholars, the method for inlaying objects into bronze is to score the bronze while it is being made, then inlay decorative objects into the grooves (Li 1991, 1997; Wang 2008; Wu 1998). If this supposition is accurate, turquoise pieces would have been cut to match the dimensions of the grooves. During the Erlitou period, turquoise used for inlay was small and thin, roughly 0.5 cm in thickness. Then a sticky substance would be used to adhere the turquoise to the bronze. A rough stone would then have been used to polish the bronze surface to make it smooth.

This typology reflects technological developments beginning in the Early and Middle Neolithic, during which most of the unearthed turquoise from the Yellow River and Han River sites can be dated. Examples along the upper Yellow River (as associated with the Majiayao Culture) include Liuwan 柳湾, Linjia 林家, and Guanghe Dibaping 广河地巴坪. Along the Han River, sites with turquoise include Jiahu 贾湖, Xiawanggang 下王岗, and Longgangsi 龙岗寺. The Dawenkou 大汶口, Yedian 野店, and Wangyin 王因 sites, which belong to the lower part of the Yellow River, are additional locations for finding turquoise inlaid objects. The distribution of turquoise is wider than for other stone materials used for ornamental purposes. The distribution of turquoise did not change much between the

<sup>6</sup> The separation of these processes marks the beginning of inlay technology in the Late Bronze Age.

Late Neolithic and the Erlitou period even though associated technology changed drastically. The stability of the distribution area may be related to the location of raw material and production of objects incorporating turquoise, discussed in the next section.

## PRODUCTION AND EXCHANGE

When inlay technology developed during the Early Neolithic, the demand for turquoise also increased. This resulted in a greater need for turquoise workshops. During that time, possessing turquoise ornaments indicated high social status, wealth, and power. Turquoise became more than just an ornamental stone. Elite people began using it in the context of festivals and political events. As a consequence, the social role of turquoise changed, not only because of its value but because of the sophistication of the associated technology. Analyzing turquoise inlay technology thus helps us understand the processes by which early dynastic polities may have been established.

### *Turquoise Sources*

Known turquoise mines in China are located in northwest Hubei 湖北, Shaanxi Baihe 陕西白河, Henan Xichuan 河南淅川, Anhui Ma'anshan 安徽马鞍山, Yunnan Kunming Anning 云南昆明安宁, Qinghai 青海, Xinjiang Hami 新疆哈密, among other places. In northwest Hubei, over 40 mines exist in the counties of Yunxian 郧县, Yunxi 郧西, and Zhushan 竹山. These are the biggest and most important turquoise mines in China. Turquoise from this region is shaded green and azure.

In Shaanxi Baihe, turquoise is found in the Yueertan 月儿潭 mine. In this area, there are three main mines: Yandongzi 岩洞子, Bailongdong 白龙洞, and Muguizhai 穆桂寨. Because the mines were heavily exploited historically, production levels today are quite low.

The scale of the turquoise mining is smaller in Henan Xichuan and Anhui Ma'anshan. It is not clear when people started to mine in these locations.

A source of turquoise in Xinjiang Hami Heishanling that was rediscovered sometime in the 1970s or 1980s had probably been exploited in antiquity. The mine is 2.5 km long and 5–40 m wide. Holes had been dug at 10 places in the mine; one of the holes was 10 m deep (Luan 2001). Archaeologists also found a small house on the mountain that contained pottery and stone tools; they surmise that it was used by miners in antiquity. Some scholars argue that the mine may have been opened as early as the Early Neolithic.

Another mine in Yunnan Kunming contains turquoise with a homogeneous color. The pieces are small and production from this mine seems to have been low. It is unknown when this mine was opened. Other turquoise mines have also been found in Sichuan and Tibet (Luan 1989).

Since source locations may be as far as 200 km from the sites where turquoise was found, we cannot assume that turquoise ornaments unearthed in any particular region were produced locally. Scientific analysis is required to determine where the turquoise came from. So far, such analysis has been implemented for only a few sites such as Jiahu, Wangchenggang, and Erlitou. Feng Min, from the University of Science and Technology of China, analyzed turquoise objects from the Jiahu site and found that the material had not originated from mines in the region (Feng et al. 2003; Mao et al. 2005). Similarly, Dong and colleagues (2011) analyzed turquoise from Wangchenggang and Erlitou and found the turquoise came from many different locations. An other report of analyses conducted on the Erlitou collection using X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), and Multi-Collector Inductively Coupled Mass Spectrometer (MC-ICP-MS) indicated that the turquoise at the Erlitou site came from mines located in Henan and Shaanxi provinces instead of Hubei Province (Shekeyuan Kaogusuo 2014). While turquoise mines exist in the vicinity of these sites, the excavated turquoise fragments were not all collected locally. How can

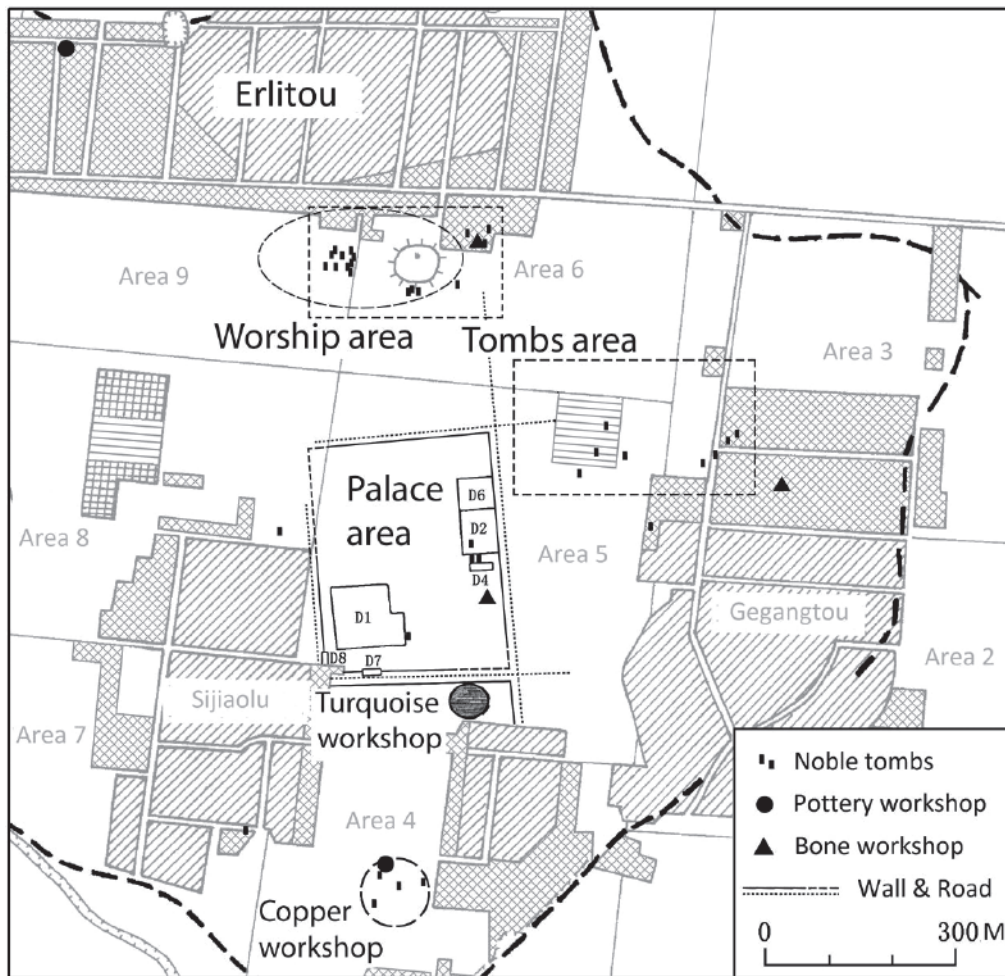


Fig. 12. Turquoise workshop at Erlitou site. Original plan by Xu Hong, translated by author.

we explain the origin of these turquoise materials?

Turquoise deposits in the form of small stones are mostly found as by-products of other ores. Small turquoise stones are easily washed downstream in rivers, making them available to people who live far from the original source.<sup>7</sup> This would explain for example why the turquoise found at the Jiahu site might not necessarily have come from the Hubei Yunxian mine, which is close to the site. The turquoise might even have been sourced from multiple locations (Feng et al. 2003; Mao et al. 2005). According to Yokota Yoshiaki (1984), most of the turquoise probably came from small nodules

that broke off from their principal source rocks and fell into rivers that carried them downstream, where they were picked up by people who used them to make turquoise ornaments. Turquoise production and consumption patterns may indicate relationships between entirely different groups who engaged in trade and exchange.

### *Turquoise Workshops*

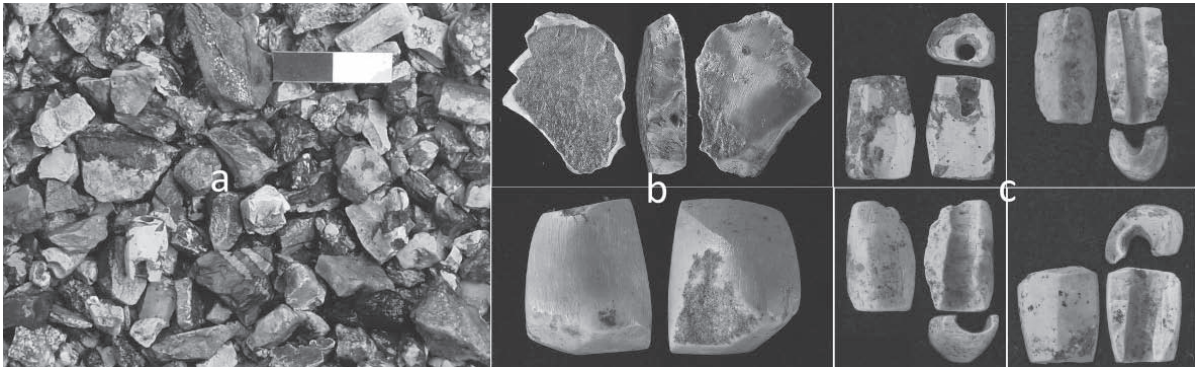
Recent excavation of the area south of the palace district at Erlitou has revealed the remains of a turquoise manufacturing workshop that belonged to the late Erlitou period (Shekeyuan Kaogusuo 2014) (Fig. 12). This workshop was located very close to the palace area. A bronze production workshop was located south of the turquoise workshop. We can thus assume the production of turquoise was directly

<sup>7</sup> A similar example of this phenomenon is in Niigata, Japan. An emerald mine is located in Niigata, but small pieces of emerald are found far downstream along a nearby river (Yokota Yoshiaki 1984).





**Fig. 13.** Turquoise product from the turquoise workshop at Erlitou site. Photos by Xu Hong.



**Fig. 14.** Turquoise from workshop at Erlitou site: (a) raw material; (b) semi-finished product; (c) damaged product. Photos by Xu Hong.

controlled by the Erlitou aristocracy.

According to archaeological coring in the vicinity of the refuse pit, large amounts of raw turquoise stones were available within 1000 m<sup>2</sup>, hence the inference that this was a turquoise production workshop. Unearthed artifacts from this site reveal the most frequently produced ornaments were turquoise tubes, beads, and ornamental panels (Fig. 13). A refuse pit was found in the workshop containing waste products of turquoise manufacture. Along with fragments of other stones, over 2000 pieces of turquoise were found in this pit. Most had traces of having been cut (Fig. 14). Analysis of these samples enables us to discern turquoise production technology. The turquoise production process can be divided into the following steps: mining of the raw stone, breaking the stone, cutting, polishing, and perforating the stone, and inlay.

#### ***Other Objects with Turquoise Inlay***

Examples of other exotic goods that were sometimes combined with turquoise were

discovered at a number of Neolithic and Bronze Age sites. For example, at the Liuwan site in Majiayao Culture contexts, 15 seashells have been found even though this site is located far from the ocean. Six stone seashell-shaped items were found in related strata. At the same site, in contexts associated with the Qijia Culture, 36 seashells were found: 34 from tomb M992, 1 from M979, and 1 from M1042 (Qinghai Wenguan chu and Shekeyuan Kaogusuo 1984). Many pieces of red carnelian beads have also been uncovered at the Zhujiazhai site (Liu 1992). Combining these materials — red carnelian beads, blue-green turquoise, and white seashell — creates a quite distinctive effect. Majiayao Culture people were the first to combine these materials, but the practice continued through the Early Bronze Age with the Qijia Culture. For example, at the Dahezhuang site, 2 red carnelian beads were found along with turquoise (Gansu Kaogusuo 1974). Red carnelian beads and seashells have also been found together at the following sites: Qinghai Zongri 青海宗日 (Chen Honghai 1999), Minhe Hetaozhuang

民和核桃庄 (Qinghai Kaogusuo et al. 2004), Gansu Huzhu Zhongzhai 甘肃互助中寨 (Yi 2016), Xujianian 徐家碾 (Shekeyuan Kaogusuo 2006), and Zhu jiazhai 朱家寨 (Liu 1992; Rawson 2010).

A bracelet with turquoise inlay along with shell decorations was found at the Taosi site (Shanxi Linfen and Shekeyuan Kaogusuo 1999; Xiajin Kaogudui 1998). Dating to the Bronze Age, red carnelian beads and seashells were found at Erlitou, and 213 red carnelian beads and seashells were also found at Dadianzi, far northeast of Erlitou (Shelach 1994). Turquoise, red carnelian beads, and seashells have been unearthed together at many important sites. This combination may be related to how these raw materials were obtained, quite possibly through long-distance exchange systems. All this information demonstrates that it would have been common for the turquoise used for inlay to have originated far from the sites where it is now found.

## CONCLUSION

Turquoise ornaments appeared very early in China. Turquoise was already being used for adornment starting around 7000 B.C. in the Peiligang Culture. Unlike objects made of other fine-stone materials (generically referred to as “jade”), turquoise was only used for small things such as earrings and pendants. This is because large pieces of turquoise are hard to find since it is a secondary mineral. Because turquoise nodules are so small, they are easy to transport over long distances. The distribution and use of turquoise was thus not limited to locations near source mines.

The development of inlay technology is associated with changing aesthetics during the middle Neolithic period. It is unclear why the perspective on beauty changed, but archaeological data demonstrate that before turquoise inlay became popular, people were experimenting with different methods of inlaying various materials with one another. The earliest forms of inlay are known from contexts associated with Majiayao Culture sites, at which time the main materials used for inlay were

bone and black adhesive. The use of black jelly adhesive represents the start of inlay technology; further research must be done to identify this material.

Bone inlays using black jelly adhesive changed to turquoise inlays using black jelly at the Zongri site. This technology continued to be associated with the Qijia and Taosi cultures. During this time, turquoise pieces were inlaid using the multi-unshaped (irregular) pieces mosaic inlay method on ornaments and ceramics. By the time of the Erlitou Culture, the fixed quantity neat-cut (regular) pieces mosaic inlay method had been adopted for ritual artifacts. Roughly contemporaneous sites such as Dadianzi show similar patterns to Erlitou. This suggests that turquoise craft techniques experienced a significant change during the Erlitou Culture period and that this manufacturing technique was used by craftspeople associated with the first state of ancient China.

Turquoise inlay became popular long after bone inlay had been established. Its popularity may be attributed to its natural characteristics and special colors. The distribution of two other special materials, red carnelian beads and white seashells, was more restricted, likely because these materials were more difficult to acquire than turquoise. Nevertheless, these have been unearthed together with turquoise at many sites, especially at Zongri and Dadianzi.

Around 2000 B.C., turquoise inlay technology became popular in the Yellow River basin. This technology peaked during the Erlitou period. Normal jade ornament culture was influenced by the Longshan Culture in eastern and southern areas. However, the turquoise inlay and earlier bronzes were more influenced by cultures to the north and northwest. Turquoise ornaments and inlay technology were not as popular in areas where the use of jade was already well developed, such as sites of Liangzhu, Ling jiatan, and Shijiahe cultures. Turquoise was much more popular among Qijia, Taosi, and Shandong Longshan cultures. Not only were turquoise decorations popular in the earlier

Majiayao Culture, so was the inlay technique. Craftspeople in these cultural contexts first applied inlay technology to bone ornaments, then developed it to include turquoise inlay.

Adhesives such as resin, animal leather by-products, natural asphalt, or paint were key materials used in early inlay technology. There is insufficient data to determine the exact type of adhesive used for turquoise inlay, but it likely was one of these substances. If future researchers identify and discover the origin of adhesives used in turquoise inlay, it would help us understand the relationship between different regions. For example, if the adhesive was a natural asphalt, then we would suspect the turquoise inlay is related to the northwest area.

As mentioned before, seashells and agate are often unearthed together with turquoise from sites in the northwest. Seashells are found in these areas far from the sea. This suggests that exchange processes must have existed between the northwest area and eastern areas such as Shandong, since many turquoise ornaments and turquoise inlay have also been found in Shandong. Agate ornaments have mostly been unearthed from Majiayao Culture and Qijia Culture sites in the northwest or northern sites such as Dadianzi. Later, agate is commonly found in association with Western Zhou noble tombs. There has been some research regarding agate ornaments (Huang 2013), but there remains a lack of data and analysis about the origin of agate and the exchange between different areas.

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